Section 5

Environmental Activities at the Bannister Federal Complex

June 1989 to Present

5.0 Introduction

5.1 Regulatory Mechanisms Compelling Environmental Clean-up

5.1.1 1989 RCRA 3008(h) Consent Order

On June 23, 1989, the DOE and EPA entered into Consent Order VII-89-H-0026 pursuant to the authority of Section 3008(h) of RCRA Consent Order. This document identified and memorialized all Release Sites at DOE managed portions of the facility. Release Sites were defined in the Consent Order as "sites or groups of sites where the spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, dumping or disposing into the environment of any hazardous waste or any hazardous waste constituent may have occurred".

The methodology employed in addressing DOE managed Release sites at the BFC under the 1989 Consent Order and later the Permit was to investigate those areas where releases of contaminants to the environment were suspected to have occurred. These areas under the RCRA Corrective Action Program are called Solid Waste Management Units (SWMUs).

The Consent Order provided a list of Release Sites in Appendix A that consisted of Solid Waste Management Units (SWMU's 1 – 35). The Consent Order included Appendices B and C that provided a list of 34 written plans and reports prepared by DOE. These were incorporated into the Consent Order as work already completed. Many of these reports were discussed in Section 4 of this DCCR. As a result of EPA review of these documents EPA determined that 10 of the original 35 Release Sites were designated for No Further Action in that no corrective action activities were required at these sites. Appendix D to the Consent Order listed Release Sites for which further investigation was required with Appendix E listing release sites for which no further action was required.

5.1.2 Missouri Hazardous Waste Management Facility Permit

Roughly ten years later, in October 1999, the MDNR issued a Missouri Hazardous Waste Management Facility Permit for the DOE portion of the BFC. This is the Permit that was

modified in 2012 to add GSA as a Permittee and to expand the definition of Facility to include the entire BFC.

Since the signing of the Consent Order in 1989 ten (10) additional SWMU's have been added to the list of Release Sites, bringing the total to 45. The original 35 Release Sites (SWMU's) along with the ten sites subsequently added are listed in Attachment 1 to this Section. This table lists each SWMU by name and number, identifies past corrective actions which have occurred at the SWMU unit and provides the SWMU's current corrective action status.

This section reviews work conducted under Corrective Action both under the Consent Order and later the permit. Investigatory activities are discussed along with environmental data collected. A review of the final selected remedies for soil and groundwater are also provided. Most of the narrative discusses work performed by DOE on DOE managed portions of the BFC. Section 5.16 and 5.17 includes work performed by GSA prior to their entry into the Permit.

Current institutional and engineering controls required by MDNR and EPA under the existing permit are discussed along with a review of deed and access restrictions placed on the BFC.

Investigation summaries are provided in no particular order. Figures and tables referenced in the text below are provided in separate groups in order of appearance at the end of this section.

5.2 Abandoned Indian Creek Outfall (SWMU 14)

5.2.1 Regulatory Submittals/Approvals

RFI Work Plan

- Sampling Plan for Site Characterization of the Abandoned Indian Creek Outfall, December 22, 1988 (IT Corporation). Note: Site characterization activities were completed prior to finalization of the RCRA Consent Order November 1989.

RFI/ CMS

- RCRA Facility Investigation / Corrective Measure Study for AICO, March 1990

✓ Submittal letter from P. T. Hoopes, DOE, to K. S. Ritchey, EPA, dated May 9, 1990

✓ Approval letter from D. A. Wagoner, EPA, to E. W. Bean, DOE dated January 2, 1991

CMI

- Construction Quality Assurance Plan, June 1988.

✓ Submittal letter from G. P. Keary, DOE, to K. S. Ritchey, EPA, dated April 30, 1992.

✓ Approval letter from K.S. Ritchey, EPA to G.P. Keary dated August 28, 1992.

- Corrective Measures Construction Volume I Program Plan and Design Report; Volume II Information for Proposers and Geotechnical Report; and Volume III Construction Quality Assurance Plan for Abandoned Indian Creek Outfall Corrective Measure Implementation July 1992

✓ Submittal letter from G. P. Keary, DOE, to K. S. Ritchey, EPA, dated June 22, 1992.

✓ Approval letter D. A. Wagoner, EPA, to E. W. Bean, DOE, dated August 28, 1992.

- Confirmation Study of the Abandoned Indian Creek Outfall June 1994

✓ Submittal letter from G. P. Keary, DOE, to K. S. Ritchey, EPA, dated June 15, 1994).

✓ EPA approval letter August 12, 1994 (Letter from K. S. Ritchey, EPA, to G. P. Keary, DOE).

- Corrective Measures Implementation Report, August 1994

✓ Submittal letter from G. P. Keary, DOE, to K. S. Ritchey, EPA, dated August 31, 1994.

✓ Letter from K. S. Ritchey, EPA, to G. P. Keary, DOE, dated July 13, 1995 notes that this submittal is outside the scope of the Consent Order.

5.2.2 Description of Unit

The Abandoned Indian Creek Outfall (AICO) area is located just south of the MMB between 95th Street and Bannister Road (Figure 5.1). Remnant PCBs were deposited at the AICO site as a result of spill events associated with the D/26 hydrotherm system. The D/26 hydrotherm system circulated a PCB based heat transfer fluid between the central heating / cooling system and plastic injection molding presses in the department. The D/26 area was investigated as two separate SWMUs. D/26 Outside (SWMU 12) was investigated under the Plating Building RFI and D/26 Inside was investigated under the D/26 RFI.

Spills associated with the D/26 PCB based heat transfer fluid system ultimately deposited PCBs at the original Outfall 002 discharge point in Indian Creek contaminating surrounding soils and sediments with PCBs. The original Indian Creek channel was relocated in the early 1970's as part of a flood protection project and the construction of Bannister Road. The channel was straightened and rerouted approximately 500 feet to the south. A storm drain was constructed by extending a box culvert from the old outfall to the new channel of Indian Creek. The original stormwater discharge point for Outfall 002 on Indian Creek became known as the Abandoned Indian Creek Outfall (AICO). As a result of the above construction, the remnant PCBs located at the AICO site and the abandoned channel downstream of AICO were essentially entombed in place. The abandoned channel downstream of AICO is now referred to as the 95th Terrace site (SWMU 42).

5.2.3 RCRA Facility Investigation (RFI)

In early 1988, sampling in the AICO area detected high concentrations of PCBs in the soil around the former outfall, apparently the result of PCB spills in the plant area that had contaminated Indian Creek sediments around the old outfall. Further sampling resulted in a total of 42 boreholes to bedrock or refusal in the AICO area to define the vertical and lateral extent of contamination. The RFI concluded that PCBs were the only contaminant with elevated concentrations in the area; that the area with concentrations above 10 ppm was about 180 feet in length in a west-northwesterly direction by 90 feet wide; and that both the native stream bed soil down to bedrock and the fill above it were generally contaminated. Maximum

PCB concentrations exceeded 9,000 ppm of Aroclor 1242 (the type of PCB detected in Therminol).

5.2.4 Corrective Actions

A large PCB remedial project was undertaken in 1993 at AICO where 27,210 tons of PCB contaminated material (up to 9,000 mg/kg) were removed for off-site disposal. PCBs at this location were primarily the result of the 1969 spill at the old 002 Outfall. Clean fill was used to restore the area to grade. AICO differed from 95th Terrace in that PCBs, up to 30 mg/kg, were present in shallow soils. At 95th Terrace, contaminated soils were isolated from ground surface by a least five feet of clean soil. Additionally, AICO was used to retain KCP storm water runoff during flood events. The AICO remediation did not reduce PCB levels in stormwater discharges from Outfall 002. Efforts to isolate Outfall 002 storm sewer system piping by grout injection of pipe joints and other efforts to install a liner system on the inside of piping had effectively precluded the migration of contaminants associated with the AICO site into the storm sewer system. This is discussed in greater detail in Section 6. Therefore, removing PCB contaminated soils from around storm sewer piping had little, if any, affect.

The AICO RFI established a cleanup level for PCBs in soil at 10 parts per million (ppm) and determined the horizontal and vertical extent of contamination. A Corrective Measures Study (CMS) in 1991 evaluated several remedial options but recommended removal of soil containing PCBs above the cleanup level and subsequent disposal of the soil in a landfill approved for PCB disposal. The EPA-approved Corrective Measures Design was presented in AICO Corrective Measures Implementation (CMI) document published in August 1992.

A Construction Quality Assurance (CQA) Plan was prepared for the AICO CMI in accordance with Task XIV of EPA's RCRA Corrective Action Plan (EPA 530-SW-88-028). The CQA Plan established a program to verify and document that the construction work met the requirements of the approved design and relevant laws and regulations. CM Construction activities were performed in accordance with the CQA Plan. CQA services were performed by Jacobs Engineering Group Inc. (Jacobs) and included full-time, on-site inspection by qualified field engineers. Jacobs was also responsible for preparation of the CS.

Corrective Measure (CM) Construction was undertaken to address contaminated soil to reduce the potential exposure to PCBs . CM Construction activities were completed by Laidlaw Environmental Services, Inc. (Laidlaw). CM Construction activities were initiated in September 1992 and were completed in January, 1994. The CM Construction included the construction of temporary support facilities, control and treatment of groundwater and stormwater, installation of steel shoring, and excavation of PCB contaminated soil, placement of backfill, and site restoration.

A key component of the CM Construction was the management of water, including the control of surface water and dewatering the excavation area. The AICO site is a low area that receives surface water from surrounding paved parking areas and Bannister Road. The water table in the excavation area is within a few feet of the ground surface. The CM Design required that once excavation of the site surface began, all water in the excavation area be collected and treated prior to discharge. In order to meet this requirement, a water treatment system was constructed on-site. The WTS was designed for an effluent concentration of less than 0.1 micrograms per liter (µg/L) of PCBs and sized to process 25 gallons per minute. A second system of similar design was constructed to add treatment capacity.

In general, the vertical excavation limit was the bedrock surface underlying the site at a depth of approximately 22 feet below grade. Shoring was used to protect workers and adjacent structures, to minimize the amount of clean soil that was removed with the contaminated soil, and to minimize groundwater infiltration into the excavation area. The structural steel shoring system included the construction of perimeter and interior steel sheet pile walls driven to bedrock. Interior bracing was placed between opposing pile walls to add horizontal stability. Installation of structural shoring resulted in dividing the site into seven independent areas (Areas 1 through 7) for excavation purposes.

The waste material removed from inside the excavation limits included substantial amounts of rock and construction debris that were used to fill the abandoned creek channel during road

construction in the early 1970s. Approximately half the volume of the excavated material was made up of gravel, cobbles, boulders, asphalt, clay bricks, concrete blocks, and concrete slabs of various sizes. The voids were filled with silty clay soil. The material was saturated and required dewatering prior to off-site disposal. Portland cement was used to stabilize wet PCB contaminated wastes for shipment.

Chemical Waste Management, Inc. (CWM) provided transport trucks and disposal services. The contaminated material was loaded into trucks and transported to CWM's TSCA-permitted landfill in Emelle, Alabama. Additional PCB-contaminated material (i.e., spent filters, sand, and carbon from the WTS, personal protective equipment), generated during the CM Construction, was also disposed in CWM's TSCA-permitted landfill. The AICO CMI resulted in the removal and offsite disposal of 27,210 tons of PCB-contaminated rock and soil, Portland cement, and water treatment wastes.

Verification of cleanup (10 mg/kg or less) was performed as seven independent sampling events in Areas 1 through 7 following the removal of Stage 3 material. Locations of sampling points were determined in accordance with EPA guidance. Individual sampling grids were developed for Areas 1 through 7. Sampled surfaces included the bedrock floor and steel walls of each excavation area, plus the exterior of the storm sewer in Area 7. Analytical results verified that the cleanup objective of 10 mg/kg was obtained at every sample location inside the excavation perimeter. Figure 5.2 provides a cross section depiction of the PCB contaminated soil removed from the AICO site and the remaining PCB contaminated soils that are addressed under the 95th Terrace RFI / CMS.

Environmental monitoring was conducted during the CM Construction activities to monitor compliance with off-site discharge requirements and ensure that public health was not adversely impacted. Water treatment system effluent was sampled on a daily basis, during periods of operation to verify that water removed from the excavation and decontamination areas met the treatment criteria for PCBs (less than 0.1 µg/L) before it was discharged to the KCD sanitary sewer. Fugitive dust was visually monitored by the CQA Inspector. Monitoring was done in the work area on a daily basis when contaminated material handling was in

progress. No visible emission of fugitive dust from contaminated material was observed during the CM Construction. Ambient air monitoring for PCBs was conducted at the site perimeter. Composite samples were collected throughout the project work period and analyzed for PCBs. The analysis indicated that the CM Construction did not significantly impact air quality. The CM Contractor also performed personnel air monitoring which indicated very low levels of airborne PCB contamination.

5.3 Department 26 Inside (SWMU 31)

5.3.1 Previous Regulatory Submittals/Approvals

RFI Work Plan

- Submitted to EPA / MDNR June 25, 1991(Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved by EPA / MDNR September 5, 1991(Letter from M. J. Sanderson, EPA to G. P. Keary, DOE)

RFI Report

- Submitted to EPA / MDNR April 22, 1993 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- EPA / MDNR review comments June 29, 1993 (Letter from K. S. Ritchey, EPA to G. P. Keary, DOE)
- Revised Report submitted to EPA / MDNR August 27, 1993 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- EPA / MDNR approval letter October 29, 1993 (Letter from K.S. Ritchey, EPA to G. P. Keary, DOE)

CMS/CMI

- Multisite Corrective Measures Study for the Department of Energy Kansas City Plant, U.S. Department of Energy, Kansas City Area Office, November 1995.
- Statement of Basis, U.S. Department of Energy Kansas City Plant, Multiple Sites, Kansas City, Missouri, U.S. Environmental Protection Agency, Region VII Office, March 25, 1998.
- Final Decision and Response to Comments, U.S. Department of Energy Kansas City Plant, Multiple Sites, Kansas City, Missouri, U.S. Environmental Protection Agency, Region VI1 Office, Kansas City, Kansas, July 1998.

Newly Identified Release

- Work Plan transmittal letter October 26, 2000 (Letter from G. P. Keary to A. H. Groner, MDNR)
- Work Plan Addendum letter November 22, 2000 (Letter from G. P. Keary to A. H. Groner, MDNR)
- Work Plan approval letter December 18, 2000 (Letter from A. H. Groner, MDNR to G. P. Keary, DOE)
- Letter Report submitted to MDNR / EPA April 25, 2001 (Letter from G. P. Keary to A. H. Groner, MDNR)

5.3.2 DESCRIPTION OF UNIT

Department 26 (D/26) functions as a plastic injection molding manufacturing department. Operations began in the late 1950s and continue to the present. Following construction of the KCP in 1942, the area now occupied by D/26 was used as an indoor loading dock for the railroad. Rail operations continued here until the late-1940s. From the late 1940s to the late 1950s, the area was used primarily for storage. The railroad tracks were removed and large presses associated with D/26 operations were installed over the former rail bed and surrounded by a raised steel deck that connects to the factory concrete floor.

Department 26 (D/26) is located in the southeast quadrant of the MMB (Figure 5.3). It occupies an area approximately 580 ft north/south by 60 ft east/west. The MMB coordinates for D/26 are: D -S.5 south to north and 48.5 -51 west to east. Most of the information pertaining to D/26 was obtained through interviews with KCP personnel at the time of the RFI.

The D/26 heat-transfer system was first installed in the mid-1960s to facilitate the department's plastics injection molding operations. The system consisted of an aboveground piping network, a heater, reservoir and expansion tanks (also aboveground), and several pumps located both inside and outside MMB. This equipment circulated heated PCB fluids through high-temperature hydraulic presses and injection molding equipment used for making plastic products back to the central heating system. The fluid capacity for the D/26 heat-transfer system was 6,500 gal. There were no secondary containment provisions with the initial installation of the heat transfer fluid system.

Much of the equipment in D/26 is located in deep pits (approximately 16 to 20 ft deep) for stability, where heat-transfer fluid often leaked. Although some of the pits were concrete lined, others may have been supported at the base only by a concrete slab. In

each case, the hot PCB oil had access to subsurface soils through cracks or joints in the concrete or through direct soil contact.

In 1974, following federal regulation of PCBs, Therminol FR-1 was discontinued as a heat-transfer fluid at KCP. To comply with TSCA (40 CFR 761), a draining and flushing process continued until testing indicated that the system contained less than 50 mg/kg of PCBs (DOE 1993c). Draining and flushing was required several times initially and approximately once per year thereafter to stay within the limits enforced under TSCA. The Therminol FR-1 was returned to Monsanto Corporation for disposal (DOE 1993c).

In 1974, following the draining and flushing process, the D/26 Therminol FR-1 was replaced with a non-PCB heat transfer fluid (Therminol 66) also manufactured by Monsanto Corporation. Therminol 66 is a hydrogenated, modified terphenyl (non-PCB) fluid with a significantly lower flash point (DOE 1993c). Although the heat transfer fluid no longer used PCBs, the replacement Therminol 66 became cross contaminated with PCBs up to 50 mg/kg. Due to the continued detection of PCBs, the entire heat transfer system was replaced in 1985. The new Therminol system installed at D/26 was constructed with adequate secondary containment.

Although the pre-1985 Therminol system was a closed system, contamination from accidental spills or breaks in the lines, as well as from past handling practices with the actual molds, presented reason for concern. Indeed, two major PCB releases from accidental spills due to equipment failure had been documented at D/26 (DOE 1993c). In 1969, an expansion joint failure spilled 1500 gal to a gravel area (along the 51 wall, between the L and K columns); an estimated 900 gal were reported to have gone into the storm sewer and discharged into Indian Creek. In 1972, most of an 1100-gal spill was confined to soils outside the building, but a small amount (a reported 23 gal) was lost to the storm sewer. At the time of the spills no clean-up, with the exception of gross surface contamination, was performed. However, numerous corrective measures have been and continue to be performed at locations impacted by these two spills. The 002

Raceway site, the discharge point of the 002 storm sewer system to Indian Creek, was remediated during 1989.

5.3.3 RFI Field Investigation

A total of 22 soil borings were completed to characterize soil contamination associated with the D/26 inside area. Soil samples were collected every 5 ft from each borehole utilizing hollow-stem auguring and continuous split-barrel sampling techniques. Samples collected were analyzed according to EPA-approved methods for PCBs, VOCs, TPHC (heavy), and priority pollutant metals. All sampling procedures and analytical methods were performed according to the D/26 RFI work plan (DOE 1993c).

5.3.4 Contamination Characterization

5.3.4.1 Groundwater Contamination

The D/26 RFI did not include a groundwater investigation for two reasons. First, groundwater contamination in the area has already been studied extensively (Korte et al. 1986) and was studied under the TCE Still Area RFI since the TCE Still Area plume underlies the D/26 site. Contaminated groundwater in this area of the facility is captured by the groundwater recovery and treatment system. The D/26 RFI determined there was no groundwater contamination associated with inorganic analytes at the D/26 Site. Previous work at KCP showed that PCBs were not mobile in the facility groundwater.

Second, the principal contaminant expected was PCBs. PCBs are any of 209 compounds consisting of two benzene rings with two or more substituent chlorine atoms. The primary PCB mixture used at KCP was Aroclor 1242 (Therminol FR-1). PCBs were detected in soil samples at the site in significant concentrations (up to 10,000 mg/kg).

VOCs and traces of BTEX were detected, but these were principally found below the water table suggesting that their presence was due to migration within the groundwater

and not due to sources within the D/26 area of investigation. In fact the Plating Building RFI identified a former vapor degreaser as the significant source of VOC groundwater contamination in this area.

With respect to PCBs, of great importance is the finding that soils at the BFC contain large amounts of clay, which greatly restrict PCB mobility. This conclusion is supported by the work of numerous researchers. For example, Tucker et al. (1975) performed an experiment whereby PCBs were introduced to the tops of soil columns followed by leaching with water. PCBs were detected in the effluent after 13 L had passed through a sandy soil. In contrast, no PCBs were detected in the effluent from a silty-clay soil even after passage of nearly 60 L. Since the soil columns were only 3 x 12 in., many column volumes were necessary for PCBs to migrate, even in the sandy soil.

5.3.4.2 Soil Contamination

Data obtained from two boreholes, D20-BH0l and D20-BH02 (Figure 5.4) installed previously, were included as part of this discussion due to their close proximity to the D/26 site.

Sample results indicated significant PCB contamination at the site. PCBs, (Aroclor 1242), were reported in concentrations up to 10,000 mg/kg. The highest PCB concentration was found to occur in borehole D26-BH06 at the base of the alluvium (41 ft. bgs).

Maps showing the horizontal and vertical extent of the organic compounds reported are presented in Figures 5.5 – 5.24. These figures are organized by analyte in a series of two maps: the first map presents results from the upper half of the alluvium while the second map shows results from the lower half of the alluvium. The areal locations of each boring are included at the top of each figure for orientation. Tables 5.1 and 5.2 provide a summary of the organic and inorganic data reported from soils collected at the site.

The soil samples collected contained PCBs (Aroclor-1242, up to 10,000 mg/kg), TCE (up to 25,000 µg/kg), 1, 2-DCE (up to 9,500 µg/kg), chloroethene (up to 180 µg/kg), TPHCs (heavy fraction) (up to 2500 mg/kg), benzene (up to 3.0 µg/kg), toluene (in one sample up to 1.0 µg/kg), ethylbenzene (in two samples up to 4.3 µg/kg), and chlorobenzene (in two samples up to 3.0 µg/kg). The most widespread contaminants are PCBs, TCE, and 1,2-DCE. Chloroethene and TPHCs were found to a much lesser extent. As shall be discussed, however, VOC contamination was later shown to be derived from the adjacent Plating Building degreaser.

When evaluating the soil data and maps, it is important to note that soil contaminated with chlorinated solvents below the water table (approximately 10 to 12 ft in this area) cannot be defined as soil contamination. It is difficult, if not impossible, to distinguish between soil contamination and contamination transported via the contaminated groundwater plume underlying the area. As a result, when considering chlorinated solvents, soil contamination below the water table is considered part of the groundwater contamination. This scenario holds true for all contaminants that are soluble in groundwater. PCBs, certain metals, and high-molecular weight petroleum hydrocarbons do not follow this scenario due to the low solubility's of these contaminants. There were no examples of chlorinated solvent contamination in the vadose zone reported from the D/26 RFI. There were, however, examples of apparent soil contamination resulting from contaminated groundwater flowing through the location, as shown in results from D26-BH06 and D26-BH13 (Table 5.1). Neither location has significant VOC contamination above the groundwater table.

The highest PCB concentrations were found at the base of the alluvium: D26-BH06 (10,000 mg/kg at 41 ft), D26-BH01 (3,700 mg/kg at 42 ft), D26-BH04 (690 mg/kg at 42 ft), and D20-BH08 (310 mg/kg at 41 ft). In only two boreholes where significant PCB concentrations were found was this not the case (i.e., the highest PCB concentrations being found at the base of the alluvium): D26-BH07 and D26-BH10.

The high PCB concentration in these two boreholes were 560 mg/kg at 8.5 ft in D26-BH07 and 390 mg/kg at 18.5 ft in D26-BH10 (Table 5.1 and Figure 5.4.

These results show that in locations where a large quantity of PCBs were deposited to the subsurface soils, a downward, vertical migration occurred over time, because the density of PCBs (1.4 to 1.5 at 20°C) is greater than water (0.998 dcc at 20°C). This explains the apparent pooling of PCBs at the base of the alluvium and top of the bedrock (Figure 5.5). Indeed, PCB concentrations observed in D26-BH06 correlate with a reported spill that occurred as a result of an expansion joint failure in 1969 at this location In boreholes D26-BH07 and D26-BH10 where PCB concentrations are highest closer to the surface (i.e., 8.5 and 18.5 ft), it is believed that the mass of PCBs deposited to the subsurface soils was insufficient to break through the surface tension of the groundwater and migrate to the base of the alluvium. With the exception of the reported spill that occurred in the vicinity of D26-BH06 that is most likely responsible for the concentrations found in D26-BH04, the remaining PCB concentrations found are believed to be the result of isolated leaks and/or spills.

Additional characterization is provided for the area directly east of D/26 (Inside) as part of the Plating Building RFI. Indeed, the data demonstrates that much of the contamination identified under the D/26 study area is contiguous with contamination reported in the Plating Building RFI. Therefore, (Figures 5.25 – 5.29) are provided which present three-dimensional figures depicting the combined results (i.e., PCB, VOC, and TPHC from this investigation and the Plating Building RFI).

In addition to the PCB contamination identified, the chlorinated solvents TCE, 1, 2-DCE, and chloroethene were found. TCE was reported at concentrations up to 25,000 µg/kg (D26-BH06 at 21.5 ft), 1, 2-DCE up to 9,500 µg/kg (D26-BH13 at 32 ft), and chloroethene up to 180 µg/kg (D26-BH10 at 40.5 ft) as shown in Table 5.1 and Figure 5.4. Indeed, contamination with these chlorinated solvents was found to occur more frequently than any other contaminant identified (Figures 5.9 – 5.20).

Also analyzed as part of the sampling suite at D/26 were TPHCs (heavy fractions) and priority pollutant metals. Concentrations of TPHCs (heavy) were reported up to 2,500 mg/kg (D26-BH01 at 42 ft) (Table 5.1 and Figure 5.4). In addition to borehole D26-BH01, TPHCs (heavy) were reported in: D26-BH04 (600 mg/kg at 42 ft), D26-BH07 (1000 mg/kg at 8.5 ft), D26-BH10 (330 mg/kg at 18.5 ft), and D26-BH11 (120 mg/kg at 41.5 ft). Again, the spatial orientation of these contaminants suggested isolated pockets rather than a continuous mass beneath the subsurface (Figures. 5.30 – 5.33). TPHC (heavy) contamination found in D26-BH07 at 8.5 ft (1000 mg/kg) lies above the water table, indicating the possibility of a petroleum release at this location.

Results reported for metals analyzed in the subsurface soils collected from the site indicated that there was no significant contamination present (Table 5.2). Concentrations of metals reported during this investigation were compared to threshold concentrations developed for the KCP (Fleischhauer 1988). This comparison revealed that a small portion of the samples contained concentrations above the contamination thresholds. Twenty soil samples contained arsenic concentrations (up to 143 mg/kg) that exceeded the contamination threshold of 13.0 mg/kg. Fifteen samples contained manganese concentrations (up to 7620 mg/kg) that exceeded the threshold value of 1210 mg/kg, and zinc was detected in one sample (452 mg/kg) above the threshold (36 mg/kg). These detections are sporadic and are not likely to be due to plant operations (Korte 1989, 1990, and 1991).

Even though none of the analytes detected pose a soil contamination threat, the elevated arsenic values in D20-BH05 (up to 143 mg/kg (Table 5.2,) deserve further discussion. The contamination threshold for arsenic in BFC soils was determined to be 13 mg/kg. Because arsenic is sorbed by iron oxides, higher arsenic concentrations can be expected in an iron-rich environment (Korte and Fernando 1991). Indeed, iron oxide subsamples from BFC soils have been reported to contain as much as 84 mg/kg of arsenic (Korte 1990).

The lithologic log for D20-BH05 indicated that abundant iron oxides were present (yellowish-brown limonite), explaining the elevated arsenic concentrations. Additionally, field studies revealed that naturally occurring reducing conditions prevalent in the subsurface are responsible for dissolving arsenic previously sorbed by iron oxides (Korte 1990; Korte 1991). KC84-09 is approximately 1000 ft upgradient from boring D20-BH05 and typically contains the highest arsenic concentrations in groundwater from the BFC (see also Section 3).

In summary, significant PCB contamination was identified at D/26. This contamination occurs in isolated pockets and in apparent pools at the base of the alluvium (Figure 5.7). Previous investigations had indicated that the bedrock was a barrier to contaminant migration (Madril et al. 1986; DOE 1990d). Nevertheless, an additional investigation was performed to determine whether this pooling of PCBs at the base of the alluvium was contaminating the underlying bedrock at the D/26 Site.

5.4 Plating Building (SWMUs 9, 10, 11, 12)

5.4.1 Previous Regulatory Submittals/Approvals

RFI Work Plan

- Submitted to EPA / MDNR September 1990
- Approved by EPA / MDNR November 2, 1990 (Letter from M.J. Sanderson, EPA to D.M. Caughey, DOE)

RFI Report

- Submitted to EPA / MDNR June 29, 1993 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved by EPA / MDNR September 28, 1993 (Letter from K.S. Ritchey, EPA to G. P. Keary, DOE)

Interim Measures

- Pipe Gallery Interim Measures Work Plan submitted to EPA / MDNR March 27, 1996 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Pipe Gallery Interim Measures Report submitted to EPA / MDNR May 8, 1997 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Pipe Gallery Interim Measures Report: EPA Approval June 12, 1997 (Letter from K.S. Ritchey, EPA to G. P. Keary, DOE)
- Plating Building Waste Oil Tank Interim Measures Report submitted to EPA December 21, 1995 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)

CMS/CMI

- See Multi Sites CMS

The purpose of this RFI was to determine the nature and extent of hazardous releases from solid waste management units (SWMUs) Nos. 9, 10, 11, and 12 as identified in the Consent Order.

SWMU 9: Plating Building Area and Acid and Alkaline Tanks

SWMU 10: Waste Oil Tank Under North End of the Plating Building

SWMU 11: Substation 18 North of the former Plating Building

SWMU 12: Department 26 (D/26) Outside

5.4.2 Description of Individual SWMUs and Areas of Concern:

SWMU 9: Plating Building / Acid and Alkaline Tanks

Plating Building Area

The Plating Building was originally constructed as a 400-ft by 60-ft single story steel building, 20- to 30-ft high above the concrete foundation. In the early 1980s, the south end of the building was shortened by 50 ft and Building 90 constructed in the vacated space.

Acid and Alkaline Tanks

The metal plating work performed in the Plating Building used numerous chemicals, including cyanides; heavy metals including cadmium, chromium, lead, and precious metals; and strong acids and alkaline solutions. Waste water from the plating processes drained through piping into underground tanks adjacent to the northeast side of the building. This tank structure was composed of three cells:

1. Waste Acid Tank (southwest cell)
2. Waste Alkaline Tank (northwest cell)
3. Pump dry well which supported both tanks (east cell)

Buried Piping

Five drain systems supported the Plating Building.

1. Waste Acid Drain System: Water drained into the Waste Acid Tank. This piping was above the subfloor slab and was flushed and removed during Phase II (see below) of the Plating Building removal project.

2. Waste Alkaline Drain System: Alkaline rinse water drained into the Waste Alkaline Tank. This piping was above the subfloor slab and was flushed and removed during Phase II of the Plating Building removal project.

3. Floor Drain System: Drains in the subfloor area of the building dropped vertically beneath the building to a depth of 5 to 8 ft below the ground surface and flowed into the Industrial Waste Sump at the northeast edge of the building. This buried drain piping network was installed under most of the former 350-ft by 60-ft building site. This piping was removed during the Pipe Gallery Interim Measures project.

4. Sanitary Sewer System: A 4-in. Sanitary Sewer line supporting rest rooms in the southwest corner of the Plating Building was terminated and capped about 1-ft east of the west foundation wall, approximately 25 ft north of the southwest comer of the Plating Building during the Phase II demolition of the foundation. The abandoned piping was removed and disposed of as non-hazardous waste.

5. Storm Sewer System: The Plating Building downspouts drained into 6-in. cast iron piping running north and south, buried along the east side and west side of the Plating Building, connecting to the 24-in. “E"-Lateral, the 24-in. "K"-Lateral, and the 30-in. "N"-Lateral. These laterals are buried approximately 8 ft below the ground surface and were the subject of previous investigations in which sampling was conducted to determine if they provided preferential flow paths for PCB migration (Fleischhauer et al. 1986; DOE 1990a). The investigation did not discover evidence indicating that the laterals were a significant flow path. It is believed that it was more likely that the laterals permitted infiltration of PCB contaminated soil which was then conducted through the storm sewer system to the outfall. Consequently, by the end of 1988, the "E- "K-, and "N-Laterals were lined with an epoxy resin liner to prevent any subsurface soil contamination in the Plating Building area from entering the 002 Storm Sewer System.

SWMU 10: Waste Oil Tank Under North End Of Plating Building

A 26,000-gal underground waste oil tank was buried under the north foundation wall of the Plating Building directly under the site of Substation 18 (Figure. 5.34). This tank was constructed in 1942 to recover spent anti-rust oil from operations in the MMB. The tank was abandoned and filled with sand in the early 1950s. In 1957, the Plating

Building was built over the abandoned tank site. During modifications to Substation 18 in the early 1980s, an access port entering the tank was uncovered. A 4-in. steel pipe and threaded cap were installed to permit sampling of the sand from the ground surface. Detectable PCB contamination were found in the sand samples in the range of 33 mg/kg of Aroclor 1254. This tank was removed under the Plating Building Waste Oil Tank Interim Measures (Section 5.4.8).

SWMU 11: Substation 18 North of Plating Building

Substation 18 was constructed in 1957 to provide electrical power for the Plating Building. It included an oil-filled transformer containing approximately 750 gal of PCB-based cooling oil (Aroclor 1260). The area around the transformer was covered with loose gravel. Employee interviews indicated that spills occurred between 1959 and 1970. On one occasion, a broken hose resulted in spraying oil on the ground. Plant records indicate this spill was reported and cleaned up. During subsequent routine environmental monitoring, near-surface samples demonstrated PCB concentrations up to 1,000 mg/kg. This transformer was removed during 1988-89. The concrete pad and associated soil was removed during the Plating Building Waste Oil Tank Interim Measures (Section 5.4.8).

SWMU 12: D/26 Outside

An injection mold heating and cooling system supporting manufacturing in the D/26 area was constructed in 1965. The D/26 Hydrotherm System was located in the gap immediately outside the west and south walls of the Plating Building. This “L"-shaped area, is referred to as the "D/26 Hydrotherm Pipe Gallery".

An underground 10,000-gal storage tank containing Therminol FR-1 was located about 45 ft east of the southeast corner of the original Plating Building. This tank was 10 ft in diameter and 17 ft in length. The buried piping from this tank was routed just to the north of the MSB Pedestrian Crossover Building and surfaced in the area outside the southwest corner of the Plating Building, where the system heating and pumping

equipment was located. This system employed Therminol FR-1 (Aroclor 1242) from 1965 until 1976. Typically, this system circulated approximately 5,000 gal of fluid, heated to about 400ºF, through the piping and expansion joints in the pipe gallery and into the MMB.

In November 1969, a failure in an expansion joint resulted in a spill of 1,500 gal of Therminol FR-1 to a gravel area near the north end of the Plating Building. Approximately 600 gal of fluid soaked into the unprotected earth. An estimated 900 gal were lost to the storm sewer and discharged into Indian Creek. As a result of this spill, the gravel-covered area in the north end of the Pipe Gallery was paved with a concrete catch basin containing sump wells and pumps to transfer storm water to the industrial waste sewer system.

In 1972, a series of spills occurred in which 1,100 gal of Therminol FR-1 were released. Twenty-three galllons reached surface waters, and 1,077 gallons were absorbed or collected and turned over to a licensed contractor for disposal in a landfill (letter from Robert Bulock, KCAO to Earl J. Stephenson, EPA Region VII, March 1976, DOE 1990a).

Remnant soil contamination associated with the above events was addressed under the Abandoned Indian Creek Outfall (AICO, SWMU), Plating Building (D/26 Outside SWMU), D/26 Inside (SWMU) and 95th Terrace (SWMU) RFI / CMS / CMI activities.

Figure 5.34 shows the locations of other sources of potential contamination in the area around the Plating Building that were investigated. The following 11 sources were identified:

1. Cyanide spill containment sump

2. Substation 18 pad and sump

3. Waste oil tank

4. Industrial waste pumping station

5. Caustic waste pumping station

6. Acid waste pumping station

7. Therminol storage tank site

8. Degreaser A

9. Degreaser B

10. Underground storage tank

11. Hydrotherm piping system.

Types of Units

The following text describes the sources investigated under the Plating Building RFI (see Figure 5.34).

The cyanide Spill Containment Sump located at the north end of the study area was used to collect cyanide solutions used in Building 59. No leaks or spills have been reported from this location. This sump was removed under the Pipe Gallery Interim Measures project (see Section 5.4.7.1).

Substation 18, at the north end of the former Plating Building, contained a power transformer and related equipment used to power the electroplating equipment in the Plating Building. The transformer contained 750 gallons of PCB-based (Aroclor 1260) heat transfer fluid and was removed in 1989. Leaks from this equipment are known to have occurred. This transformer was removed during 1988-89 and the associated concrete pad was removed under the Pipe Gallery Interim Measures project (see section 5.4.7.1).

The Industrial Waste Pumping Station located east of the waste oil tank and substation 18 was the sewer system collection point for all drains from the Plating Building. The system currently supports the East Boilerhouse. There is no known history of leaks. There are extensive underground utilities in the area. Consequently, drilling could not be performed adjacent to the station.

The Caustic Waste Pumping Station is located south of the Industrial Waste Pumping Station. High pH and cyanide-bearing solutions were transferred at this location. There are no known or suspected releases at this location.

The Acid Waste Pumping Station is located south of the Industrial waste pumping station. Low pH and metal-bearing solutions were transferred at this location. There are no known or suspected releases at this location.

Degreaser A was in the northeast portion of the Plating Building. According to employee interviews, it probably was installed at the same time the building was constructed (1957) and operated as a trichloroethene (TCE) degreaser until 1976. According to employees, leaks are believed to have occurred during this period. It was converted to a tetrachloroethene (PCE) vapor degreaser in 1976. Even though some of the PCE might have been lost through evaporation, it is possible that a considerable amount may have leaked from the unit. The unit was taken out of service in approximately 1985.

Degreaser B was in the central-east portion of the building. This was a Detrex TCE degreaser from 1958 until 1982, when it was replaced by a Phillips Model SP-20RU degreaser. The second degreaser was taken out of service in 1988. Information concerning operation of this degreaser is limited. It is assumed, however, that leaks occurred during the operating period.

The Emergency Generator Underground Storage Tank located near the north end of the study area contains diesel fuel. The tank has been leak tested and found to be sound. This tank was also equipped with cathodic protection. No leaks or spills are known or suspected at this location. This tank was closed and removed in accordance with MDNR UST regulations.

5.4.3 Building Description/Demolition

The Plating Building (Building 57) was constructed in 1957 to provide on-site metal plating services for the KCP's manufacturing processes. It was taken out of service after the construction of a new facility in 1987. The Plating Building was a 60-ft by 350-ft, single story, steel structure on a reinforced concrete foundation. This building contained, or had adjacent to it, utilities, plating equipment, an electrical substation, material handling equipment, heating, ventilating, and air conditioning (HVAC)

equipment, partitions, wastewater collection and pumping systems, lighting, fire suppression systems, an abandoned underground storage tank, deionized water systems, and restrooms. Due to the type of work performed in the Plating Building, portions of the building structure, including concrete floors and walls, were found to contain heavy metals, polychlorinated biphenyls (PCBs), cyanide, and total petroleum hydrocarbons (TPH).

The Old Plating Building was decommissioned after the new Plating Building was brought on-line in 1987. The demolition of the Plating Building was completed in three phases as follows:

Phase I

Demolition and removal of all of the Plating Building (including Substation 18) above the concrete foundation (IT Corporation 1989).

Certain portions of the structure and appurtenances were left in place to minimize subsoil disturbance until further investigations could be completed:

- Floor drain piping (capped 2 ft below grade)*;
- The West and North Plating Building foundation grade wall*;
- Underground waste oil tank (SWMU 10)**;
- 30' x 30' concrete subfloor slab in N.E. corner (over SWMU 10)**;
- Caustic Waste Pumping Station Sump Structure*; and
- Acid Waste Pumping Station Sump Structure**.

*Removed under the Pipe Gallery Interim Measures project

**Removed under the Waste Oil Tank Interim Measures project

Phase II

This phase consisted of the demolition and removal of the concrete foundation excluding the west and north grade walls. All exposed soil was covered with imported

clay fill and paved with crushed rock and asphaltic concrete. (Completed July 1989 through September 1990 and summarized later in this section.)

Phase III

This phase consisted of the corrective measures for the remediation of soil contamination beneath the ground surface of the Plating Building area and associated contaminated building components, including the west and north foundation wall and underground tank structures. Corrective measures were subsequently completed under the Pipe Gallery and Waste Oil Tank Interim Measures activities to remove the remaining Plating Building foundation walls and the Waste Oil tank.

The superstructure of the Plating Building was removed in the summer of 1989. Most of the foundation was also removed at that time, including the upper 1-ft (approximately) of underlying soil. In addition, the sumps and pipe gallery between the Plating Building and the adjacent MMB were steam-cleaned, and contaminated sludges and sediments removed. The portions of the Plating Building identified as hazardous were removed.

Portions of the Plating Building foundation were removed between October 1989 and July 1990. In three areas, greenish discoloration permeated the full thickness of the concrete and the top 6 to 12 ins. of the underlying soil. The discolored material was disposed of as hazardous waste. Verification sampling confirmed that no contaminants were present in underlying soil.

Verification samples of soil and pooled water (rainwater which collected on the foundation and in the excavations) were taken during October and November of 1989 to provide assurance that contaminated material had been completely removed. Remaining nonhazardous portions of the foundation were removed by August of 1990. The remaining hazardous portions of the foundation were removed during the Pipe Gallery Interim Measures project.

5.4.4 Contamination

A number of soil borings were completed as a part of various preliminary site environmental investigations. During the Plating Building investigation 30 soil borings

were advanced to, at or near, the base of the alluvium. The borings were continuously logged for soil classification as they were advanced. Soil samples were collected at 3-ft intervals for PCB and TPH analyses. To facilitate disposal of wastes generated by the soil borings, samples collected from the 3, 15, and 27-ft intervals and from the last interval above the alluvium/bedrock interface were also analyzed for volatile organic compounds (VOCs), Toxicity Characteristic Leaching Procedure (TCLP) metals, and cyanide. Two of the soil borings were completed as dual-completion groundwater monitoring wells.

Generally, asphaltic concrete was observed to a depth below ground surface (bgs) of approximately 0.7 ft. Beneath the asphalt was a clean clay soil layer of approximately 1-ft thickness that was placed after removal of the Plating Building. Additional fill material, of a sandy and gravelly nature was then observed to depths ranging from 1.4 to 5.8 ft bgs. A clayey silt sequence was then encountered that extended to depths ranging from 32.5 to 38.7 ft bgs. Although this clayey-silt sequence undergoes at least three distinct color changes, previous pump testing has shown that it behaves as one hydraulic unit. The clayey-silt zone rests on a basal gravel zone that is 0.3 to 3 ft thick. The gravel, in turn, rests unconformably on the fine-grained Knobtown Sandstone. Interpretations from this and previous studies indicate that, in the study area, approximately 2 to 3 ft of the Knobtown Sandstone rests upon a competent shale of the Pleasanton Group which acts as a local confining unit.

While some slight variations were observed, the average depth to groundwater in the open boreholes was approximately 15 ft. Groundwater flow patterns in the immediate vicinity of the study area are controlled by a groundwater pumping well located over the site.

Cyanide was not detected above the analytical method detection limit in any soil sample collected in this investigation. Likewise, no soil samples contained metal concentrations above any RCRA regulatory level.

PCBs were found in significant concentrations in two general areas. One area of PCB contamination is associated with the former north end of the Plating Building and the

pipe gallery area located between the Plating Building Area and the MMB. While there were irregularities in areal extent of contamination with depth, it appeared that PCBs in concentrations exceeding 10 mg/kg was present throughout the full depth of overburden in this location. Several potential sources for this contamination exist.

Transformer Substation 18 was formerly situated near the north end of the Plating Building and included equipment containing PCB-based heat transfer oil. Leaks from this equipment are known to have occurred.

In addition, a 10,000-gal underground waste oil tank, (SWMU 10), was buried beneath former Substation 18 (note: this tank was removed under the Plating Building Waste Oil Tank Interim Measures project). This tank was constructed in 1942 to support machining operations in the MMB. The tank was abandoned and filled with sand in the early 1950s. In 1957, the Plating Building was constructed with the north foundation wall and Substation 18 lying directly over the abandoned tank. During modifications to Substation 18 in the early 1950's, an access port that enters the waste oil tank was uncovered and a 4-in. steel pipe and threaded cap were installed to facilitate sampling from the ground surface. PCB contamination was detected in the tank sand samples. Soil borings directly over the waste oil tank met refusal (plate steel - apparently the top of the waste oil tank) at approximately 5 ft bgs. The soil immediately above the tank was saturated with oil apparently due to leaks in the buried piping connected to the tank. The soil above the tank was so non-cohesive that samples were unrecoverable with the equipment available on-site. This area (Substation 18 and the abandoned tank was remediated under the Plating Building Waste Oil Tank Interim Measures project (DOE 1995).

The contamination at the north end of the study area also may have originated from a Hydrotherm piping system that runs in the pipe gallery between the MMB and the Plating Building. Several spills of PCB-based Therminol are known to have occurred in this area. Finally, it was also found that sources within Department 26 (immediately adjacent to the study area) significantly contributed to the PCB contamination.

There is also an area of PCB contamination in the southeast portion of the study area. This area of contamination also extends throughout the depth of overburden. The most likely sources of this contamination are the Hydrotherm piping system discussed above and a former Therminol storage tank that was located in the southeastern corner of the study area. The contamination in this area also extends beneath the MMB and was, therefore, further investigated as part of the D/26 RFI. The D/26 RFI delineated the extent of contamination to the west such that the entire contiguous area of contamination wasdefined.

TPH contamination (greater than 100 mg/kg) was also found in the study area. As was the case for PCB contamination, two primary areas of TPH contamination were observed. The locations of the two areas are essentially the same as for PCBs, suggesting that some or all of the sources are the same for both contaminants. Contamination extends beneath the MMB where it has been further evaluated as part of the D/26 RFI.

The results of this investigation also revealed the presence of VOCs in the north portion of the Plating Building. VOCs detected included TCE, 1, 2-DCE, tetrachloroethene, chloroethene (Vinyl chloride), 1, l-dichloroethane (1, l-DCA), and 1, l-dichloroethene (1, l-DCE). VOCs were detected both above and below the water table. Suspected sources were two degreaser units that operated inside the building. Solvents used in these degreasers included trichloroethene and tetrachloroethene which were the most commonly detected VOCs in the study area. Like PCBs and TPHs, the VOC contamination extends beneath the MMB and was further evaluated as part of the D/26 and TCE Still Area RFIs.

As stated earlier, the RFI borings terminated at or near the interface of the overburden and the Knobtown Sandstone. The Knobtown Sandstone underlies the contaminated overburden and consists of very fine- to fine-grained sandstone that is between one and three orders of magnitude less permeable than the overlying basal gravel. The largest areal extent of PCB, TPH, and VOC contamination was observed at the interface between the overburden and the sandstone bedrock. A probable explanation is that vertical migration of the dense non-aqueous phase liquids (DNAPL) (i.e., therminol oil,

solvents, etc.) stopped at the interface due to the contrast in hydraulic conductivity between the gravel and the sandstone. This DNAPL then contributes to a groundwater contaminant plume that moves in the direction of groundwater flow. In the study area, this direction is to the south.

Volume estimates indicated that the study area contains approximately 19,000 yd^3 of PCB-contaminated soil (greater than 10 mg/kg), 35,000 yd^3 of TPH-contaminated soil (greater than 100 mg/kg), and 55,000 yd^3 of VOC-contaminated soil. These volumes represent conservative estimates, and in some areas include the removal of near-surface non-contaminated soils in order to access deeper contaminated soils.

5.4.5 Previous Investigations

Contamination in the Plating Building area was initially investigated in 1985 as part of an assessment of contamination in the 002 Storm Sewer drainage area (Fleischhauer et al. 1986). The investigation was conducted in May and June of 1985 because PCB concentrations in the 002 stormwater effluent exceeded regulatory discharge limits. The objective of this 1985 study was to locate the possible sources of PCB contamination and to assess the various surface and subsurface pathways of PCBs in the sewer system.

The results of this investigation revealed contamination of 1,500 to 43,000 mg/kg PCBs in three sumps (S-16, S-17, and S-18) (Figure 5.153) around the Plating Building. Likewise, analyses of samples collected from shallow soil borings performed within the pipe gallery revealed significant contamination over large portions of the northern and southern sections of the area. Sediment samples were also collected from the pipe gallery, between the Plating Building and the MMB. This sediment was found to be contaminated and was removed.

The 1985 investigation also included the installation of three monitoring wells (KC85-33,-34, -35) that were placed in the drive area east of the Plating Building (Plate 1). Soil samples were collected during the boring of these wells. PCB contamination was found in soil samples from KC85-33 at depths from 11 to 26 ft. Concentrations ranged from 31 to 48 mg/kg of Aroclor 1260. This Aroclor was not present in the Therminol system,

but was present in the Substation 18 transformer. Soil samples from the other two monitoring well locations had no detection of PCBs, except for the 5.5- to 6-ft interval in KC85-34 where a concentration of 10 mg/kg of Aroclor 1260 was found (DOE 1990a, Fleischhauer et al. 1986).

Soil borings were also advanced in the area of the 002 sewer laterals during the 1985 002 investigation in order to evaluate potential preferential flow paths. Borings were drilled to 19.5 ft. Analyses revealed PCB contamination ranging from less than 1 mg/kg to 32 mg/kg. Two borings, E85-3 and E85-4 (Figure 5.153), had PCB concentrations above 10 mg/kg. E85-4 had its highest PCB reading at the 19.5 ft depth (Fleischhauer et al. 1986). Additional limited PCB sampling was performed during 1987 and 1988 in conjunction with construction projects in the Plating Building area (DOE 1990a, DOE 1993a). The data showed that more than 100 mg/kg of PCBs were present in shallow soils in the south end of the study area.

In 1988, 36 additional soil borings were placed around and within the Plating Building (Figure 5.153). Borings were drilled to a maximum depth of 18 ft. These samples were analyzed for PCBs, EP Toxicity metals, and TPH. Four were analyzed for total volatile organic compounds (VOCs). No samples were found to contain hazardous levels of EP Toxicity metals and no VOCs were detected.

TPH was detected in several areas, but was mostly concentrated at the northern and southern ends of the Plating Building, where the highest concentrations of 3,300 mg/kg and 745 mg/kg, were found. Two other borings, 57-16 and 57-18, also showed TPH contamination but at much lower levels than reported above (156 and 77 mg/kg in 57-16 and 94 mg/kg in 57-18).

The source of the TPH contamination at the south end of the building is unknown, but may originate from the oil in the heat transfer system and associated spills and leaks. Spills of heat transfer fluid and leakage from the underground waste oil tank and piping are potential sources in the northern area.

Borings 57-08, -12, -21, -26, -27, -28, and -29 at the northwest and south ends of the Plating Building showed the highest PCB contaminant concentrations in those borings

at the maximum depth (12- and 15-ft) sampled. The highest concentration measured in borehole 57-26 was in the sample from the lowest depth, with a concentration of 152 mg/kg at 18 ft. Again, the maximum depth of completion of these 1988 investigation borings was 18 ft.

The 1988 investigations identified an area of significant PCB contamination at the southern end of the Plating Building and around Building 90 where the original Therminol heating equipment was located. Borings 57-12, 28, and 29 are all in the pipe gallery area and the open area between the passageway and Building 90. The highest concentrations occurred between the depths of 8 and 14 ft with the highest values found at 11- and 14-ft depths in Boring 57-29, with levels of 2,030 and 2,010 mg/kg , respectively. Boring 57-28 had a concentration of 410 mg/kg at 8-ft depth and boring 57-12 had a high concentration of 275 mg/kg at 8-ft depth. Borings 57-12 and 57-29 both had PCB contamination greater than 10 mg/kg in their deepest samples at 14 ft.

Boring 57-21, at the southeast comer of the Plating Building and northeast comer of Building 90, also showed contamination, with a value of 107 mg/kg at a depth of 14 ft. Additional characterization data for this general area is provided by boring 57-27.

Soils under the MMB were evaluated as a part of the D/26 Inside (SWMU 31) RFI activities. However, four soil samples were collected in July of 1988 in the area occupied by D/26 during an excavation performed prior to installation of a foundation for a new piece of equipment. The samples, designated X-1, -2, -3, and -4, were collected at a depth of 18 to 24 ins. below floor level. The sample results were 1.9 mg/kg, 118 mg/kg, 1,250 mg/kg and 27 mg/kg PCBs, respectively. All samples with the exception of X- 1 reportedly contained Aroclor 1232; sample X-1 contained Aroclor 1242.

Potential contaminants derived from these sources included: metals, cyanide, PCBs, VOCs, and other hydrocarbons not specifically identified (but which can be generally categorized as light and heavy TPHs). The sections below describe the above sources and contaminants associated with each.

5.4.6 RFI Contaminant Characterization

In total, during the Plating Building RFI, 30 soil borings were advanced to near the base of the alluvial water table. Figure 5.35 shows the location of these borings. In accordance with the Work Plan (IT Corporation 1990), soil samples were collected at 3-ft intervals to bedrock and/or refusal and were analyzed for PCBs (EPA Method 8080), TPH [light], EPA Modified Method 8015), and TPH [heavy], EPA Modified Method 8015). In addition, soil samples collected at 3, 15, and 27 ft bgs and refusal were also analyzed for VOCs (EPA Method 624), Toxicity Characteristic Leaching Procedure (TCLP) metals, and cyanide all of which were not required by the Work Plan. The latter analyses were needed for determination of waste profiles necessary for disposal of the auger cuttings.

Groundwater samples were collected on two occasions from monitoring wells KC91-164 U, L and KC91-165 U, L. (These wells correspond to boreholes 20 and 19, respectively where "U" refers to the upper screened interval and "L refers to the lower. The water samples were analyzed for pH, conductivity, temperature, 23 priority pollutant metals, TPH (light), TPH (heavy), VOCs (EPA Method-624), and seven PCBs (see Sect. II.C.1.a).

Table 5.3 presents the analytical results for PCBs, TPH, and VOCS for all soil samples collected from each borehole. These results are indexed by borehole number. Data are presented along with associated interpretations for the study area only. Figures are referenced as appropriate in the following text.

Table 5.4 presents previously-obtained results for total metals and cyanide in the soils. These data were collected in 1988 during the initial work performed to remove the Plating Building structure. A review of the table demonstrates that metal and cyanide concentrations werenot elevated. Sampling locations were presented on Figure 5.35.

Figure 5.36 presents the 3-dimensional PCB distribution for concentrations greater than 10 mg/kg, the maximum areal extent of PCB contamination above 10 mg/kg, and shows the extent of PCB contamination above 10 mg/kg at each sampling depth interval. Due to the uncertainty in depicting the extent of soil removal during previous

Interim Measures, the PCB distribution at 3 ft is based primarily on the data collected during this RFI. These figures demonstrate that the distribution of PCBs is generally confined to two major locations.

The area of PCB contamination towards the north end of the Plating Building appears to be related to a variety of potential sources including previous PCB releases near the Substation 18 pad and sump, leakage from the sand-filled waste oil tank, the 1969 spill from the Hydrotherm piping system (and other possible releases from this system), and activity inside D/26. The irregular and sometimes discontinuous distribution of PCB contamination shown in these figures can be explained by two general factors. First, as stated above, a number of probable sources exist or have existed in the immediate area. Each would have released contamination over time at different point locations, at different rates of release, and by different media (i.e., Hydrothem fluid, transformer fluid, etc.) These factors alone would contribute to an irregular and discontinuous contaminant distribution. The other major factor involves any heterogeneity of the subsurface.

The extent of contamination in the north end of the facility is well defined to the north, south, and east (Figure 5.36). The contamination that extends to the west beneath the MMB was evaluated as part of the D/26 RFI (DOE 1993a). However, subsequent field observations during maintenance on pumping wells located east of the Plating Building site noted the presence of an oily matrix on the pump when removed from the well. Based on the action of the pumping wells in this area the zone of influence created by the pumping well effectively drew contamination present in the basal gravel layer of the alluvium towards the pumping well and the adjacent monitor well KC85-33.

A second area of PCB contamination is evident in the southwest corner of the study area. Borings 1 and 25 show contamination above 10 mg/kg consistently throughout the full depth of the alluvium. These are bound by "clean" (i.e., PCB contamination <1 mg/kg) borings 2, 11, and 26. Again, contamination extends beneath the MMB underneath D/26 (Figure 5.7).

Volume estimates of PCB-contaminated soil (greater than 10 mg/kg) indicate that the study area contains approximately 19,000 yd3 of contaminated soil. This volume represents a conservative estimate and, in some areas, includes the removal of upper non-contaminated soils to access lower PCB-contaminated soils.

TPH

Figure 5.37 shows the 3-dimensional distribution of TPH (above 100 mg/kg), the maximum areal extent of TPH, and shows the extent of contamination at each depth interval sampled.

As was the case for PCB contamination, two major areas of TPH contamination are present. The locations of the two areas of contamination are essentially the same as for PCBs, suggesting that some or all of the contaminant sources might be the same for both contaminants.

The TPH contaminated area identified in the northern portion of the study area is more extensive than the area identified for PCBs. There is irregularity and some minor discontinuity in the extent and shape of the soil plume with depth. The discussion presented previously concerning the factors affecting the shape and extent of the PCB contamination is applicable here. The extent of contamination is generally well defined to the north, east, and south.

Volume estimates of TPH-contaminated soil (greater than 100 mg/kg) indicate that the study contains approximately 35,000 yd^3. This volume represents a conservative estimate and in some areas includes the removal of upper non-contaminated soils to access lower TPH-contaminated soils.

VOCs

Soil VOC data were collected at depths of 3, 15, and 27 ft bgs and at bedrock surface. These data appear to demonstrate that at least two, near-surface spills or leaks have contributed to VOC contamination in the study area.

TCE: The highest concentration of TCE, 14,000,000 µg/kg, occurred in borehole 24 at refusal, immediately above the Knobtown Sandstone. Borehole 5 had 46,000 µg/kg at refusal. Borehole 16 had 18,000 µg/kg at 40 ft, and borehole 13, had 16,000 µg/kg at 38.6 ft. Decreasing TCE concentrations in the upward direction occurred within borehole 5, 7, 8, 13, 16 and 24 (31,000 µg/kg at 27 ft, 10,000 µg/kg at 15 ft and 330 µg/kg at 3 ft), suggesting the existence of a pool of DNAPL (Figure 5.11).

The most likely scenario based on all the VOC data collected to date is that a release (leak or spill) of TCE occurred near boreholes 13, 14, and 24. Based on available data, the release apparently occurred for some unknown period and was then stopped, because the TCE concentration increases with depth. The DNAPL then moved vertically downward through the unsaturated zone due to gravity and spread laterally due to spatial variations in hydraulic conductivity which are particularly evident at the bedrock interface. Because the leak was stopped, the initial source was cut off and a trail of residual TCE was left behind above the bedrock/alluvial interface.

The distribution of 1, 2-DCE is similar to that of TCE except the concentrations are lower. Concentrations of 1, 2-DCE reached a maximum of 11,000 µg/kg in borehole 24 at refusal, immediately above the Knobtown Sandstone.

Perchloroethylene (PCE): PCE contamination is restricted to the northern portion of the study area. The data collected during the RFI indicate PCE contamination near ground surface, one near boreholes 7 and borehole 14. The data show, however, that the primary release of PCE occurred near borehole 14, with concentrations decreasing laterally around borehole 14 in all directions.

1,1,2,2-PCA: The data for 1,1,2,2-PCA support the model of a near-surface release of DNAPL near borehole 7. These low concentrations (Table 5.3) may represent residual DNAPL remaining in the soil.

Vinyl Chloride: Vinyl chloride reached a maximum concentration of 1,400 µg/kg in borehole 24 at refusal and can be used to support the theory of a release of DNAPL near this borehole. Volume estimates of VOC-contaminated soil (above detection limits) indicate that the study area contains approximately 55,000 yd^3. This volume represents a conservative estimate and, in some areas, includes the removal of overlying non-contaminated soils in order to access lower VOC-contaminated soils.

TCLP Metals and Cyanide

Soil samples collected from each borehole at the 3, 15, and 27 ft bgs and refusal depth intervals were also analyzed for TCLP metals and cyanide. Cyanide was not observed above the method detection limit (typically 1 mg/kg) in any sample. No metals were detected above the RCRA TCLP regulatory standards. Only barium was reported above the method detection limit and that was in just one instance (borehole 8 at 15 ft -8.66 mg/kg).

5.4.7 Additional Corrective Actions

5.4.7.1 Pipe Gallery Interim Measures

Caustic & Acid Sump Structure

This abandoned concrete sump pit was removed (see Figure 5.38). This excavation included plugging abandoned industrial waste and storm sewer piping with concrete, and replacing a storm sewer catch basin. Removed Waste: About 46 cubic yards of concrete and 100 cubic yards of adjacent soil: ~ 243 tons.

Bldg. 57 Floor Drain Piping

This abandoned piping (Figure 5.38) totaled about 1,286 feet of 8" cast iron pipe buried five to eight feet below the ground surface. It was flushed during demolition of the Plating Building foundation in 1989. The inlets were plugged with portland cement and a mechanical plug was put in the outlet which empties into an industrial waste sump at the northeast edge of the Plating Building area. As a part of this Interim Measure, this piping was removed and disposed of by direct burial at a RCRA/TSCA Hazardous Waste Landfill. The pipe penetration into the industrial waste sump was sealed with grout. The top 75% of the excavated soil removed to expose the pipe was returned to the trench for back fill.

Removed Waste: About 140 cubic yards ~92 tons.

Pipe Gallery Containment Structure and Bldg. 57 Foundation Remains

Following the modifications to utility piping supports, this task removed the concrete containment including the remains of the west foundation wall of the former Plating Building (Figure 5.38). The soil between the Plating Building foundation wall and the Main Building was excavated to the bottom of the Main Building column footings (a depth of five feet below the ground surface). Excavation below the column footings was avoided. This removal volume included abandoned downspout piping (not to be confused with the separate Bldg. 57 Floor Drain Piping discussed above) from the former Plating Building which connected to three storm sewer laterals (near the "E" column, the "J" column, and the "N" column) draining into the Outfall 002 storm sewer system. These laterals had been lined in this area with fiberglass to prevent direct infiltration. However, there remained some potential for contamination to migrate through the pipe bedding to infiltration points beyond the fiberglass liner. The following steps were taken to reduce this migration potential.

1. Removal of the abandoned downspout piping.

2. Sealing the openings with hydraulic cement where this piping joined the laterals.

3. Replacing the contaminated Pipe Gallery soil around the laterals with clean clay.

Removed Waste: About 1,042 cubic yards (375'xlYx5'deep)--about 2,141 tons of RCRA/TSCA solid waste.

Cyanide Spill Containment Sump Removal

This sump structure, located on the north exterior of the Q-Tunnel (Figure 5.38) had no known spills and was not part of SWMU 9 or 12. Since trace PCB and cyanide contamination had been detected in the water in this sump, it was identified for removal as part of this project. Concrete core samples were collected from the bottom (floor) of the containment structure. These concrete samples did not indicate hazardous contaminants. However, based on the Plating Building RFI, the soil outside the sump had potential PCB and TCE contamination. Since the soil and concrete would be commingled during demolition and excavation, all soil and debris (about 225 tons) was disposed of as RCRA/TSCA hazardous waste. An air conditioning unit resting on the

pavement next to the sump served Building 75, east of the sump. This ground mounted unit was replaced by a roof mounted unit before demolition occurred. An abandoned 10 inch fire main valve near the west edge of this sump and 15 feet of piping running southwest into the north wall of the Q-Tunnel was also removed along with the sump demolition (Figure 5.39). The pavement around the sump was removed bounded on the east by Bldg. 75, on the north by the south end of Bldg. 59, on the west by the Main Bldg. 51 wall, and on the south by a curb installed between the south face of the service elevator and the Main Bldg. 51 wall.

5.4.7.2 Q-Tunnel Leak Repairs

Chronic water seep problems have existed in the pedestrian Q-Tunnel near BQ-51. Chemical grout injection work has been performed on multiple occasions with some success. This project performed the following four work packages to reduce infiltration along the north wall of the Q Tunnel. All soil and debris was disposed of as RCRA/TSCA Hazardous Waste.

Q-Tunnel Sump Well Construction

(See Figure 5.40) A gravel drain, two feet wide, twenty feet long, and eight feet deep, was installed along the north face of the Q-Tunnel. Clay soil was removed from the north exterior of the Q-Tunnel between the 51 Wall and Building 75 and backfilled with clean 3/4 inch gravel. A sump pump was placed 6 inches above the bottom of the gravel drain and enclosed in a well casing made from a 12-inch diameter Schedule 40 steel pipe. The discharge line from this pump was plumbed through the Q-Tunnel wall opening left by the removal of the abandoned fire main valve, and tied into the existing floor drain system. This floor drain system drains to the BQ37 sump which is equipped to handle contaminated groundwater collected by area foundation drains. The BQ37 sump and treatment system was installed by the a separate project.

Original construction drawings of the MMB indicate foundation drains outside the Q-Tunnel. However, the chronic water leakage in the BQ51 area indicated that these

drains were either not installed or have silted in and no longer drain properly. To provide improved drainage for the north wall, nine weep holes (2 inch diameter by 16 inches long) were cored through the north wall of the Q-Tunnel 4 inches below the floor surface between the BQ50.5 Column and the foot of the stairway at the east end of the Q-Tunnel. This required removal of a 4 foot wide by 42 feet long section of the floor slab along the north wall of the Tunnel, beginning at the foot of the east stairway running to the west about two feet beyond the BQ50.5 column. Perforated pipe bedded in pea gravel was placed next to these weep holes. The perforated pipe was sloped to drain into the existing floor drain system which tied into the BQ37 foundation drain sump. The pea gravel and perforated pipe was covered with 5 mil plastic sheeting and a 4 inch concrete slab finished to match the surrounding floor.

5.4.7.3 Camera Inspection, Cleaning And Repair Of Obstructed BQ51 Foundation Drains

The floor drain system was camera inspected and cleaned with high pressure water to remove any obstructions. Some rinse water, to prevent flooding the Q-Tunnel floor, was collected by a vacuum truck and transferred to the temporary water treatment system. Most of the rinse water drained to the BQ37 treatment system. Forty feet of 4 inch PVC perforated pipe (mentioned in item 2 above) replaced collapsed clay tile from the original foundation drain system.

5.4.7.4 Q-Tunnel Surface Drainage Improvements.

As mentioned above in the Cyanide Spill Containment Sump Removal discussion, the pavement around the abandoned sump and over the Q-Tunnel was removed during the excavation activities. New concrete pavement was placed over the entire area as shown in (Figure 5.39). A curb was installed between the Q-Tunnel service elevator and the Main Building (midway between Column “P” and “Q”). Two storm sewer catch basin inlets were installed. These inlets are tied to the Bldg. 59 downspout drain line which ties into the “T” Lateral which drains into the 001 Storm Sewer Outfall, which drains into the Blue River northeast of the Kansas City Plant.

Previously, a D/26 spill containment sump (part of SWMU 12) was located above and to the north east of the BQ51 column (where the new Q-Tunnel Sump Well was placed). A curb separated the old containment area from the pavement around Building 75 and the south end of Bldg. 59. Bldg. 75 roof gutters drained into this area east of the D/26 spill containment sump. The gutters drained to the pavement which was sloped to the northeast to a small culvert that went under the hallway between Building 75 and Building 59. This culvert had become plugged with debris causing this water to pond against Building 75 directly over the Q-Tunnel stairway. The spill containment sump over BQ51 also caused water to pond in this area. To eliminate this ponding problem, two storm drain catch basins were installed in the repaved alley between Building 59 / 75 and the Main Building, south of the "T" aisle ramp door. The new pavement is divided into two water sheds by a crown between the southwest comer of Building 59 and the Main Building. (See Figure 5.39). The north half of this alley pavement slopes from the crown to the north where the inlet is installed at the base of the ramp for the sliding doorway into the Main Building "T" aisle. The south half slopes to a catch basin four feet south of the southwest comer of Building 59. An existing sanitary sewer manhole is positioned to the west of the storm sewer inlet. A new water tight cover for the sanitary manhole was cast into the new pavement at the same elevation as the pavement crown. In the event surface water leaks through the concrete pavement, the gravel trench drain will collect this water and pump it into the BQ37 foundation drain system. Due to restricted access and the reach limitations of available equipment, the well pump elevation was installed three feet above the Q-Tunnel floor. This limitation required the weep holes as a secondary measure to allow hydraulic pressure against the wall to drain under the floor into the BQ37 foundation drain system. Removed Waste: The above four items, along with the Cyanide Spill Sump demolition, generated about 100 cubic yards--225 tons of RCRA/TSCA solid waste.

5.4.8 Plating Building Waste Oil Tank

This Interim Measure addressed partial removal of contamination associated with Solid Waste Management Units (SWMU) #10 (Waste Oil Tank) and #11 (Substation 18) as identified in the Consent Order.

This Interim Measures Work was executed using a remedial action contractor to remove the remaining Substation 18 transformer pad and containment structure and the abandoned waste oil tank buried beneath the Substation 18 site.

5.4.9 Substation 18 Removal

The PCB electrical equipment and transformer had been removed during earlier demolition in 1988-89 (Figure 5.34). The spill containment curb structure for Substation 18 was directly over the waste oil tank and continued west to the edge of the spill containment for the D/26 Outside piping. This ten feet by ten feet area outside the northwest corner of the sheet piling was excavated four feet below grade and backfilled with clean clay and covered with asphaltic concrete pavement.

5.4.10 Waste Oil Tank Removal

Previous investigations determined that the abandoned waste oil tank had oil floating in the void spaces of the tank. Pump tests indicated that the tank leaked and ground water freely mingled with the tank contents. The tank was partially filled with sand before the plating building had been constructed over it in 1957. Laboratory analysis of the oil recovered from the tank determined it was a motor oil type of petroleum. Trace PCB and chlorinated solvent contamination had also been detected.

The waste oil tank excavation involved driving seventy-two sheet piles twenty-eight to thirty feet deep in a rectangular arrangement averaging twenty feet wide and fifty feet long. The west wall of sheet piling was placed seventeen feet from and parallel to the outside face of the main building. The north wall of sheet piling was placed ten feet south of the brick face of the Building 75 Emergency Generator enclosure. All material inside the sheet piling was removed to a depth of seventeen feet below the surrounding

grade. This volume included the steel tank and the concrete saddles and two foot thick slab beneath the tank. The tank was eleven feet in diameter and thirty-seven feet long. The horizontal cylindrical tank was constructed of welded 1/4 inch steel plate, with flat ends, and a baffle plate (parallel to the ends) located at the center of the tank. The bottom of the tank was about fifteen feet below grade. Piping connected to the tank was removed to the edge of the excavation. This piping ran parallel to and about six feet north of the north foundation wall of Building 57. The piping did not contain any fluids and was sealed with clay during backfilling. Accumulated water and oil was pumped out and treated and the excavation was backfilled with clean imported clay soil.

Oil (about 5,000 gallons) was transferred to a hazardous waste tanker and transported to the Aptus incinerator in Coffeyville, Kansas.

About 100 tons of non-hazardous concrete rubble and debris was transported to the Johnson County, Kansas municipal landfill.

All of the soil and debris inside the piles, except for the top two feet which was treated as non-hazardous, was disposed of as TSCA(PCB)/RCRA(F001) solid hazardous waste at the Envirosafe landfill in Grand View, Idaho, totaling about 1,100 tons. The top two feet of soil was clean clay that had been placed after the Plating Building demolition in 1989 (this material was used for backfill).

The steel waste oil tank was broken into two pieces to facilitate cleaning and shipping.

5.5 95th Terrace (SWMU 42)

5.5.1 Previous Regulatory Submittals/Approvals

RFI Work Plan
RFI Work Plan Submittal - Letter from G. P. Keary, DOE, to K. S. Ritchey, dated May 22, 1996
RFI Work Plan Approval - Letter from K. S. Ritchey, EPA to G. P. Keary, DOE, dated June 23, 1998.

RFI Report
RFI Report Submittal - Letter from G. P. Keary, DOE, to K. S. Ritchey, dated September 30, 1999
RFI Report Approval - Letter from K. S. Ritchey, EPA to G. P. Keary, DOE, dated

CMS / CMI

5.5.2 Description of Unit

Starting at AICO and terminating at the 002 Outfall on Indian Creek, 95th Terrace is contained approximately within the boundaries of the old Indian Creek channel (- 25 ft wide) and occupies an area approximately 650 x 125 ft (Figure 5.41). Between 5 and 50 ft of clean soil, defined as having PCB concentrations less than 1 mg/kg covers the site.

No manufacturing activities occurred at 95th Terrace. Rather, 95th Terrace was the terminal discharge location for the 002 storm sewer prior to rerouting of Indian Creek. PCBs present at the site resulted primarily from a 1969 spill at D/26 rather than from 95th Terrace activities. At present, 95th Terrace is composed of sediments from the former Indian Creek channel, fill and the concrete box culvert.

A 6-ft-wide by 5-ft-high reinforced concrete box structure (conduit) is located in the former channel of Indian Creek. The conduit was constructed by the Missouri Highway Department (MHD) as part of the relocation and widening of Bannister Road. The conduit is also an important element of the Bannister Federal Complex Flood Control Project and the USACE reimbursed the MHD for the cost of constructing the conduit. The conduit including backfill details was designed by the USACE and furnished to the MHD. Conduits or drainage structures through or beneath levees and floodwalls are

designed and constructed with features intended to minimize the potential for seepage and internal erosion to occur along the structure. The structure was designed to minimize subsurface flow that could result from an Indian Creek water level near the top of the levee on the riverward side and an unflooded condition on the landward side. The resulting design gradient is a more severe hydrostatic condition than occurs during normal non-flood operation of the structure.

It is important to understand the design and construction details of the structure in order to evaluate the potential impact of the structure on contaminant migration and distribution. Several sources of information were utilized to develop a clear understanding of the design and construction of the drainage structure. Those sources included: inspection of the structure, MHD Final Plans for the Bannister Road project, logs of borings drilled along and near the structure, and personal communication with Messrs. Joseph Lilley and Scott Loehr of the USACE. Mr. Lilley is currently the USACE project manager for the Bannister Federal Complex Flood Control Project and was a construction engineer assigned to the project during the 1969 through 1971 construction period. Mr. Loehr was the project design leader for the modifications to the flood control project, which were constructed in 1992 and 1993.

Figure 5.42 depicts the conduit, sluice gate, the location and size of the seepage collars, backfill details, the pre-construction channel bottom, and the approximate top of bedrock in those areas where there is sufficient boring data.

The drainage structure (conduit and sluice gate) is cast-in-place reinforced concrete. The base elevation of the structure is generally 2 to 5 ft. above the bottom elevation of the former Indian Creek channel. Where boring data are available, the top of bedrock is approximately 8 to 9 ft. below the bottom of the conduit. The thickness of the basal gravel, which directly overlies the bedrock, is generally 3 to 4 ft thick in this portion of the BFC. Therefore, the fill beneath most of the length of the structure was likely placed directly on the silty clay that overlies the basal gravel. There are, however, short reaches where the fill might have been placed on the clayey gravel. The final plans show that

measurable settlement of the conduit was anticipated especially where the embankment fill is thickest, beneath Bannister Road. The monolith lengths (length of conduit sections) and the thickness of the side, top, and bottom of the conduit are variable, which demonstrate that the structure was designed to withstand the variable loading and deflections imposed upon it. Rubber waterstops were installed at each joint in the structure in order to prevent seepage into or out of the conduit. Concrete seepage or cutoff collars were constructed around the conduit both landward and riverward of the sluice gate in the reach that was backfilled with impervious fill in order to further prevent seepage along the conduit. The collars are 8 in. wide and extend out 36 in. from the conduit.

Normally foundation preparation for the conduit would consist of removing rubble, rocks, and unusually soft and wet material. The contract plans clearly show that the impervious fill was to be placed beneath and around the full perimeter of the conduit from a point 100-ft. riverward of the centerline of the sluice gate to 40 ft. landward of the sluice gate centerline. The borings near the conduit were not drilled for the purpose of investigating the nature of the backfill. However, the logs of the borings do verify the presence of impervious fill in the areas in which it was required. Impervious fill placed in levees is subject to rigorous specifications regarding moisture content and in-place density. The specifications for the fill immediately adjacent to the conduit normally require hand compaction in order to assure intimate contact between the fill and the concrete.

The impervious fill is generally described in the boring logs, as stiff to very stiff high plasticity clay with fragments of shale. Considering that the construction required considerable excavation on the east side of Blue River Road, it is likely that the impervious fill came from selective excavation of residual clay and weathered shale in that area. Where the impervious fill was placed on the alluvial silty clay, the contact between the materials is very noticeable in the boring logs. The alluvial silty clay is typically described as soft or very soft. The drawings suggest that the backfill around and beneath the conduit riverward of the impervious fill is a rock fill and that the rock fill

was required to extend up to at least elevation 770. The boring data and the drawings provide evidence that a major portion of the remainder of the embankment was constructed of material from the excavation east of Blue River Road. Much of that fill was described as shale and limestone fill. The boring logs suggest that the fill riverward of the impervious fill is largely shale and limestone fill but that the fill landward of the impervious fill contains considerably more clay.

Observations made while collecting soil samples through the bottom of the box culvert at three locations and through the 002 Raceway at three locations (Figure 5.43) provided additional insight into the potential for the conduit to impact contaminant migration in the former channel area. No water was observed flowing from BC1. Paper-thin layers of water discharged from BC2 and BC3. However, at BC4, BC5, and BC6 that were drilled in the 002 Raceway adjacent to Indian Creek, significant water was observed discharging from the core holes. The floor of the raceway was below the stage of Indian Creek at the time of drilling. The boring locations were sandbagged and dewatered prior to drilling.

Boring BC1 is located in the section in which impervious fill surrounds the conduit. BC2 and BC3 were drilled in the section of conduit that is enveloped in limestone fill up to elevation 770. The hydrostatic head in the basal gravel from the vicinity of BC1 downgradient to the approximate location of BC3 is about 6 ft above the conduit floor. The head decreases downgradient from that point. The most conductive alluvial material is the basal clayey gravel. The basal gravel would be the major source of potentially contaminated groundwater to the conduit backfill. The data indicate that 3 ft or more of alluvial silty clay overlie the basal gravel along most if not all of the conduit alignment. A variable thickness of either select impervious or rock fill was placed over the silty clay channel bottom essentially as a leveling course. The fill extended up to the conduit foundation grade elevation. The specifications for the foundation preparation were not available, however, it is likely that the dewatered channel bottom was compacted prior to placement of the impervious clay or rock fill.

The hydraulic conductivity of the impervious fill is likely in the range of 3×10^{-5} ft/day to 3×10^{-4} ft/day, which is 2 to 3 orders of magnitude lower than the conductivity of the surrounding clayey-silt. The limestone fill is estimated to have a conductivity that is at least 2 orders of magnitude greater than that of the basal gravel. The potential for the migration of contaminated groundwater upward from the basal gravel and into the limestone fill is dependent on:

- Hydraulic conductivity and thickness of the silty clay beneath the fill,
- Hydraulic conductivity of the limestone fill,
- The head in the basal gravel,
- The degree of hydraulic connection between the limestone fill and the Indian Creek channel.

Based on the preceding observations, the groundwater flow from the BC borings provides information regarding groundwater flow conditions along the conduit. The lack of flow from BC1 confirms that the impervious fill does have a low permeability especially considering the steep hydraulic gradient into the conduit. Considering that there is approximately 6 ft of head differential in the vicinity of BC2 and BC3, the very small discharges from these borings indicate that the hydraulic conductivity of the limestone fill beneath the conduit at these locations is low. It is not contradictory for the conductivity of the limestone fill beneath the conduit to be rather low. In areas where the fill thickness is small, it is likely that when the limestone fill was compacted the soft silty clay was forced up into the voids in the limestone fill thereby reducing the conductivity. There is no evidence that either the conduit or the backfill around the conduit creates a groundwater pathway.

It is concluded that the drainage structure does not facilitate the migration of potentially contaminated groundwater to Indian Creek. The structure was designed and constructed to minimize hydraulic communication between the plant and Indian Creek along the outside of the conduit. The low conductivity of the alluvial silty clay inhibits groundwater flow from the basal gravel to the conduit backfill.

The culvert is a very substantial structure that was designed to remain serviceable for a long time. The economic life of flood protection projects such as this is 100 years. The sidewalls of the conduit range from 12 to 16 in. thick and the thickness of the top and bottom range from 16 to 24 in. The conduit contains two layers of steel reinforcing bars, 5/8 and 7/8 in. in diameter respectively, placed on a 12-in. grid. Rubber waterstops were cast in the monolith joints to minimize seepage. It is important to note that the drainage structure is an important component of the Bannister Federal Complex flood control system. The conduit must be maintained in order to assure the effective and safe operation of the flood control system. Prevention of uncontrolled seepage into the conduit is a major consideration during required periodic inspections of the flood control project.

During 1989, any of the culvert joints that appeared to leak or showed potential for leaking were made watertight by sealant injection. Confirmation inspections after sealing did not note any leaking joints.

In summary, the culvert does not appear to be a preferred flow path or sink for the release of 95th Terrace groundwater into Indian Creek.

5.5.3 RFI Field Investigation

The investigation at the 95th Terrace site was conducted under the DOE Environmental Restoration (ER) Program according to a RFI work plan reviewed in 1996 (DOE 1996a) and an addendum reviewed in 1998 by EPA and MDNR. The investigation was performed by personnel from the Oak Ridge National Laboratory (ORNL) office in Grand Junction (GJ), Colorado, and Maxim Technologies, Inc., Kansas City, Kansas. The Human Health and Ecological Risk Assessments were performed by URS.

5.5.4 Contamination Characterization

5.5.4.1 Groundwater Contamination

Low level PCBs, typically about 1 ug/L, have been detected in groundwater samples collected from 95th Terrace wells. PCBs are believed to be relatively immobile in groundwater (Tucker et al. 1975, Grifin and Chou 1981, and Roberts et al. 1982) so the detection of PCBs was perplexing. The detected PCBs could potentially be dissolved in groundwater, transported via colloids, or the result of PCB containing sediment introduced into the well during sampling. To divine the truth, a specialized sampling program was initiated in 1998.

Four rounds of groundwater samples were collected from Wells 193L, 44, 201, and 233 using micropurge techniques, the colloidal borescope, and a bailer. Because Well 233 had not been installed at the time of the first sampling event, two rounds of samples, separated by at least one day, were collected during the third and fourth sampling events. Well 193L, the most contaminated well on site, while not a 95th Terrace well was included in the study because of expected high PCB concentrations. Prior to micropurge sample collection, the colloidal borescope was used to identify colloidal rich zones. Both filtered and unfiltered bailer and micropurge samples were collected. A comprehensive review of colloid studies by McCarthy and Degueldre (1993) showed that in clay rich environments similar to BFC colloids typically range in size from 0.01 to 0.45 microns. None of the studies conducted in clay rich environments reported

colloids bigger than 0.45 microns. Based on this size range, filter sizes of 0.1, 0.2 and 0.45 microns were selected.

Based on expected colloid size, particles above 0.45 microns are believed to be immobile under typical BFC groundwater flow conditions and are only mobilized as a result of sampling activities. Thus, PCBs detected in either the unfiltered micropurge or bailer samples represent both mobile and immobile PCB fractions. PCBs measured after filtration represent potential mobile PCBs, either dissolved or attached to colloids.

Only the first, second, and fourth rounds of samples were used in this analysis. The third round sample results are questionable because the non-filtered micropurge sample collected immediately prior to the filtered samples contained no detectable PCBs while the filtered samples contained PCBs (Table 5.5). This makes no sense and may be explained as described below. If PCBs were truly present they should have been detected in both filtered and non-filtered samples. The sampling crew used a different type of tubing to collect the third round of samples. The same tubing was used to collect two sets of samples from Well 233 during the sampling. Because Well 233 had not been installed at the time of the first sampling event two rounds of samples, separated by two days, were collected during the third sampling event. Due to the stiffness of the tubing the peristaltic pump produced minimal flow. All non-filtered micropurge samples were collected at this minimal flow rate. The flow was further reduced when filtering. In the interest of time, when obtaining filtered samples the sampling crew turned the flow control too high which, given the rigidity of the tubing, likely produced oscillating pressure waves in the well.

The net effect was a gentle surging effect in the well during sample collection. Additionally, the higher pressures associated with the higher pump setting likely caused filter failure (small tears) as evidenced by the low PCB concentrations present in the 0.2 and 0.1 micron filtered sample results. As a result, third round sample results are not considered representative.

Micropurge sampling always resulted in lower concentrations than bailer sampling (Table 5.5). These results show that bailing likely results in immobile soil particles being collected and analyzed along with groundwater. Except for those wells equipped with dedicated micropurge sampling equipment, groundwater samples at the BFC are collected using a bailer. In the past, bailers were used to evacuate three well volumes prior to sampling. Presently, peristaltic pumps are used to evacuate the wells prior to sampling. After evacuation, a bailer is used for sample collection. Based on study results, it is likely that any sample collection involving bailing will result in biased sample results that do not reflect the true potential mobile PCB fraction.

While a considerable improvement over sample collection with a bailer, colloidal borescope measurements collected during micropurge sampling show that micropurge sampling is not a panacea and also biases sample results. Figure 5.44 shows particle size and velocity versus time in Well 192 for an 18 hour period before and during micropurge sampling. In the 16 th hour before sample collection, particle size and velocity remained relatively constant. During sample collection (16 to 18 h) particle size increased by a factor of 10 to 15 and velocity by a factor of 6 to 8. Despite using best practice sampling techniques, micropurge sampling did influence ambient groundwater flow and consequently colloid size and density. Thus, similar to bailer sampling, but to a much lesser degree, micropurge sampling results in over representation of the true mobile PCB fraction. Therefore, micropurge PCB results at or near the detection limit of 0.5 µg/L are surmised to be an artifact of sampling and not representative of the true mobile PCB fraction.

All 192L non-filtered micropurge samples contained PCBs in excess of 1 µg/L (Table 5.6). Based on expected colloid size, the non-filtered samples represent both mobile and immobile PCB fractions. After 0.45 micron filtration, PCB concentrations were non-detect and 0.64 µg/L. Given the low PCB concentration detected (0.64 µg/L), it is likely the PCBs were mobilized by the increased groundwater velocity associated with micropurge sampling. Without the increased velocity it is unlikely the PCBs would have been detected in groundwater. PCBs were not detected in any of the 0.2 and 0.1 micron

samples suggesting that dissolved PCBs are not present in measurable quantities in the vicinity of Well 192. These results support the argument that dissolved chlorinated solvents do not enhance PCB solubility. Well 192 is the most highly contaminated (both PCBs and VOCs) on site, with TCEconcentrations approaching the solubility limit. If dissolved VOCs enhance the solubility of PCBs, then dissolved PCBs should have been present in detectable quantities.

One of the three Well 44 non-filtered micropurge samples contained PCBs in excess of 0.5 µg/L. Based on expected colloid size, the non-filtered samples represent both mobile and immobile PCB fractions. The second round 0.45 micron filtered sample contained PCBs at 1.6 µg/L. The other 0.45 micron sample contained PCBs at non-detectable levels. As before, the PCBs present in the second round samples are believed to be an artifact of micropurge sampling. PCB concentrations were non-detect for the 0.1 micron and 0.2 micron filtered samples. The lack of PCBs in the smaller filter size samples suggests that dissolved PCBs are not present in measurable quantities in the vicinity of Well 44.

None of the Well 201 non-filtered micropurge samples contained PCBs in excess of 0.5 µg/L. Based on the absence of detectable PCBs in the first, second, and fourth round 0.1 micron 0.2 micron filtered samples, detectable dissolved PCBs are not present in the vicinity of Well 201.

One of the three non-filter Well 233 micropurge samples contained PCBs above 0.5 µg/L. Similarly, one of the three 0.45 micron filtered micropurge samples contained PCBs above 0.5 µg/L. Again, these PCBs are believed to be an artifact of micropurge sampling. As before, based on the absence of detectable PCBs in the first round 0.1 micron and 0.2 micron filtered samples, dissolved PCBs are probably not present in the vicinity of Well 233.

In summary, the data show that bailer sample results are not representative of mobile, both dissolved and colloidal, PCB concentrations. Based on expected colloid size, the

filtered micropurge samples best represent mobile colloid concentrations. However, even the micropurge samples contain some bias. Velocity and colloid size measurements collected with the colloidal borescope during sample collection show an increase in velocity and colloid size during sampling (Figure 5.44). Thus, despite best efforts, even the micropurge samples do not represent ambient flow conditions. Given that the filtered samples containing PCBs above the drinking water standard of 0.5 µg/L were very close to the standard (1.6 µg/L in Well 44, 0.64 in Well 192, and 2.4 in Well 233), it is likely that actual mobile PCB concentrations are below 0.5 µg/L. None of the remainder of the filtered micropurge samples contained PCBs above 0.5 µg/L, further supporting this hypothesis. Thus, there is no evidence that PCBs, either colloidal or dissolved, are mobile at the BFC at concentrations, above the PCB drinking water standard. These results are similar to the findings of Tucker et a1 (1975), Griffin and Chou (198 1) and Roberts et al. (1982).

Tucker et al. (1975) performed an experiment whereby PCBs were introduced to the tops of soil columns followed by leaching with water. PCBs were detected in the effluent after 13 L had passed through a sandy soil. In contrast, no PCBs were detected in the effluent from a silty-clay soil even after passage of nearly 60 L. Because the volume of the soil columns were relatively small (3-in. diameter x 12-in.), many pore volumes were necessary for PCBs to migrate, even in the sandy soil.

Griffin and Chou (1981) reported that PCBs do not move readily through earth materials leached with water or with contaminated solutions such as landfill leachates. Indeed, only the application of pure organic solvents mobilized the PCBs. These authors concluded that the most likely path for redistribution or migration of PCBs in soils may be vapor transport through the unsaturated pores.

Finally, results at a site in Canada also indicate that PCB migration in water is not expected. Roberts et al. (1982) concluded that greater than expected vertical movement of PCBs was due to migration of the oily liquid downward through fractures in the clay soils being studied.

For completeness, comprehensive PCB groundwater sample results for Wells 44, 93, 94, and 201 (which replaced 93) are presented in Table 5.6. These samples were not collected using micropurge techniques and probably over estimate actual mobile PCB concentrations. These results show, as predicted by current partitioning theory, that despite high PCB soil concentrations (i.e., >8,000 mg/kg) 95th Terrace PCB groundwater concentrations are quite low.

Despite the evidence that PCBs are not mobile in groundwater at concentrations greater than 0.5 µg/L, the drinking water standard, assume that PCB groundwater concentrations are 1.0 µg/L, a typical concentration when PCBs are present in groundwater samples. Groundwater discharge from 95th Terrace ranges between 29 ft^3/d (218 gal/d) and 109 ft^3/d (818 gal/d). Thus, the PCB loading rate to Indian Creek from groundwater, assuming PCBs are mobile, is 0.8 to 3.0 mg/d.

5.5.4.2 Soil Contamination

Samples were collected during four separate investigations conducted in 1993, 1996, 1998, and 1999. The 1993 effort was discussed in the 95th Terrace RFI Work Plan (DOE 1996a). The 1996, 1998, and 1999 data were collected according to the 95th Terrace Work Plan. For clarity, this data will be discussed as one data set.

Accessibility is limited at the site by 95th Terrace (the road), Bannister Road and the flood levee. In the accessible areas, 247 soil samples from 44 soil borings were collected as part of the four 95th Terrace field investigations (Figure 5.45). In the boreholes drilled with an auger rig, soil samples were collected from each boring at 5-ft intervals to bedrock. All soil samples were analyzed for PCBs. Samples at the water table contact and at the alluvium bedrock contact (approximately 35 and 50 ft, respectively) were analyzed for VOCs in addition to PCBs. In less accessible areas, seven soil samples were collected by coring through the bottom of the box culvert at six locations (Figure 5.43). Box culvert soil samples were collected six inches to one foot beneath the bottom of the culvert and analyzed for PCBs. Finally, soil samples representative of PCB

concentrations in the top 18 in. of soil were collected at 18 locations in 1999 (Figure 5.45).

All samples were collected and analyzed in accordance with the work plan (DOE 1996a). Borehole and corehole locations were based on information gathered during the preparation of the site work plan, investigation concentration results and access.

PCBs

Because 95th Terrace PCBs are the result of an accidental release of PCBs to old Indian Creek, contamination should be found solely within the old creek channel. Interestingly, some of the highest PCB concentrations (BH06 through BH09) are found outside of the creek channel (Figure 5.45). Additionally, PCB concentration trends within the old creek channel are not continuous. Zones of higher concentration are separated by zones of lower concentration. The likely explanation is that during box culvert construction activities old Indian Creek was leveled to accommodate the culvert. Excavated creek bottom sediments from creek bottom highs were used to fill surrounding low areas and to cover the culvert resulting in unlikely contamination distributions. For example, at Well 233 PCB concentrations are greater in shallow soils than with depth (Figure 5.2). During box culvert construction some Indian Creek sediments were likely removed and stock piled. Sediments first removed from the creek bottom probably had the highest PCB concentrations and ended up on the bottom of the stock pile. During covering operations stock piled sediments were used in reverse of excavation. As a result, the vertical contamination profile at Well 233 is opposite of expected. Dirt moving associated with box culvert excavation also explains the presence of PCBs above the water table at some locations (Borehole 6) and how PCBs could be isolated above and below by clean dirt (Borehole 01) (Table 5.7). In summary, the PCB distribution at AICO and 95th Terrace is the result of dirt moving activities and not contaminant migration.

The highest 95th Terrace PCB concentrations are found immediately south of the AICO (up to 8,300 mg/kg in A159 at 45.5 ft) and generally decrease towards Indian Creek where the highest concentration encountered was 29 mg/kg (BC3). PCBs are absent

(below detection limits) from surface soils except in the immediate vicinity of the 002 Raceway and Outfall. Two soil samples, collected on either side of the spillway, contained PCBs at 0.41 mg/kg and 0.66 mg/kg (Figures 5.45, 5.2 and Table 5.7). PCB concentrations at both locations are less than the 1.0 mg/kg cleanup level for soils where the potential for migration is possible, as agreed upon in the Consent Order.

Typically, PCB contamination is greatest with depth except as noted at Well 233 (Figures 5.2 and Table 5.7). With the exception of PCBs in the vicinity of Well 233, the PCBs are isolated from land surface by tens of feet of clean soil. 1987 sampling (ORNL 1988) showed that surface soils (1 ft. below ground surface) in the vicinity of the Well 233 contained 0.44 mg/kg PCBs. Thus, higher PCBs concentrations (2.7 mg/kg) at Well 233 are separated from ground surface by five feet of soils containing less than 1 mg/kg of PCBs. PCBs beneath the 002 Outfall are separated from ground surface by 1 ft of concrete. Based on Figure 5.2, approximately 7,897 kg (1,440 gal) of PCBs are present in 95th Terrace soils

VOCs

Chloroform, methylene chloride and bromodichloromethane were reported at low concentrations (0.005, 1 and 0.11 mg/kg, respectively) in some of the soil samples. These chemicals were determined during the QC evaluation to be common laboratory contaminants and not actual site contamination.

5.5.4.3 RFI Summary

Approximately 7,897 kg (1,440 gal) of PCBs are present in 95th Terrace soils. The contamination, up to 8,300 mg/kg, is present in old Indian Creek fill areas and beneath the box culvert (Figures. 5.45 and 5.2). PCB concentrations tend to decrease approaching Indian Creek and increase with depth. With the exception of the area surrounding Well 233, tens of feet of clean soil separate the PCB contamination from land surface. At Well 233 a minimum of five feet of soil containing less than 1 mg/kg PCBs separates soil concentrations of up to 2.7 mg/kg from ground surface. This location had previously been remediated to 4 mg/kg or less of PCBs. Thus, the presence

of 2.7 mg/kg PCBs was not unexpected and is not indicative of PCB migration. Common VOC laboratory contaminants were reported at low concentrations in some soil samples.

5.5.5 Surface Water and Sediment Contamination

Sediment and surface water samples were collected from Indian Creek and Blue River during 1998 and 1999 (Figure 5.46). PCBs were detected at concentrations between 0.48 mg/kg and 2.3 mg/kg in sediment samples collected in the immediate vicinity of the 002 Outfall. PCBs were not detected in any of the other Blue River or Indian Creek sediment samples. The 1998 and 1999 sample results represent a significant decrease from 1987 when Indian Creek sediments in the vicinity of the outfall contained PCBs up to 792 mg/kg (ORNL 1988). PCBs were not detected in any of the surface water samples that were collected during low-flow conditions.

Surface water quality is further discussed in Section 6. In addition, as required by the MHWMF Permit the KCP is required to complete a PCB Fate & Transport Study. This study is currently underway.

5.5.5.1 RFI Summary:

1) PCB soil contamination, up to 8,300 mg/kg, is present in old Indian Creek channel and other fill areas. PCB distribution is a function of the old creek channel topography and dirt moving activities. PCB concentrations tend to decrease approaching Indian Creek and increase with depth. Eighteen shallow (18" or less) soil samples were collected in 1999. PCBs were not detected at concentrations greater than 1.0 mg/kg in any of the shallow soil samples. With the exception of the area surrounding Well 233, tens of feet of clean soil separate the PCB contamination from land surface. At Well 233 approximately five feet of soil containing less than 1 mg/kg (0.44 mg/kg) separates higher PCB concentrations (2.9 mg/kg) from ground surface. Approximately one foot of concrete separates PCB contamination beneath the 002 Outfall spillway from land surface.

2) Mobile PCB groundwater concentrations, both dissolved and adsorbed to particulates, are below 0.5 ug/L, the groundwater standard for PCBs. Based on organic carbon content, PCBs are retarded relative to groundwater movement by a factor between 9,749 and 974,733. Thus, the potential that 95th Terrace PCBs will migrate in groundwater at concentrations above drinking water standards is minimal, if not nonexistent.

3) The box culvert has minimal influence on groundwater flow or PCB migration. Fill surrounding the box culvert was derived from native clayey-silt. Thus hydraulically, the fill is similar to the surrounding native clayey silt. In fact visually, the fill and surrounding clayey-silt are so similar that they would be indistinguishable from each other if not for the occasional presence of broken glass and plastic. Because of the impervious material surrounding the culvert beneath the flood control wall, the crushed limestone gravel beneath the box culvert transmits minimal water. Thus, the box culvert is not a groundwater sink or source.

4) PCBs were not detected in water samples collected from Indian Creek during low-flow conditions. Fish tissue samples contained PCBs at levels below the FDA (1984) permissible consumptive fish and shellfish tissue concentration of 2 µg/g. Indian Creek sediment samples in the immediate vicinity of the 002 Outfall contained sediment contaminated PCBs up to 2.3 mg/kg..

5) The source of chronic low level 002 discharge PCBs is residual contaminated sediment residing in the main plant area storm sewer system. As noted in Section 6.10, this discharge has been addressed with the installation of the Outfall 002 re-route system.

6) The potential for PCB exposure is minimal because:

Groundwater sample results indicate the PCBs are not mobile in groundwater (dissolved, sorbed or free phase) at concentrations above the drinking water standard of 0.5 µg/L.

Soil contamination is separated from ground surface by at least five feet of clean soil, defined as containing less than 1 mg/kg of PCBs.

Indian Creek fish tissues contain less than the FDA (1984) permissible consumptive fish and shellfish tissue concentration of 2 µg/g.

Indian Creek PCB sediment concentrations in the vicinity of Outfall 002 are monitored on a quarterly basis (see discussion provided in Section 6). PCBs were not present in any other portions of Indian Creek.

The human health risk assessment conducted as part of this RFI determined there was minimal risk associated with the 95th Terrace site and Outfall 002 (URS 2000).

5.5.5.2 Migration Pathways

A detailed evaluation of potential exposure pathways is presented in the Human Health Risk Assessment (URS 2000).

5.5.6 Corrective Measures Implementation/MDNR's Recommended Remedy

The recommended clean-up alternative for 95th Terrace site was the implementation of institutional controls, engineering controls and monitoring. Clean-up goals were set in the corrective measures study for soil, surface water, surface sediments and fish tissue. These clean-up goals were subsequently chosen by MDNR as a part of the final remedy. The institutional and engineering controls selected as the final remedy were employed at the site to either prevent and/or minimize exposure of potential receptors to contamination in media that are above site clean-up goals or to assure, through continued monitoring, that the clean-up goals are not exceeded.

The selected remedies are specifically designed to achieve the following:

- Minimize exposure of potential receptors to soil contamination in excess of the risk-based cleanup goals for soil.

- Minimize infiltration of PCB-contaminated soil into the 002 storm sewer system.
- Minimize exposure to sediment containing PCBs in Indian Creek near the 002 Outfall to be protective of recreational users and future construction workers who would work in Indian Creek near the 002 Outfall.
- Minimize exposure to surface water near the 002 Outfall drainage way.
- Minimize, to the extent practicable, human consumption of fish from Indian Creek near the 002 Outfall.

5.5.6.1 Soils Remedy

The objective of the chosen remedy for soils is to minimize exposure of potential receptors to soil contamination by PCBs in excess of the 6 mg/kg and to minimize infiltration of PCB-contaminated soil into the box culvert for the 002 stormwater system.

How the remedy is implemented for soils

PCB contaminated soil at the 95th Terrace site is buried under clean fill at depths of 3 feet near the bank of Indian Creek to over 40 feet at Bannister Road.

Engineering controls for soils at 95th Terrace are implemented through visual inspections of the 002 storm sewer system. Integrity failures of the storm sewer system may result in the infiltration of contaminated soil into the stormwater piping allowing for its transport into Indian Creek. Semiannual inspections were conducted of the 002 storm sewer piping to look for degradation of pipe integrity such that contaminated soil is allowed to enter the storm sewer piping. Should an integrity issue be identified from the inspection, repairs will be made as soon as possible with no repair taking longer than 180 days to complete unless otherwise extended by MDNR. A memo documenting the inspection and any issues found will be prepared and submitted with the annual groundwater corrective action report.

5.5.6.2 Indian Creek Sediment Remedy

The goal of the selected remedy for Indian Creek sediments at the 95th Terrace site is to minimize exposure of recreational and construction users of the creek near the 002 stormwater outfall to sediment containing PCBs over site clean-up goals. These goals are as follows:

Construction Worker - 6 mg/kg

Recreational Receptor, Child - 4.9 mg/kg

Recreational Receptor, Adult - 5.3 mg/kg

How the remedy is implemented for Indian Creek Sediments

Engineering controls implemented as part of the final remedy for Indian Creek sediments include the maintenance and upkeep of a protective barrier over the Outfall 002 raceway installed by DOE in 2004. Installation of this protective barrier eliminates potential human exposure to the 002 Outfall sediments and effluent within the raceway where PCB concentrations may be higher than site clean-up goals. The barrier is inspected on a quarterly basis as a part of a preventative maintenance program. A photograph of the protective barrier is provided as Figure 5.47.

Signs have also been previously installed by DOE in the area of the 002 outfall advising people not to drink water, wade, swim or eat fish caught in Indian Creek near the 002 outfall. Posting and maintenance of these signs is also a component of the final remedy and is designed to lower the potential for exposure to PCBs at the site and to minimize potential impacts to human health by discouraging fishing, wading and swimming in Indian Creek near the 002 Outfall. The condition of the signs will also be evaluated and repairs or replacement made as a part of the same quarterly inspections for the protective barrier. A photograph of one of the signs posted is provided as Figure 5.48.

The semi-annual integrity inspections of the 002 storm sewer system noted above will also assess the presence of excessive sediment accumulation in the 002 storm sewer. If sediments have accumulated over 1 inch thick at the 002 sluice gate these sediments will be removed through cleaning.

An extensive sediment monitoring program is performed as a part of the final remedy to monitor for the presence of PCBs both within the 002 storm sewer system and within Indian Creek. This sampling is performed to assure that concentrations of PCBs greater than PCB clean-up goals are not being released to the environment. The sampling component of the remedy includes triggers for additional work should certain sediment sampling results indicate increasing PCB concentrations.

Monthly sampling of sediments for PCBs at the sluice gate structure within the 002 storm sewer system will occur. A sediment collection tray is in place to collect sediments that may be transported through the 002 system.

Sediment sampling within Indian Creek occurs on a quarterly basis near the 002 Outfall. Three individual samples are collected near the outfall and analyzed for PCBs. Anomalously high values will be reported to MDNR. Results of the three samples will be averaged and utilized in the calculation of a Hazard Index (HI) for sediment.

Should a HI greater than 1 be calculated for two consecutive quarters, additional sampling of Indian Creek sediment downstream will occur. Should a HI greater than 1 be calculated for 4 consecutive quarters an investigation would be conducted to evaluate potential causes for the upward trend of PCBs in Indian Creek sediments. Sampling of Indian Creek sediments will occur at the following locations:

- Site HOB (Holmes Bridge) is located at the intersection of Holmes Road and Indian Creek on the downstream side of the bridge. This location serves as the upstream background sampling site. Three grab samples will be combined from this location as a single sample.

- Site 002 is located near the point at which the Outfall 002 raceway enters Indian Creek. Three grab samples will be collected from the following locations: 1) immediately downstream of the 002 raceway, 2) immediately upstream of the raceway (to account for

the effects of an eddy near the raceway) and 3) cross channel from the raceway within five to ten feet of the end of the raceway.

All data collected from this sampling is included as a part of the annual groundwater corrective action report submitted March 1 of each calendar year.

5.5.6.3 Surface Water Remedy

The goal of the surface water remedy at the 95th Terrace site is to minimize exposure of potential receptor populations to surface water near the 002 Outfall drainage way. A surface water clean-up goal of 0.26 µg/L was selected by MDNR as a part of the 95th Terrace remedy. This cleanup goal is based on the child recreational receptor and is protective of workers performing common construction/excavation activities as well as recreational users of the creek near the 95th Terrace site.

How the remedy is implemented for Indian Creek Surface Water

The installation of the protective barrier noted above in the Indian Creek sediment section also minimizes potential receptor exposure to surface water that may be over 95th Terrace surface water clean-up goals. In addition the signs posted in the area of the 002 outfall are also worded to prevent potential receptors from coming into contact or ingesting the surface water in the area.

A comprehensive surface water sampling program has been implemented to comply with the remedy selected for the 95th Terrace site.

Stormwater sampling is conducted at the Outfall 002 flap gate twice a month. A sample is collected and analyzed for PCB's, trichloroethylene, 1, 2-dichloroethene and chloromethane. This is in addition to samples collected twice a month at the NPDES compliance point (002 sluice gate) located approximately 300 feet upstream of the flap gate sampling point. Reports of stormwater sampling in Outfall 002 are reported annually in the Annual Groundwater Corrective Action Report.

In addition, samples of stormwater and surface water are collected annually from all 4 regulated outfalls and 6 surface water locations on Blue River and Indian Creek. These locations are shown in Figure 6.7.

Results of this sampling will be provided (for analytes detected) in tabular form along with a narrative discussion in the annual groundwater corrective action report submitted by March 1st of each year.

In addition six locations on the Blue River and Indian Creek as well as stormwater from the outfall 002 flap gate are analyzed on a semi-annual basis for PCBs using EPA method 1668A. Results are tabulated by congener and be provided in the annual groundwater corrective action report. These locations are as follows and are also shown in Figure 6.7.

- ICU - Site ICU (Indian Creek Upstream) is located on Indian Creek approximately 50 yards upstream from the point where Outfalls 003 and 004 enter Indian Creek.
- ICDA - Site ICDA (Indian Creek Downstream A) is located on Indian Creek approximately 60 yards downstream from the point where Outfalls 003 and 004 enter Indian Creek.
- ICDB - Site ICDB (Indian Creek Downstream B) is located on Indian Creek approximately 125 yards downstream of the point where Outfall 002 enters Indian Creek.
- ICBR - Site ICBR (Indian Creek/Blue River confluence) is located on Blue River upstream of all KCP discharges approximately 30 yards upstream of the point where Indian Creek flows into Blue River.
- BRU - Site BRU (Blue River Upstream) is located on Blue River approximately 60 yards downstream of the point where 95th Terrace Bridge crosses the Blue River, which is downstream of ICBR.
- BRD - Site BRD (Blue River Downstream) is located immediately downstream of the Prospect Avenue Bridge, which is downstream of all KCP stormwater discharges (Outfalls 001 -004) and downstream of Boone Creek which receives Outfall 001 stormwater discharges.

5.5.6.4 Indian Creek Fish

The remediation goals for Indian Creek Fish in the area of 95th Terrace are to minimize, to the extent practicable, human consumption of fish from Indian Creek near the 002 Outfall. A PCB target level in fish of 0.159 mg/kg was established by MDNR as a part of the 95th Terrace final remedy.

How the remedy is implemented for Indian Creek Fish

Periodic monitoring of fish tissue PCB levels are conducted. This sampling is a continuation of similar studies that have been conducted at the site since 1991. Fish are collected in seven locations on Indian Creek and the Blue River. Results are provided in a report submitted to MDNR and EPA upon completion. In addition, signs warning people to not eat the fish in the area were also posted along Indian Creek and the four regulated stormwater outfalls at the site.

5.5.6.5 Institutional Controls for the 95th Terrace Site

Institutional controls are non-physical controls exerted through legal documents, laws, ordinances, or the internal rules of an organization. They are used to limit human activities at a contaminated site to protect human health and the environment from exposure to the contaminants of concern, for as long as the contaminants remain above levels that would allow unrestricted use of the property. Institutional controls are appropriate where contaminants remain in place and are not being transported in the environment, as is the case at the 95th Terrace site. They help assure that human activities (e.g., excavation) do not mobilize the contamination. These controls for 95th Terrace and the rest of the BFC are discussed in more detail in Section 5.22.

5.6 Miscellaneous Vehicle Repair Shop Sump (MVRSS) (SWMUs 17 and 36)

5.6.1 Previous Regulatory Submittals/Approvals

RFI Work Plan
RFI Work Plan Submittal - Letter from G. P. Keary, DOE, to K. S. Ritchey, dated September 9, 1993.

RFI Work Plan Approval - Letter from K. S. Ritchey, EPA to G. P. Keary, DOE, dated August 2, 1993

RFI Report
RFI Report Submittal - Letter from G. P. Keary, DOE, to K. S. Ritchey, dated June 6, 1995

RFI Report Approval - Letter from K. S. Ritchey, EPA to G. P. Keary, DOE, dated August 3, 1995

CMS / CMI
CMS / CMI activities for the sites covered under the MVRSS RFI are addressed in the Multiple - Sites CMS.

5.6.2 Description of Unit

5.6.2.1 Maintenance Vehicle Repair Shop Sump (SWMU 36)

The MVRSS pits were constructed in 1970 to house a dual-cylinder, hydraulically operated vehicle lift. Dimensions for the northern pit are approximately 7.25 ft. (E/W) x 3.3 ft. (N/S) (Figure 5.50). The depth of this pit is approximately 8.5 ft. The southern pit is L shaped and is approximately 13.75 ft. long (N/S), x 1.5 ft. wide at the northern end, 4.5 ft. wide at the southern end, and approximately 7.5 ft. deep. A sump was located at the southern end of this pit along with a cylinder that housed the lift.

Many of the vehicles used at the KCP were repaired in the maintenance vehicle repair shop. These vehicles were routinely put on the lift in the south pit and washed prior to maintenance. The wash water, along with any dirt, grease, oil, or wastes from plant operations that were on the vehicles, drained into the pits (personal communication from J. Mayerchak, AlliedSignal Inc., Kansas City, Mo., with J. E. Peterson, ORNL-GJ, 1992). Routine vehicle washings continued until approximately August 1990 when it was reported that the pits would almost fill up with wash water but would never

overflow. It is not known exactly how long this condition existed. However, it is likely that the pit contents leaked into the ground throughout the period of operation. EPA was notified of this possible release site, and the lift was decommissioned following evaluation of sample results of the pits contents that indicated the presence of hazardous constituents (letters from D. M. Caughey, KCAO/DOE to K. S. Richey, Region VII, EPA, September 6, 1990 and January 24, 1991). The lift ram was removed, and the hydraulic oil was pumped from the cylinder in the north pit. This pit was filled with sand, and a concrete cap was poured over the pit. A three inch conduit which connected the two pits was also concrete filled. The cylinder was never removed from the north pit. The lift cylinder, ram, and hydraulic oil reservoir were removed from the south pit.

Because the KCP required a place to wash facility vehicles, it was decided to keep the south pit open to contain water from vehicle washing operations. Prior to being put back into service, the pit was sandblasted, a new concrete floor was poured, the inside surface was painted with an epoxy sealant, and the pit was leak-tested. During the sandblasting, cracks near the bottom of the southern end of the pit were discovered. These cracks were seeping an oily substance back into the pit (personal communication from J. Mayerchak, AlliedSignal Inc., Kansas City, Mo., with J. E. Peterson, ORNTJGJ, 1992). Even with the epoxy sealant, the leak-test results showed that the pit still leaked when the water level was within 3 in. of the top. As a result, an alarm was installed to ensure that the water level never rose higher than 16 in. from the top of the pit. Written approval was received from EPA on June 15, 1992, to return the pit to service. KCP waste management is responsible for pumping and disposing of the pit contents.

5.6.2.2 Building 54

The original area of concern at Building 54 was the cooling tower sump that lies approximately 60 ft west of the MVRSS, west of the building's basement. Building 54, constructed in the mid-1950s (during Westinghouse's occupation of the facility) to test

jet engines, was called the High-Power Components Development Laboratory. The building's basement housed electric motors used to circulate water through cooling towers to the north. Several 8 inch pipes, now capped, lead through the west wall to an underground concrete vault approximately 47 ft (N/S) x 12 ft x 9 ft (deep) that served as a sump just west of the building. Water circulated from the cooling towers to the equipment was pumped into the sump and returned to the cooling towers. Exactly which cooling water additives were used during these operations is unknown. However, common additives include algaecides and rust inhibitors such as zinc chromate, various organic compounds, and sodium hydroxide. In August 1990, field reconnaissance work found water still present in the vault.

In the mid-l980s, several cracks were noticed along the west basement wall of Building 54 (Figure 5.50). Along with appearing wet, the cracks seeped a brown and black viscous substance, some of which stained the basement floor. There was a concern that the source of this substance could have been the cooling water.

5.6.2.3 Reported Underground Tank

Historic information on the reported underground tank south of the MVRSS pits is limited (Figure 5.50). The tank was identified on a 1963 engineering drawing. The drawing is a foundation plan that includes a detail entitled plan of Waste Engine Oil Tank and Pump Connections. It is believed that the tank was constructed of concrete and that it was demolished, backfilled, and covered with a concrete pad in approximately 1985 or 1986 (personal communication from G. Mathews, AlliedSignal Inc., Kansas City, Mo., with J.E. Peterson, ORNLIGJ, 1992). There was no evidence that the tank was actually used to store waste oil; the tank was empty when it was demolished (personal communication from G. Mathews, AlliedSignal Inc., Kansas City, Mo., with J.E. Peterson, ORNLIGJ, 1992).

5.6.2.4 Test Cell Area

(See also Section 5.19.4 which provides a description of an Interim Measures project that removed USTs in the Test Cell Area.)

The test cells, constructed in approximately 1942 as part of the initial plant construction activities, were first used to test Pratt and Whitney aircraft engines. After World War II, test cell operations ceased until approximately 1949, when Westinghouse assumed occupancy of part of the MMB. Westinghouse used the test cells to test jet engines and remained a tenant of the building until 1961, when its lease was terminated (Korte et al. 1986). Since 1961, the test cell area has been used primarily as a storage facility for office equipment and manufacturing tools and equipment.

Because the test cells have not been in operation since 1961, contacting KCP personnel that remember operating procedures and the condition of the test cell area during engine testing was not successful. It is likely, however, that the use of fuels, oils, and degreasers was widespread during peak manufacturing activities. Two 10,000-gal steel (underground storage tanks (USTs) and one 1,000-gallon UST of unknown composition are shown on design drawings (circa 1943) in what is known as the test cell area of the plant. The larger tanks were identified on the drawings as "Waste Oil Tanks" and the smaller tank noted as a "dirty kerosene tank". These tanks were likely used by the two U.S. Department of Defense (DOD) subcontractors that previously occupied this area of the plant. DOE gained control of the test cell area in 1964. Access to the tanks was not possible since they are reportedly located under the concrete floor in the test cell area. No tank openings were evident. Because these tanks were not used by DOE or its subcontractors, it is unknown what materials the tanks stored other than what is noted on the design drawings. The Miscellaneous Contaminated Soils RFI identified an area north of the AFLs and east of the test cells where sample results indicated that a release of hazardous constituents probably occurred.

5.6.3 RFI Field Investigation/Contamination Characterization

Twenty-one soil borings were drilled and sampled during this RFI and information from these and from 10 of the soil borings drilled and sampled under the Miscellaneous Contaminated Soils RFI were utilized to characterize the study area.

5.6.3.1 Groundwater Contamination

Forty-four groundwater samples from eight monitoring wells were collected during the field investigation of the MVRSS sites. Four dual completion temporary wells were installed and sampled during the field investigation (TW01-TW04), as were four previously installed dual completion monitor wells (KC91-149, 172, 176, and 177) (Figure 5.51).

VOC Contamination

Tables 5.8 – 5.10 summarize VOC results from monitor wells sampled during and previous to this investigation. Consistent with other RFI investigations completed at the KCP, TCE and its degradation products, 1, 2-DCE and chloroethene (Kloepfer et al. 1985; Wilson and Wilson 1985; Cline and Viste 1985) were the compounds commonly detected in groundwater.

High Boiling Petroleum Hydrocarbon (HBPHC) Contamination

Eight dual completion wells were sampled during this investigation. HBPHCs were detected at low concentrations in the upper completion of one well, KC91-172U where jet fuel has been detected on several occasions. The analytical lab utilized by the KCP utilizes the California modified 8015 method for the analyses of HBPHC. HBPHCs can be further identified as gasoline, jet fuel, kerosene, fuel oil, diesel fuel, and mineral spirits if the analysis can be "fingerprinted" against a standard.

Semivolatile Organic Compound Contamination

Tables 5.8 and 5.10 summarize results for semi-volatile compounds detected in groundwater from eight dual completion wells sampled during this investigation. Di-n-butyl phthalate and bis (2-ethylhexyl) phthalate were noted in numerous groundwater samples in the 10 to 35 µg/L range. These compounds were also noted in the associated method blank on numerous occasions. Other occurrences of these compounds in groundwater can be discounted based on the fact that their occurrence is less than five times the Method Detection Limit (MDL) (EPA 1991). On two occasions bis (2-ethylhexyl) phthalate was detected above five times the MDL of 10 µg/L. Well TW02L

indicated 58 µg/L of the above compound on one occasion; however, three other sampling events did not detect this contaminant. Well KC91-172U detected 110 µg/L of bis (2-ethylhexyl) phthalate on one occasion; however, 19 mg/L of jet fuel was also detected, possibly resulting in matrix interference causing an erroneous detection of bis (2-ethylhexyl) phthalate. Two other sampling events did not detect this semi-volatile compound. Moreover, phthalates, a class of semi-volatile compounds are very insoluble in water, further discounting their occurrence in groundwater. In summary, the two semi-volatile compounds detected, bis (2-ethylhexyl) phthalate and Di-n-butyl phthalate, are common laboratory contaminants, and were reported in numerous blanks and all reported sporadically. Thus, further discussion regarding the occurrence of semi-volatile organic compounds in groundwater is not warranted.

Metals Contamination

Tables 5.12 and 5.13 provide a summary of metals results for groundwater samples collected from wells monitored during the MVRSS field investigation. With the exception of arsenic, no metals have been verified above drinking water standards. Table 5.13 lists lead results for wells KC91-176 and KC91-177 from September 1991, which are above drinking water standards. Cadmium is also noted on Table 5.13 once above drinking water standards from well KC91-177 during January 1993. However, the above lead and cadmium results are considered erroneous due to analytical interferences.

PCB contamination

PCBs were detected once in wells KC91-172L, KC91-176U and KC91-177U during the initial sample event at 0.4 µg/L, 0.2 µg/L and at the detection limit of 1 µg/L, respectively. Subsequent analyses for PCBs in these wells did not detect PCBs. The initial detection of PCBs is considered erroneous because concentrations were noted at or near the detection limit and have not been noted in subsequent sample events. Although preliminary samples of the MVRSS pit did indicate relatively low levels of PCBs in the contents of the pits (Tables 5.14, 5.15, 5.16), no other source areas were apparent and analysis of soil samples collected during the investigation did not detect

PCBs. Therefore, PCBs in groundwater were not investigated further as a part of the RFI.

5.6.3.2 Soil Contamination

Ninety-eight samples were collected from 21 soil borings (BH01-BH21) and four monitoring wells (TW01 - TW04) during field investigations (Figure 5.52). In addition, 39 samples were collected From 10 soil borings (MSBH-25, 31-33, 38-41, 43,44) and three monitor wells (KC91-172, 176, and 177) installed during the Miscellaneous Contaminated Soils RFI investigation (Figure 5.53). In addition, 18 samples were utilized from three soil borings (SB07, 08, and BH91-06) and two wells (KC91-149 and 155) installed during the TCE Still Area RFI investigation (Figure 5.54). Machinery and walls inside the buildings, the buildings themselves, and utilities influenced the final locations of the boreholes and wells. All samples were collected according to the MVRSS Work Plan (DOE 1993a). Soil samples were collected from both above and below the water table. During drilling, the depth of groundwater was determined through visual inspection of the continuous soil core. Soil samples collected above the saturated zone were identified as coming from above the water table, and soil samples collected below the saturated zone were identified as coming from below the water table. Typically, a minimum of three soil samples were collected from each boring. One from approximately 3 ft bgs, a second at the water table interface and a third at the bedrock-alluvium contact.

Data collected as part of the MVRSS field investigation, previous investigations, and quarterly groundwater sampling indicate portions of the study area are contaminated with VOCs and HBPHC. Semi-volatile organic compounds were noted infrequently, and are attributed to anthropogenic factors associated with hydrocarbon combustion. Semi-volatile compounds were not reported in groundwater samples during the investigation. PCBs were not detected in any of the soil samples. Although one soil sample location (KC91-176 at 39 ft) contained metal concentrations that substantially exceeded background, samples passed the TCLP, there is no evidence of contaminant plume of metal contamination, and ample evidence that metals do not migrate at the

KCP. Metals samples were detected above background concentrations in a few other cases; however, these occurrences are attributed to natural geochemical processes and not considered due to releases of hazardous wastes.

The Building 54 / MVRSS pits / reported underground tank study area contains VOC contaminated groundwater, evident by the contamination in monitor wells TW01, TW03, and KC91-176. Maximum concentrations of TCE were 910 µg/L in well TW-01 and 1500 µg/L 1, 2-DCE and 52 µg/L chloroethene in well TW-03 VOC contamination in the vadose zone was identified only in BH10, which detected up to 22,000 µg/kg of tetrachloroethene in soil at 14 ft (Table 5.21). The likely cause of VOC contamination noted at this location is indiscriminate spills of solvent. HBPHC contamination is also noted in significant concentrations (480 mg/kg) in BH10 at 14 ft adjacent to the MVRSS pit. BH05 and soil samples from well KC91-176 also noted the presence of HBPHCs (390 mg/kg at 10 ft and 1300 mg/kg at 12 ft, respectively) (Table 5.18 and 5.19). The HBPHC in BH10 is noted as jet fuel and is likely due to Building 54's past operation as the High Power Components Development Laboratory during operation by Westinghouse for jet engine development purposes. The highest HBPHC concentration was in soils from KC91-177 at 1300 mg/kg. HBPHCs were detected at or above the water table in soils during this investigation; groundwater HBPHC contamination was not identified with the exception of 0.2 mg/L detected in KC91-177L (Table 5.9). Semi-volatile organic contaminants were detected in the vadose zone in BH11 and soil samples associated with the installation of monitor wells KC91 - 177, TW01, and TW04 (Tables 5.19 and 5.20). Again, the detection of these compounds is likely due to their association with combusted hydrocarbons from both, previous operations of Building 54 to develop jet aircraft engines and their common occurrence in the environment.

The test cell area detected significant areas of HBPHC contamination throughout the study site. The highest concentrations of HBPHCs in soil were 2800 mg/kg in MSBH41 at 9 ft (Table 5.17). The occurrence of all HBPHCs was noted at or above the water table. Well KC91-172U detected the presence of HBPHCs in groundwater as jet fuel at

concentrations up to 19 µg/L. BTEX components were detected in soil, for the most part, east of the test cells, and at concentrations up to 1100 µg/kg benzene in MSBH41 at 8 to 9 ft (Table 5.17). BTEX components were detected both above and below the water table in soils. VOCs were detected sporadically and at relatively low concentrations both above and below the water table. The highest concentration of TCE was 630 µg/kg in BH18 at 23 ft, 1400 µg/kg 1, 2-DCE in BH18 at-21 ft., and 360 µg/kg chloroethene in MSBH41 at 22 ft. (Tables 5.11 and 5.21).

Groundwater associated with this investigation is being contained by the groundwater pumping system and Building footing tile drains (DOE 2013).

5.6.3.3 Summary of Combined Investigation Areas

This summary provides a discussion of groundwater contamination characterized as it pertains to both areas investigated under this RFI. The Building 54 area which includes the MVRSS pits, the reported underground tank and Building 54 is bounded by the following clean wells; TW04 to the north, KC91-173 to the northeast, and KC84-09 to the west. The area of groundwater contamination that originates near TW01 and TW03 migrates in an eastward direction. TW02 serves as a northern boundary for contamination that has originated near TW01 and TW03 which has spread to the east. As contaminated groundwater migrates further to the east from this location groundwater associated with the former Underground Tank Farm is encountered (DOE 1993b). Therefore, a distinguishing boundary, to the east, cannot be determined between the contaminated groundwater noted above and that associated with the former underground tank farm.

Directly south of Building 54 lies a smaller set of test cells (Figure 5.53) which detected relatively low levels of fuel related VOCs in soil samples (Table 5.21). The area south of this area is bounded by well KC91-155, which only sporadically detects VOCs but no fuel related compounds. Well KC91-155 also serves as a western boundary of groundwater contamination originating in the larger set of test cells (Figure 5.53). The larger set of Test Cells is bounded to the south by well KC91-149. This well

serves to bound the HBPHC contamination identified in the test cell area as it has not detected fuel related VOC compounds, however, this well routinely detects VOCs. It is likely that VOCs detected in this well are attributable to both releases originating in the Test Cells and from sources addressed under the TCE Still Area investigation, namely the D/95 area and the former Aluminum Chip Handling and Sales building (DOE 1994a). Monitor well KC91-172 located east of the test cells routinely detects HBPHCs and fuel related VOCs. This well is located downgradient of the test cell area which detected significant HBPHC contamination. Approximately 75 yards east of this location well KC91-171 is encountered. The VOC contamination detected in this well is attributed to the AFLs which are addressed under the Miscellaneous Contaminated Soils investigation (DOE 1993a). Therefore, a distinguishing boundary between contaminated groundwater originating from the Test Cell area and the AFLs cannot be determined.

Proceeding north from this location TW-02 is used to delineate the northern boundary of groundwater contamination for the study sites. TW-02 is on the fringe of a contaminant plume as this well only periodically detects VOCs.

5.7 Department 27 (Outside)

5.7.1 Previous Regulatory Submittals/Approvals

RFI Work Plan
RFI Work Plan Submittal - Letter
RFI Work Plan Approval - Letter D/27 inside RFI workplan approved on 8/27/93

RFI Report
RFI Report Submittal - Letter
RFI Report Approval - Letter D/27 inside RFI report approved by EPA on September 8, 1995

IM
NFA determination for D/27 outside IM Public noticed June 12, 1996
Interim Measures Report Approval No further Action Letter from EPA dated 11/13/95

5.7.2 History Of Unit

The purpose of Department 27 was to mold and form plastics. Operations were very similar to D/26 operations. Beginning in 1966, Therminol FR-1, was used as a heat transfer fluid in the D/27 manufacturing processes. This PCB oil was stored in an underground tank outside the main building (Figure 5.55). The equipment in which the PCB oil was heated and distributed throughout the department was known as the Therminol Unit and was also located outside the main building (Figure 5.55).

This outside area, for remediation purposes became known and D/27 (outside).

Periodically (approximately once a year), back pressure from hydrochloric acid forming within the system's feed and return lines caused "blowouts" through vents in the expansion tank. The hydrochloric acid was formed during displacement of chlorine in the Therminol FR-1 by hydrogen, which entered the system through water condensation caused by extreme temperature changes within the system. Hydrochloric acid contamination of the surrounding soils during these "blowouts" is unlikely due to the small volume of acid in the lines and the neutralizing effect of the soil. No containment provisions existed for the equipment at that time (D. Floersch, AlliedSignal, Inc., personal communication with S.C. Hall, ORNL, 1990).

Spills and leaks from this equipment resulted in contamination of the area. Use of the PCB fluid was discontinued in 1975. The Therminol storage tanks were removed in 1985 and the entire system was replaced with a new enclosed system. Soil sampling performed during the 1985 removal project demonstrated that some of the soil near the tanks contained several thousand ppm of PCBs. That soil was removed during the tank removal and the area is now paved and covered with a building (New Therminol Building**).**

5.7.3 Investigation Activities

A total of twenty-two soil borings were drilled initially in the RFI. Results, indicated two locations in which PCB concentrations exceeded a 10 ppm (mg/kg) cleanup guideline for non-migratable soils used at the KCP. These two locations were; BH01 and BH08 (Figure 5.56). BH01 contained 58 ppm of PCBs between 33.5 ft. and 38.5 ft., whereas, BH08 was found with 60 ppm of PCBs.

Following the first phase activities, PCB contamination was reported within an abandoned sanitary sewer line located to the east of the northern portion of the D/27 Outside area. This contamination was discovered during an investigation of contaminated wastewater at the KCP by George Butler Associates in 1989. As a result of this study the abandoned sanitary sewer line was sealed-off from the main 24-inch line at the manhole when the main line was Insituform lined. The abandoned line runs west from the manhole, through the D/27 Outside area and leads into the main building west of the site, however, attempts made to locate the line entering the building were unsuccessful.

A second phase of sampling was required to confirm and further define the location and volume of PCB contaminated soil at the D/27 Outside site. The abandoned line noted above was identified to be included in this phase.

The Phase 2 sampling results confirmed and defined the PCB contaminated soil noted in Phase I sampling (Figure 5.57 and Table 5.22). Two zones of soil contamination existed. A shallow zone at a 1-3.5 ft. depth and a deep zone at a 18-40 ft. depth. The

deep zone was located next to the MMB foundation. It was decided that this area would be addressed in the D/27 (Inside) RFI (See Section 5.8). The extent of shallow contamination had been identified within an area of approximately 290 square feet, located at the southeast corner of the new Therminol Building (Figure 5.57).

EPA allowed the remaining shallow contamination to be addressed by Interim Measures. The April 1993 Interim Measures Report documented removal of the shallow PCB contaminated soil material as specified in the design document.

Several concrete structures (slabs, pads, and column footings) not identified on the design drawings were located in the excavation area.

Additional soil was excavated from locations 1,10, 12, 15, 22 and 28 (Figure 5.58). The new limits of excavation for each location were defined by the nearest sample locations which showed PCB concentrations below 10 ppm. An oily pea gravel over a layer of clay soil was found. Exploratory holes were dug around the site in order to determine the extent and location of the pea gravel. The pea gravel extended approximately 22 feet from sampling location 36 in a southwest direction to a 12-inch sanitary line, located in an east-west direction. This line was removed from the MMB wall (west area of the excavation, (Figure 5.60) to the sanitary sewer man-hole (east area of the excavation, Figure 5.59). A portion of the line, however, had to be left in place, under the concrete wall footing. Debris and sediments inside the remaining pipe were removed. The inside was steam cleaned. The line ends were plugged at the MMB wall and at the sanitary sewer man-hole.

Four column footings, as well as an additional four-inch abandoned sanitary sewer line, were uncovered (Figure 5.60) during additional excavation related to the pea gravel. The footings and the four-inch line were also removed (Figure 5.61). The column footing at location 34 had oil seeping out from under it. The footing and associated soil were removed. All the pea gravel, approximately 3 feet deep, and at least the first six inches of clay were excavated before any verification sampling was performed. Figure

5.59 shows the final extent of the pea gravel excavation. Since locations 34 and 36 were so greatly expanded, a new grid system was necessary for verification sampling. Soil composite samples were taken from the following areas: A, B, C, D, E and F.

The results of the second round of sampling (Table 5.23) revealed some areas with PCB concentrations above 10 ppm: the bottom of Area A, the bottoms and east walls of Areas C and D, the bottom of Area E, the east wall of Area F, locations 10, 12, 15, 28, and the east concrete pad at the north end of the original excavation. Approximately one additional foot of soil was excavated in each of the soil areas, the east concrete pad was removed, and new soil verification samples were taken. Area A was excavated to a depth of approximately 9 feet in order to remove the column footing. It was believed that additional excavation from the bottom of Area A (Figure 5.62), which showed 12 ppm PCB, could affect the structural stability of the building footing. Thus, this area was not excavated any farther. This area was addressed as part of D/27 Inside RFI.

Fourth and Fifth Round Verification Sampling

Analytical results from the fourth round of sampling (Table 5.24) showed that location 28 contained soils with PCB concentration of 14 ppm. This area was excavated one additional foot farther east and resampled.

In order to completely remove the four-inch abandoned sanitary sewer line, a 2.5-foot thick portion of concrete slab #1 had to be removed. The top 12-18 inches of the slab were broken in pieces (Figure 5.63) and disposed in a sanitary landfill. The bottom portion of the slab was also broken down in pieces, and a composite sample from the bottom of each of the large pieces of concrete was taken. This sample was analyzed (see Table 5.24, sample Concrete-1), which indicated 44 ppm PCB. Accordingly, this material was disposed as contaminated waste. One foot of soil was excavated in the area where slab #1 was removed, a sampling grid established, and a composite sample was taken. This sample (see Table 5.24, sample GC-1C) indicated no PCB contamination. The remaining portion of slab #1 rested on top of slab #2, shown in Figure 5.59. Slab **#2** was another 2.5-foot thick slab on which rested the New

Therminol Building footing. Original characterization indicated no PCB contamination in this area.

After the fifth round of verification sampling was completed, laboratory results revealed PCB levels below 10 ppm at location 28. Excavation activities concluded at this time.

5.8 Department 27 (Inside)

5.8.1 Regulatory Submittals/Approvals

Interim Measures
Interim Measures Work Plan
- Submitted to EPA / MDNR May 5, 1990
- Approved by EPA / MDNR with clarifications August 3, 1990 (Letter from M. J. Sanderson to D. M. Caughey, DOE)
- Submitted to EPA / MDNR May 8, 1991 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)

Interim Measures Report
- Submitted to EPA / MDNR May 4, 1993 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved by EPA / MDNR (No Further Action) November 13, 1995 (Letter from W. A. Spratlin, EPA to D. A. Gurule, DOE)

RFI Report
- Submitted to EPA / MDNR October 1989. Note this RFI pre-dates the RCRA Consent Order.

CMS/CMI (Addressed under the Multi-Site CMS / CMI)
CMS
- Submitted to EPA / MDNR November 29, 1995 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Statement of Basis, U.S. Department of Energy Kansas City Plant, Multiple Sites, Kansas City, Missouri, U.S. Environmental Protection Agency, Region VII Office, March 25, 1998.
- Approved by EPA / MDNR July 15, 1998

CMI Work Plan
- Submitted to MDNR / EPA October 28, 2000 (Letter from G. P. Keary, DOE to A. H. Groner, MDNR)
- Approved by MDNR November 6, 2000 (Letter from A. H. Groner, MDNR to G. P. Keary, DOE)

5.8.2 Description and History

D/27 (Inside) is located in the northeast quadrant of the MMB (Figure 5.64). The MMB coordinates for D/27 (Inside) are: V south to AA north and 31 west to 34 east (Figure 5.65). Most of the information pertaining to D/27 (Inside) was obtained through interviews with KCP personnel.

The location of the department's operations remained the same throughout its history. D/27 (Inside) encompasses 24,000 ft^2 and was historically partitioned into several rooms containing presses, separators, radiographic equipment, and other machinery. The floor consisted of a concrete slab approximately 6 in. thick.

PCBs were suspected in the D/27 (Inside) subsurface soils because of past use of Therminol FR-1 used in the department's heat-transfer system for plastics molding operations. The thermodynamic stability of PCBs made Therminol FR-1 a preferred medium as the heat-transfer fluid because the fabrication process subjects molds to extreme temperature changes (R. Hishaw, AlliedSignal, Inc., personal communication with S.C. Hall, ORNL, 1990). The PCB fluid was stored in an underground tank directly north and just outside of the MMB. This site was investigated as D/27 (Outside).

The D/27 (Inside) heat-transfer system was installed in 1966 (Floersch 1992). The system consisted of an aboveground network of pipes; a heater, reservoir, and expansion tanks (also above- ground); and several pumps located both inside and outside the MMB. This equipment circulated heated PCB fluids through high-temperature hydraulic presses and injection molding equipment used for making plastic products. The fluid capacity for the D/27 (Inside) heat-transfer system was 5000 to 5500 gal (D. Floersch, AlliedSignal, Inc., personal communication with M. J. Wilson, ORNL, 1992).

Both the feed and return lines for the system historically ran as an above ground "pipe gallery" along interior corridors AA and 34, which lie north and east of D/27

respectively (Figure 5.65). The pipe gallery fed presses at entry points located inside rooms on the north and east sides of the department. Once inside D/27, the piping network served several pumping stations referred to as "pump packages". From the pump packages, heat-transfer fluid was distributed to individual pieces of equipment. Much of the equipment in D/27 (Inside) was located in pits (approximately 4 to 22 ft deep), where heat-transfer fluid was reported to have often leaked (Floersch 1992). Similar to the D/26 (Inside) site, some of the pits were concrete lined, while others may only have been supported at the base by a concrete slab (Miller 1990). In each case, the hot PCB oil had access to subsurface soils through cracks or joints in the concrete or through direct soil contact.

In the mid-1960s, Monsanto Corporation informed its customers that PCBs were hazardous. In 1974, following federal regulation of PCBs, Therminol FR-1 was discontinued as a heat-transfer fluid at KCP (Floersch 1990). The Therminol FR-1 was drained from the D/27 (Inside) system, which was then flushed with Therminol FR-55, a low-PCB concentration fluid manufactured by Monsanto Corporation. The FR-55 fluid acted as a solvent for removing residual Therminol FR-1 (Floersch 1990). In 1974, following the draining and flushing process, the D/27 (Inside) Therminol FR-1 was replaced with Therminol 66, a non-PCB heat-transfer fluid also manufactured by Monsanto Corporation. Therminol 66 is a hydrogenated, modified terphenyl (non-PCB) fluid with a significantly lower flash point (DOE 1990b) Both the Therminol FR-1 and the contaminated Therminol FR-55 were returned to Monsanto Corporation for disposal. This lower flash point required installing a fire protection sprinkler system in D/27 (Inside). An increase in PCBs in the D/27 (Inside) heat-transfer system following the change to Therminol 66 was attributed to previously adsorbed PCBs leaching from porous materials and residual Therminol FR-1. This continuing resurgence of excessive PCB concentrations (>50 mg/kg) prompted replacement of the hardware for the entire heat-transfer system in 1985. The new Therminol system installed at D/27 (Inside) had a containment building, located north of the site, that housed the reservoir tank and heater in the D/27 (Outside) area (Figure 5.66). Once replaced, PCB concentrations remained below the limit of 50 mg/ kg.

Previous to installation of the Therminol FR-1 heat-transfer system, temperature was controlled by steam and water through the use of individual electric heaters, called "sterelco heaters," that used a non-PCB fluid referred to as "Ucon fluid" (R.W. Nee, AlliedSignal, Inc., personal communication with *S.C,*. Hall, ORNL, 1990).

It is important to make note of the PCB clean-up guidelines previously used at the KCP: 10 mg/kg for non-migratable soils, 1 mg/kg for migratable soils, and 10 $\mu g/100cm^2$ for indoor, low-contact, restricted-access surface contamination. These clean-up guidelines used at the KCP were derived in part by consideration of the standards required by 40 CFR 761 (DOE 1990b). These standards, however, may not apply to much of the PCB contamination at the KCP because the spills occurred prior to issuance of the regulations.

5.8.3 Department 27 (Inside) RFI

Although the pre-1985 Therminol system was a closed system, contamination from both accidental spills or breaks in the lines, as well as from past handling practices of the molds, presented sufficient reason for concern. Indeed, various leaks occurred at D/27 throughout the period of PCB use (DOE 1990a).

Samples were collected from 14 soil borings as part of the field investigation of the D/27 (Inside) site (Figure 5.67). Borehole locations were selected based on information gathered during the preparation of the site work plan and field site access. The investigation focused primarily on the end distribution points of the Therminol system within D/27. In addition, the investigation addressed potential continuation of a deep zone of PCB contamination adjacent to the exterior wall of the MMB that was identified during the D/27 (Outside) investigation (DOE 1989a)(Figure 5.67).

Soil samples were collected from each boring at 5-ft intervals to bedrock (approximately 40 ft.). All soil samples were analyzed for PCBs. Samples from approximately 3 ft. below ground surface, at the water table contact (approximately 10

to 20 ft.), and at the alluvium/bedrock contact (approximately 35 to 40 ft.) were analyzed according to EPA approved methods for PCBs, VOCs, TPH-h, and priority pollutant metals (Table 5.25).

Sample results indicated low concentrations of PCBs at the site (Table 5.25). The highest PCB concentration (3.6 mg/kg) was found in borehole D27-BH10 at a depth of 17 ft, approximately the top of the water table. The horizontal extent of the PCB contamination reported is presented in Figure 5.67. Low PCB concentrations were found in D27-BH08 at 35 and 39 ft. (1.0 and 1.6 mg/kg respectively), D27-BH10 at 17, 19, 33, and 38 ft. (3.6, 1.5, 1.0, and 1.0 mg/kg), and D27-BH12 at 39 ft. (1.0 mg/kg).

VOCs

VOC's in soil were detected primarily below the water table (approximately 10 to 20 ft. in this area). As such it was difficult, if not impossible, to distinguish between soil contamination and contamination transported via the contaminated groundwater plume underlying the area.

There were no examples of significant chlorinated solvent contamination in the vadose zone reported from the D/27 (Inside) RFI (Table 5.25). There was, however, examples of apparent soil contamination resulting from contaminated groundwater flowing onto the location, as shown in results from samples collected from boreholes D27-BH02, -BH03, -BH04, -BH05, -BH09, -BH10, -BH11, -BH12, -BH13, and -BH14 (Table 5.25). None of these locations had significant VOC contamination above the groundwater table. (Figure 5.68) presents the horizontal extent of total VOC contamination (i.e., TCE, 1,2-DCE, and chloroethene) reported from soil samples collected at the D/27 (Inside) site. Vertical extent can be obtained from Table 5.25. Further discussion of these solvents was referred to the TCE Still Area RFI report (DOE 1993a).

TPH-h

In addition to the low concentrations of PCBs reported, TPHs-h were found at concentrations up to 6,100 mg/kg in borehole D27-BH10 at 17 ft. (at the water table, Table 5.25). All TPH-h concentrations were reported at or below the groundwater table. No TPH-h concentrations were reported above the water table. (Figure 5.69) presents the horizontal extent of TPH-h contamination reported from soil samples collected at the D/27 (Inside) site. Vertical extent can be obtained from Table 5.25. Table 5.25 also shows that samples containing TPH were generally associated with samples that were also reported to contain PCBs. Upon further review by the analytical laboratory, these TPHs-h concentrations were found to be primarily Therminol. However, the oil constituent was determined to be a terphenyl, the constituent in the new heat-treat fluid (Therminol 66), rather than the biphenyl, known to be a constituent in the old heat-treat fluid (Therminol FR-1). In addition to borehole D27-BH10, TPH-h were reported in D27-BH09 (12 mg/kg in one sample at 39 ft.).

Metals

Results reported for priority pollutant metals analyzed in the subsurface soils collected from the site indicated that there was no significant contamination present (Table 5.25). Detections were sporadic and not likely indicative of contamination (Korte 1989, 1990, 1991). Even though none of the reported metal concentrations posed an environmental threat, arsenic was detected (up to 20.3 mg/kg) over the 10.5 mg/kg threshold (Dickerson et al. 1993). Because arsenic is sorbed by iron oxides, higher arsenic concentrations were expected in an iron-rich environment (Korte and Fernando 1991). Iron oxide subsamples from KCP soils have been reported to contain as much as 84 mg/kg of arsenic (Korte 1990). Lithologic logs for D27-BH01, D27-BH04, D27-BH06, and D27-BH12 from the RFI indicated that abundant iron oxides were present (yellowish-brown limonite staining), explaining the elevated arsenic concentrations. Additionally, field studies revealed that naturally occurring reducing conditions prevalent in the BFC subsurface are responsible for dissolving arsenic previously sorbed by iron oxides (Korte 1990,1991).

TPH-h concentrations ranging from 12 to 6,100 mg/kg were reported (Table 5.25). At the D/27 (Inside) site, the TPH-h was determined to be primarily Therminol 66 (the new heat-transfer fluid).

5.8.3.1 Summary

In summary, low levels of PCB contamination were reported at two boreholes (BH10 and BH12) associated with the D/27 (Inside) site and one borehole (BH08) at the D/27 (Outside) site (Figure 5.67). Previous investigations had indicated that the bedrock was a barrier to contaminant migration (Madril et al. 1986; DOE 1990b). Bedrock coring conducted at the D/26 site to determine whether pooling of PCBs at the base of the alluvium were contaminating the underlying bedrock concluded that the underlying bedrock was not contaminated (DOE 1993d). All but four samples of reported soil VOC contamination occurred at depth intervals located beneath the water table.

This RFI did not include a groundwater investigation because groundwater contamination beneath the MMB had already been studied extensively during the TCE Still Area RFI (DOE 1993a) and because the suspected principal contaminant, PCBs, has extremely low solubility in water. VOCs and traces of BTEX were detected in soil samples, but these were principally found below the water table, suggesting that their presence is due to migration with groundwater and not due to sources within the D/27 (Inside) area of investigation. In addition, TPH-h concentrations were reported in soil samples collected from one location at or beneath the groundwater table. TPH-h concentrations reported from this single location are believed to be primarily Therminol 66.

It was determined that a significant soil contamination problem does not exist at the site. Low PCB and relatively high TPH-h concentrations exist in subsurface soil at the D/27 (Inside) site (Table 5.25). It was also determined that suspected PCB contamination from the D/27 (Outside) site does not continue beneath the MMB.

5.8.4 Department 27 Inside Interim Measures

On August 9, 2004, a Phase 2 Work Plan for proposed excavations in the area of the former Department 27 (SWMU 32) was submitted in accordance with Special Permit Condition XII.A.2 of the Permit (MO9890010524). Note: An earlier Phase 1 Work Plan dated May 27, 2004 was written to perform initial excavations in this area. This Phase 1 Work Plan was approved by MDNR in August 2004. Subsequent to the submission of the Phase 1 Work Plan it was determined that the thickness and makeup of the concrete floor in Department 27 was not appropriate for its intended use as a bulk metal storage facility (floor out-of-level and unreinforced). The Phase 2 Work Plan was therefore written to address this additional concrete removal to be performed in former Department 27, the details of which are provided below.

As a part of efforts to consolidate operations inside the MMB of the DOE Kansas City Plant, a Bulk Metal Stores facility was to be potentially constructed in an area of former Department 27 (inside Solid Waste Management Unit 27). Approximately 15,500 ft^2 of the department floor was constructed on-grade with approximately 6,500 ft^2 constructed above a basement. The on-grade portion of the floor is located in the eastern (right) portion of (Figure 5.70). Areas overlying basement are located in the western (left) portion of (Figure 5.70). The primary renovation consisted of replacement of the old unreinforced concrete floor (slab on grade) with a new reinforced and level concrete floor suitable for heavy fork lift traffic and storage rack loads. Where practical, interim measures were also performed to remove or contain potential PCB contamination.

Interim measures included the following activities

• **Topping Removal on Floor over Basement**– The western portion of the Department floor is above a basement. Topping removal in this area consisted of removing a nominal two (2) inch thick concrete floor topping above the concrete sub-floor slab above the basement (approximately 6,500 ft^2) and scarification of the sub-floor (maximum 1/8-inch) to prepare the sub-floor for a new topping. Although not contaminated above TSCA levels, removal of the topping has the benefit that low levels of potential PCBs are removed.

• **Slab-On-Grade Area Floor Removal** – The eastern and northern portions of Department floor consisted of a 2-inch concrete topping constructed on a 10-inch concrete slab (approximately 15,500 ft^2) all over an "unexcavated" area. Concrete floor removal in this area consisted of removing the 2-inch topping above the floor slab and the 10-inch floor slab beneath the topping. This interim measure served to remove PCB areas exceeding TSCA levels, particularly concrete adjacent to former concrete pits along the 34-wall, AA-aisle wall, and an area located in Bay V32.

• **Sub-Grade Removal ("Unexcavated" Area)** – Based upon the geotechnical condition of the subgrade soil beneath the floor slab, approximately 6 to 12-iches of sub-grade material was removed. This material was primarily composed of coarse sand to gravel (old imported fill) and areas of native clay. All subgrade material removed was assumed to exceed TSCA levels; therefore, handled and disposed as a TSCA-regulated material.

• **Buried Piping Removal** – Buried storm, sanitary and industrial waste piping was located throughout the Department as shown in Figures 5.71 and 5.72. This piping, which was no longer in use, was removed. This piping was located below the concrete flooring in soil up to a depth of approximately 4 feet. All of the soil that was generated during the piping removal process and the removed piping was disposed according to applicable TSCA regulations.

• **Sump Demolition** - A steel-lined sump was located just northeast of post location Y-32 and is shown in Figure 5.71. The sump was partitioned into a 2-ft deep side that once housed a pump and associated controls and a second side that was approximately 9-ft deep served as a collection point for area floor drains, prior to discharge to the industrial waste sewer. This sump was removed and disposed. The sump was surrounded by a large area of imported sand backfill. Therefore, in order to remove the sump, a minimum 1:1 slope was employed, resulting in disposal of additional subgrade as TSCA regulated material.

• **Pit Demolition** - Twelve pits were located along the north and east walls of Department as shown in Figure 5.71. The concrete/steel decking tops of these pits were removed and the walls of each of the pits were removed to approximately 2 feet below

the ground surface. No other demolition below 2 feet occurred other than to remove protrusions such as metal studs, brackets, and ladder rungs from the pit walls.

• **Sub-Grade Replacement** - Approximately 6 to 12-inches of subgrade was removed to accommodate new granular backfill. Clean backfill (Missouri Department of Transportation Type 1 Aggregate) was placed and compacted.

• **Backfill of Sumps and Pits -** Following demolition of the sump and pit tops, the sump and pits were backfilled with flowable fill to approximately 24-inches below the final factory floor elevation. The concrete pits were also lined with 10-mil reinforced polyethylene sheeting prior to backfilling with flowable fill.

• **Installation of Flexible Membrane Liner** (east floor) – A flexible membrane liner (FML) was installed above the new sub-grade material. The FML (40 mil HDPE) was installed throughout the entire bare subgrade area (from the basement walls to each of the three walls of the Department). In additional a 20-mil woven geotextile was placed between the FML and the compacted subgrade to cushion the FML from potential construction loads as an extra precaution (although no vehicular equipment was allowed to contact the FML).

• **Installation of Epoxy Bonding Agent** (western portion of the floor) – A bonding agent (epoxy) was applied to the western portion of the Department floor that is above the basement following surface preparation via scarification. This bonding agent was installed to allow the sub-floor and the new 2" topping to act as an integral structural unit. Prior to installation of the epoxy bonding agent, the concrete sub-floor over the basement was scarified to remove potential contamination associated with mastic and former wood block floor residues and to facilitate a strong bond between the topping and sub-floor. Although no PCB contamination was indicated as present, the epoxy layer serves as an additional barrier should low levels of PCBs have escaped detection or removal.

• **Installation of Concrete floor (East Floor) and Concrete Topping (west floor overlying basement)**: A new 12-inch thick reinforced concrete floor (east) and new, nominal 2-inch thick topping (west) was placed in the former Department 27 to provide a new, level floor. The floors, concrete pits, steel sump, floor drains, subsurface piping, and underlying soil in the former Department 27 were contaminated or potentially

contaminated with polychlorinated biphenyls (PCBs) due to historic operations. Approximately 15,500 ft^2 of the department was constructed on-grade (this area is locally referred to as the "slab-on-grade") and approximately 6,500 ft^2 of the floor space was constructed above a basement (referred to as the "basement area"). The slab-on grade area floor consisted of a 2-inch thick concrete topping placed over a 10-inch non-reinforced concrete slab. Over the basement area, the same 2-inch floor topping was constructed over a 10-inch reinforced concrete basement ceiling slab. The 2-inch concrete topping is not original construction and replaced a former wood block flooring that existed sometime prior to the conversion of the area for Department 27 operations during the late 1960's.

Twelve pits were located along the north (AA-hall line) and east (34-column line) walls and a steel sump was located at approximately 20 ft. northeast of column Y32. Subsurface utilities removed in the Department consisted of storm sewers, sanitary lines, and industrial waste piping that was connected to numerous floor drains and roof downspouts located throughout the Department.

5.8.4.1 Grid Sampling of Residual Soil (Soil Grid Map Tabular Results)

After removal of all granular sub-grade and prior to backfilling with clean imported aggregate, a grid sampling system was set-up to document the near surface PCB concentrations left in place (Figure 5.73). This data was collected to augment existing subsurface information on deeper soils documented by historical boring information. Table 5.26 and Figure 5.74 summarize the grid sampling results.

The grid spacing consisted of collecting a sample every 1-meter interval on a north/south and east/west aligned grid. Samples were collected from the top 3-inches of the sub-grade unless the grid intersected the location of a pipe trench such as the trench bottom, sidewall or top edge. In such cases, the sample was taken and the information (top, bottom, or side) was noted as part of the sample number. A total of 341 soil samples were collected and analyzed for PCBs.

The sub-grade areas around the pits (along 34-column wall and east-half of AA-hall wall) were not sampled because this area was sufficiently close to the pits that the soil was likely to exceed TSCA levels based on previous pre-characterization.

The results of the PCB grid sampling were as follows (Figure 5.75):
1. The highest detected area of PCB contamination was located in Bay V32, at south part of the Department. This contamination is consistent with historical information indicating that handling and cleaning of equipment in contact with PCBs occurred in this area.
2. Areas around the pits were likely contaminated above TSCA levels based on knowledge that PCB equipment occupied the pits, historical sampling indicated PCB contamination exceeding TSCA levels (Section 1.0), and discoloration of soil immediately adjacent to several pits was observed indicating possible oil contamination.
3. An isolated spot above TSCA levels (Sample 311 at 103 mg/kg) was located adjacent to the manhole area. It is possible this PCB hit may be associated with the storm sewer because the storm sewer lines, where observed, connected to former pit interiors and to floor drains adjacent to the pits. Low levels of PCBs, approximately 10 mg/kg, were located along the former storm sewer trench bottom (Sample 111BT and 175BT), indicating slightly elevated levels along this possible pathway.

All concrete and soil along the wall bordering the slab-on-grade area was removed to the maximum extent possible without undermining the walls. Remaining concrete surfaces were cleaned with a needle gun to remove visible mastic and staining. Dust from this operation was controlled with a local vacuum system with a HEPA filter. In order to isolate potential residual contamination, additional concrete curbing was installed adjacent to the existing curbing and column bases under the walls. Concrete forms were constructed such that the curbing was keyed into the new reinforced concrete floor to minimize potential migration of residual contaminants (although no liquid contamination was observed). This new curbing as well as the floor were labeled with PCB warning signs to prevent future disturbance by unauthorized personnel.

The post-demolition sub-grade varied from approximately 18 inches to 24 inches below the top of the final finished floor after demolition of the upper 2 ft. of each concrete pit, removal of the buried piping and steel sump, and backfilling of all areas deeper than 2 ft. below final grade with flowable fill.

Therefore, approximately 6 to 12-inches of granular backfill (Missouri Department of Transportation Number 1 Aggregate) was placed in 6" (maximum) lifts and compacted to a grade of 12-inches below top of the final finished floor prior to installation of a 40-mil HDPE geomembrane system (Figures 5.76 and 5.77). Areas where the aggregate was approximately 12-inches thick include areas over former pits and pipe excavation trenches (backfilled with flowable fill to 2 ft. below finished grade). Areas with a nominal sub-grade removal of 6-inches received approximately 6 inches of new compacted sub-grade.

The top of the compacted sub-grade was surveyed with a laser level and controlled such that a nominal 12-inch thick replacement slab could be poured to the final finished grade.

After the compacted granular base course was placed a HDPE liner system was installed consisting of a 20-mil woven geotextile cushion (Propex) followed by a 40-mil HDPE flexible membrane (Figures 5.77 – 5.79).

Prior to installation of the liner system, the aggregate was checked for compaction and grade verified for final construction. AT Abatement installed the 20-mil woven geotextile cushion by hand with an overlap of approximately 1-ft. between parallel rolls. After placement of the 20-mil cushion, the 40-mil smooth HDPE liner was installed under the supervision of a representative from Lange Containment System. Field welding of all seams was performed by Lange Containment Systems. Special construction details were installed around columns consisting of lap bolted seams and flexible caulk sealant between the membrane and concrete column. The liner was

lapped against the basement wall and sealed with flexible caulk (Tremco-Vulkem 116 Sealant). All concrete edges at the basement wall and column bases were prepared by cleaning the surface with a needle gun to remove mastic and potential contamination along the former cold joint between the walls and the former slab-on-grade. After installation, the entire membrane was carefully inspected for potential punctures and repairs were made by welding 40-mil HDPE patches over the punctures. The few small punctures that were weld-repaired were caused by initial forklift handling of the HDPE bundle in the staging area prior to installation

Walls: Although the walls were visibly coated with demolition generated dust, these surfaces were wipe-tested and shown not contaminated above 10 μg/100 cm^2. Table 5.27 shows wipe testing results for the uncleaned walls and roof webs. A total of 17 pre-cleaning wall wipes were collected with results ranging from 2.0 to 5.9 μg/100 cm^2. Although not contaminated above 10 μg/100 cm^2, these surfaces were HEPA vacuumed by AT Abatement to produce a visibly clean surface for housekeeping purposes with no additional characterization necessary. Roof webs are vertical concrete structures similar to walls. A total of 6 pre-cleaning roof web samples were collected and results ranged from 1.1 to 2.1 μg/100 cm^2. A keyhole penetration of a roof web was also sampled. The keyhole surface is rough concrete that allows additional dust to adhere. A result of 9.9 μg/100 cm^2 was obtained. All walls, roof webs, and keyholes were subsequently HEPA vacuumed as part of the final cleaning activities.

• **Barrel Ceiling**: Inspection of the painted concrete barrel-roof ceiling showed no visible adhering dust. Wipes were only very lightly discolored to clean appearing after sampling. A total of 7 painted ceiling wipe samples were collected with all results non-detect for PCBs (Table 5.28). The exception was a limited to a 15- by 20-ft. area of unpainted ceiling that was indicated contaminated by historic operations unrelated to demolition dust generation. The unpainted ceiling area was located in Bay V32 and averaged approximately 20 μg/100 cm^2 total PCBs (Table 5.28). The contamination appears historic due to the presence of Aroclor 1260. (Aroclor 1260 was not detected in demolition dust and wipes from all other surfaces) This limited area will be

addressed by future TSCA cleaning. The suspected reason for PCBs exceeding 10 µg/100 cm^2 was that this limited area was not accessible during historic Department 27 cleaning and painting due to former partitions preventing overhead access to this limited area for cleaning and subsequent painting.

• **Overhead Piping and Similar Surfaces**: Inspection of the overhead piping showed areas where dust had settled in a layer thicker than observed for vertical surfaces such as walls. A total of 20 wipe samples were collected from the dust covered horizontal surfaces with results ranging from 53.9 to 239 µg/100 cm^2 and averaging approximately 125 µg/100 cm^2 (Table 5.29). The topside of the overhead surfaces was sampled where accumulated dust was the thickest. In addition to the wipe samples, sufficient dust was present to brush into 4 oz. sample jars for analysis. Two dust bulk samples were collected (315 mg/kg and 495 mg/kg PCBs, Table 5.29).

Surfaces with accumulated dust were HEPA vacuumed and sampled to test the effectiveness of cleaning (Table 5.30). HEPA vacuuming was sufficient in removing enough dust to achieve residual levels of less than 10 µg/100 cm^2. Areas were also HEPA vacuumed and cleaned with towels wetted with a cleaning agent (Lysol Tub and Tile Cleaner). Limited or no additional cleaning benefit was observed with this additional wipe-cleaning step, indicating that PCBs were associated with the removed dust and underlying surfaces were not contaminated above 10 µg/100cm^2.

The exception was the unpainted ceiling area indicated to be associated with historical contamination. Cleaning by vacuuming and vacuuming/wet wiping did not decrease the observed contamination. Because this area was not the result of demolition dust contamination, decontamination work will be conducted under a separate contract using a solvent such as d-limonene as part of the procedure.

Final Room Cleaning

All surfaces were cleaned using HEPA vacuum equipment to remove dust on surfaces that accumulated as a result of demolition activities. This included vacuuming the

walls, columns, fixtures, piping, and overhead utilities, steel channels, pipe hangars, roof webs, roof web keyhole, ceiling recesses, brackets, supports cables, wires, and duct work (Figure 5.80). Both the top and bottom surfaces of utilities and fixtures were vacuumed until visible loose dust was no longer observed.

This cleaning step was performed prior to placement of the 40-mil HDPE barrier in order to prevent potential cross-contamination of newly imported materials. This cleaning was also done prior to dustless scarification and vacuuming of basement area sub-floor. After cleaning of the walls and overhead areas, 319 wipe samples were collected from surfaces such as overhead piping, cables, steel channels, electric conduit, duct banks, light fixtures, PA horns, unistrut, electric breaker boxes, and similar overhead surfaces (Figure 5.81, Table 5.31 and Figure 5.75). A visual inventory of all such surfaces was performed prior to sampling in order that a representative number of samples could be collected from each surface. Also during overhead sampling, the piping and other surfaces were inspected for visual cleanliness. If a surface was identified that appeared could benefit from additional cleaning these areas were flagged with green survey tape for re-vacuuming and additional sampling.

As result of the confirmation samples, a few surfaces were indicated to exceed 10 $\mu g/100cm^2$. These surfaces were re-cleaned for a minimum length of 10 ft. on each side of the exceedances and a second confirmation sample was taken at a new spot (i.e., no samples were taken on the same exact spot as the original exceedances because the hexane wipe sample procedure would have removed PCBs from that original 10 cm x 10 cm sample area.). Re-cleaning was performed by re-vacuuming and adding a dry wipe procedure to remove potentially adhering dust from the surface. This procedure was successful in reducing the concentrations to below 10 $\mu g/100\ cm^2$. This also indicated that dust was the source of contamination as opposed to direct contact of overhead surface with PCB leaks, mists or aerosols that could have occurred during historical operations and is consistent with the information that the overhead surfaces were previously decontaminated (i.e., before the dust generating demolition) using wet-wiping.

Interior Bus Duct Sampling

The overhead utilities include three bus ducts (480 Volt 3 phase ducts). The ducts, upon inspection, did not have visible openings to the duct interior such that demolition dust could enter. There were various removable plates and closed covers on the ducts that were potential intrusion of vapors or dust depending upon how tightly these access points are sealed. Therefore, given there was no information to show that the bus duct interiors were previously sampled and given the former long-term historical use of PCBs in the Department, a decision was made to sample the bus duct interiors.

A total of 20 wipe samples were collected for the overhead bus duct closest to the former pit areas (Bays V33, W33, X33, Y33, and Z33). The results are summarized in Table 5.32. The bus duct was de-energized (locked-out and tagged-out) and a lift was used to access the bus duct. An electrician opened the access panel (tap switch plate), double-checking with a meter that the circuit was de-energized, and Burns & McDonnell collected wipe samples from the top of each bus bar located inside the bus duct. There were four bus bars (approx. 1-inch wide and 1/8-inch thick) at each location. Therefore, four wipes were collected at each location starting from the top bus bar. Results were all below 10 $\mu g/100cm^2$ with the exception of second bus from the top in Bay Y33. Due to the exceedance of this sample, the overhead bus ducts were labeled with PCB warning stickers, given these access points to the bus duct interior are limited with no practical way of interior cleaning (Figure 5.75)

5.9 Miscellaneous Contaminated Soils (SWMUs 18, 19, 20 and 21)

5.9.1 Regulatory Submission/Approvals

RFI Work Plan

- Submitted to EPA / MDNR June 16, 1993 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved with comment by EPA / MDNR August 27, 1993 (Letter from M. J. Sanderson, EPA to G. P. Keary, DOE)
- Submitted to EPA / MDNR November 3, 1993 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)

RFI Report

- Submitted to EPA / MDNR July 19, 1995 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved by EPA / MDNR September 8, 1995 (Letter from K. S. Ritchey, EPA to G. P. Keary, DOE)

CMS/CMI (Addressed under the Multi-Site CMS / CMI)
CMS

- Submitted to EPA / MDNR November 29, 1995 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Statement of Basis, U.S. Department of Energy Kansas City Plant, Multiple Sites, Kansas City, Missouri, U.S. Environmental Protection Agency, Region VII Office, March 25, 1998.
- Approved by EPA / MDNR July 15, 1998

CMI Work Plan

- Submitted to MDNR / EPA October 28, 2000 (Letter from G. P. Keary, DOE to A. H. Groner, MDNR)
- Approved by MDNR November 6, 2000 (Letter from A. H. Groner, MDNR to G. P. Keary, DOE)

5.9.2 Description of Units

The Miscellaneous Sites RCRA Facility Investigation Work Plan, along with the Miscellaneous Sites 1991 field investigation, originally included the Building 54 site. Preliminary soil and groundwater sample results indicated that another potential spill location, the Maintenance Vehicle Repair Shop Sump (MVRSS), may have been responsible for the contamination. It was decided to combine the Building 54 investigation with MVRSS.

The Miscellaneous Contaminated Sites Consists of the Following Units:

North Lot

Prior to paving sometime between 1981 and 1983, the North Lot routinely contained several trailers and vehicles and may have been used as a staging area for various facility activities. Aerial photographs reveal a blackened area indicating that trash was burned there at one time. It is also possible that drums were stored in the area but the contents of the drums is unknown

Building 16

Building 16 was constructed in 1945 and was first used by the Pratt and Whitney Corporation for training machinists and for storing materials. Materials stored ranged from magnesium chips to test equipment and gauges. Later operations included mold flushing and testing in a centrifuge room. The primary areas of concern were the centrifuge room sump and a covered concrete pit. The sump historically contained some water and hydraulic fluid from occasional leakage of the centrifuge hydraulic lines. The sump is equipped with an oil-water separator, with only water pumped to the sanitary sewer system. Even though the centrifuge room, floor, and sump are concrete, groundwater leaks into the sump. There was concern that sump contents may have leaked to the surrounding soil and groundwater.

Sometime between July 1984 and September 1985, a covered concrete pit was added to Building 16. Its purpose was to recover waste fluids from the mold-flushing operations. Because PCB-containing heat transfer fluids were used with the molds, waste fluids could have been contaminated. These fluids are pumped into 55 gal drums, located in the concrete pit.

Fuel Oil Tank Unloading Area

The Fuel Oil Tank Unloading Area includes the two fuel oil tanks, the area enclosed by the tank retaining walls, and the unloading area to the east of the tanks (Figure 5.82). Westinghouse Corporation installed the two 400,000-gal tanks in 1957 to store jet fuel

for an engine test facility. Fuel was routed from the tanks through the pump house (Building 15) and to the test cells.

The tanks were deactivated in the early 1960s. In 1973, the tanks were renovated, and the original floating roofs were replaced with fixed conical roofs;. The tanks were filled with #6 fuel oil for use as boiler fuel. This boiler fuel was loaded and unloaded at the fuel unloading area by tank trucks (Figure 5.82).

From 1973 until approximately 1983, the tanks were heated and used as the central fuel-oil storage facility for the East and West Boilerhouse boilers. From 1983 until December 1989, the tanks remained full but were not heated (DOE 1990). During the winter of 1989, the south tank was heated again, and an opened valve allowed steam into the north tank. A steam condensate return line leaked inside the north tank, and heated #6 fuel oil entered the line. Some of this contaminated condensate spilled onto the ground (Figure 5.82), and some was accidentally routed east through the 001 storm sewer line. The storm sewer line was cleaned up as soon as the spill was detected. However, the part of the spill inside the containment wall, along with occasional spilling around some of the tank valves, was not cleaned up (personal communication to J. E. Peterson, ORNLGJ, from J. Nolan, Allied Signal, Inc. Kansas City, Mo., 1990).

Although the tanks rest on concrete pads, there is soil with some gravel within the retaining walls (personal communication to J. E. Peterson, ORNL-GJ from J. Nolan. Allied Signal, Inc., Kansas City, Mo., 1990). Initially, containment was minimal (berms). Throughout the 1980s improvements were made to bring the site into compliance with current environmental health and safety regulations (DOE 1990c). Nevertheless, in November 1989, a DOE survey team (Tiger Team) determined that the storage tank facilities did not comply with current regulations for containment. Plans to upgrade and renovate the tank facility were completed in March 1990 (DOE 1990c).

Renovation of the Fuel Oil Tank site commenced in FY 1991. The #6 fuel oil was removed. The remaining residue in the tanks was sampled, removed, and incinerated at

an off-site facility, and the insides of the tanks were cleaned with water-based detergent.

Abandoned Fuel Lines

The underground fuel lines were installed during the initial facility construction in 1942 and 1943. An entire network of underground lines connected a pump house (Building 15) and unloading stations to underground tanks in the tank farm and continued west to test cells in the MMB. These fuel lines carried fuels, oils, solvents, steam, steam condensate and compressed air. The lines were abandoned when test cell operation ceased in the early 1960s.

Subsequently, portions of these abandoned underground fuel lines have been cut and removed during various construction and excavation activities, including removal of the tank farm. In many instances, the AFLs were ripped up with a backhoe and left uncapped. Although most lines were not full of fluids, some reportedly leaked some of their contents onto the ground.

5.9.3 Contamination Characterization

5.9.3.1 Soil Results

Two hundred twenty-eight samples were collected from soil borings and from monitoring wells during well installation as part of the field investigation of the four Miscellaneous Sites

North Lot

Thirty-seven soil samples were collected from the North Lot site as part of the Miscellaneous Sites field investigation (KC91-173 through KC91-175 and MSBH-11 through MSBH-18) (Table5.33). One sample at 3 ft. from KC91-173 contained 450 µg/kg of toluene. The soil sample taken at 8 ft. was clean. The toluene in KC91-173 at 3 ft. is believed due to a small amount of fuel spilling out of a vehicle or due to laboratory contamination. No PCB, TPHC, or VOC contamination was detected.

Building 16

Twenty soil samples were collected from the Building 16 site (MSBH-26 through MSBH-30 and MSBH-35) (Table 5.33). One sample at 4 ft. from MSBH-26 contained 1.2 mg/kg of PCBs, just about the detection limit of 1.0 mg/kg. The only other soil contamination was 27.0 TPHCs (heavy fraction) at 1 ft. in MSBH-29. No other contamination was detected at the site.

In summary, PCBs were detected in only one sample, just above the detection limit. TPHCs were also detected in only one sample. These TPHCs were detected below the water table, and no other contamination was detected in subsequent sampling in the area (MSBH-35). The report indicated that there was no soil contamination problem at the Building 16 site.

Abandoned Fuel Lines (AFL) Site

One hundred twenty-three soil samples were collected from the AFL site as part of the Miscellaneous Sites field investigation (Table 5.33). Although KC91-167 and KC91-165 were included in the Fuel Oil Tank Unloading Area site field investigation, they also serve to replace abandoned Tank Farm Area wells KC84-01 and KC84-02. Because the data indicate that KC91-167 and KC91-168 contain contaminants found in the Tank Farm Area plume, which overlaps much of the AFL site, these two new monitoring wells were included in AFL site discussion.

The soil samples contained TCE (up to 440.0 µg/kg), 1, 2-DCE (up to 610.0 µg/kg), chloroethene (up to 360.0 µg/kg), TPHCs (heavy fraction) (up to 2500.0 mg/kg), benzene (up to 1100.0 µg/kg), toluene (up to 24.0 µg/kg), t-xylenes (up to 2000.0 µg/kg), styrene (in one sample at 1700.0 µg/kg), and dichlorobenzene (in one sample at 13.0 µg/kg).

TCE was detected at 2.5 to 3.5 ft from MSBH-06 (20.0 µg/kg) and at 15.5 to 16.5 ft from KC91-166 (13.0 µg/kg). KC91-171 contained 39.0 µg/kg of TCE at 37.5 to 35.5 ft, while MSBH-44 contained up to 440.0 µg/kg of TCE contamination in soil samples

from 2.5 ft. down to 17.5 ft. The contamination in KC91-171 is probably due to the Tank Farm plume or from a source to the northwest. Soil data from MSBH-44 indicate that there may be a TCE source in the area. BTEX were detected in samples from MSBH-41, MSBH-43, and KC91-172. BTEX found below the water table were from MSBH-41 (totals of up to 159.0 µg/kg) and KC91-172 (26.0 µg/kg in one sample). MSBH-11 and MSBH-43 both contained BTEX contamination (from 24.0 to 2000.0 µg/kg) near the surface at 2 to 9 ft, indicating a possible source in the area (Figure 5.83).

With, the exception of one detection (MSBH-08 showed 25.0 mg/kg at 27 to 25 ft.), all of the TPHCs at the site were found at or above the water table, indicating possible petroleum releases in these areas. One area approximately delineated by MSBH-05, MSBH-06, and MSBH-07 contained up to 100.0 mg/kg of TPHCs at 2.5 to 13.5 ft., a possible result of leaking fuel lines. A second area roughly defined by MSBH-25, MSBH-35, MSBH-41, MSBH-43, and KC91-172 contained up to 2800.0 mg/kg of TPHCs at 2 to 13 ft. A concentration of 250 µg/kg was also reported at 5 to 10 ft from KC91-175 and appears to be somewhat isolated as no TPHC contamination was reported in MSBH-09 and MSBH-10. The fuel lines may have contributed to some of this contamination. The contamination at and below the water table indicates a source to the northwest.

In summary, the majority of the contamination detected below the water table can be attributed to the Tank Farm plume. However, soil sample results from borings and wells to the west of Building 74 (MSBH-25, MSBH-38, MSBH-41, MSBH-43, MSBH-44, KC91-171, and KC91-172) suggest that an unknown source, or sources, in the area and to the northwest may be responsible for this solvent and petroleum contamination.

Fuel Oil Tank (FOT) Unloading Area

Forty-eight soil samples were collected from the FOT site as part of the Miscellaneous Sites field investigation (MSBH-01 through MSBH-03, MSBH-19 through MSBH-24,

MSBH-34, MSBH-36, and MSBH-37). Discussions incorporating soil sampling results from KC91-167 and KC91-168 are included in the *AFL* site discussion above.

The soil samples contained TPHCs (heavy fraction) (up to 1300.0 µg/kg), 1,1,2,2-tetrachloroethane up to 15.0 µg/kg), ethylbenzene (in one sample at 22.0 µg/kg), and t-xylenes (up to 87.0 µg/kg). The contaminants of concern are TPHCs and BTEX. BTEX were detected in soil samples from MSBH-02 (109.0 mg/kg) at 35 to 36 ft. and from MSBH-19 (48.0 mg/kg) at 3.5 to 4.5 ft. This contamination is probably due to small petroleum releases. The contamination in MSBH-02 is below the water table and may be due to contaminated groundwater, while the MSBH-19 contamination appears to be a localized incident.

All of the TPHC contamination at the site was detected at or above the water table, indicating possible petroleum releases in these areas. One area is approximately delineated by MSBH-20, MSBH-21, MSBH-23, and MSBH-37 and contained up to 1300.0 mg/kg of TPHCs at 8.5 to 13 ft. MSBH-01 also contained up to 180 mg/kg of TPHCs from two samples at 3.5 to 8 ft.

In summary, most of the BTEX and TPHC contamination was detected at or above the water table and appears to be the result of small, localized petroleum releases. It is not known why traces of 1,1,2,2-tetrachloroethane were detected in two samples (15.0 µg/kg in MSBH-01 at 7 to 8 ft and 10.0 µg/kg in MSBH-02 at 35 to 36 ft.). Continued routine quarterly groundwater sampling of adjacent monitoring wells will determine whether these traces indicate a 1,1,2,2-tetrachloroethane contamination problem in this area.

5.9.4 Conclusions

Soil data indicates that chlorinated solvent, TPHC, and BTEX contamination is present above the water table at the AFL and FOT sites. Soil sample results from borings and wells to the west of Building 74 (MSBH-25, MSBH-38, MSBH-41, MSBH-43, MSBH-44, KC91-171, and KC91-172) suggest that an unknown source, or sources, in the area and to the northwest, may be responsible for this solvent and petroleum contamination.

An area at the FOT site, approximately delineated by MSBH-20, MSBH-21, MSBH-23, and MSBH-37, contained up to 1300.0 mg/kg of TPHCs at 8.5 to 13 ft. MSBH-01 also showed up to 150 mg/kg of TPHCs from two samples at 3.5 to 8 ft, and MSBH-19 contained 38.0 µg/kg of BTEX at 3.5 to 4.5 ft. Additionally, a soil sample collected at 5 to 10 ft during the installation of monitoring well KC91-175 reported a TPHC concentration of 250 mg/kg . This BTEX and TPHC contamination was detected at or above the water table and appears to be the result of small, localized petroleum releases.

Some of the soil samples collected during this investigation contained TPHC contamination (up to 2800.0 mg/kg). In addition, several specific VOCs also were detected in the soil.

5.9.5 Corrective Measures Study (CMS)

The Miscellaneous Contaminated sites CMS evaluated the following corrective measures:

No Action

The No Action option was included to provide a baseline against which other alternatives will
be compared.

Institutional Action

This alternative was a passive measure to prevent any potential human or ecological exposure by prohibiting future excavation of contaminated soil without formalized plans to prevent harmful human and ecological exposure. There would also be a requirement to dispose excavated soils properly.

In-situ bioremediation

This alternative consisted of installing bioventing wells designed to maximize oxygen delivery to TPH contaminated soils and promote biological degradation of contaminants in the vadose zone.

Excavation/Landfarming

This alternative consists of excavating TPH contaminated soil, landfarming the soil in a lined biocell constructed on-site, and replacing the remediated soil back into the excavations. Soil nutrients, moisture level, and microbial populations will be controlled to achieve biodegradation of TPH contaminants in the soil.

Excavation/Low Temperature Thermal Desorption

This alternative involves excavating TPH contaminated soil, treating the soil in a low temperature thermal treatment unit, and replacing the remediated soil back into the excavations. Temperatures high enough to volatilize contaminants, but low enough so that the soil is not actually burned, will be used to achieve a reduction in TPH levels in the soil. The volatilized contaminants are then typically treated in the air stream by catalytic oxidation or a similar technology.

Excavation/Off-Site Disposal

This alternative consists of excavating TPH contaminated soil and transporting to a permitted sanitary landfill for disposal. Clean soil from off-site will be used to backfill the excavations.

5.9.5.1 Recommended Alternative

After thorough evaluation, the institutional action alternative (Alternative 2) was recommended for the site. This alternative consisted of utilizing excavation controls at the KCP to prohibit human and ecological exposure to constituents of concern unless adequate health and safety protections are in place. Site data indicated that the only exposure pathway existing for constituents of concern was excavation of subsurface soils such as would be required for construction purposes. This alternative effectively addressed this migration pathway and protects human health and the environment. Minimal costs were associated with this alternative, and implementation would require less than one month. The proposed corrective measure met the corrective action objective established for the site.

The chosen groundwater remedy was continued operation of the site groundwater pump and treat system.

5.10 Southeast Parking Lot (SWMU 29)

5.10.1 Regulatory Submittals/Approvals

RFI Work Plan

- Submitted to EPA / MDNR April 26, 1991 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved with comment by EPA / MDNR July 16, 1991 (Letter from M. J. Sanderson, EPA to G. P. Keary, DOE)
- Submitted to EPA / MDNR August 12, 1991 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)

RFI Report

- Submitted to EPA / MDNR March 3, 1993(Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved by EPA / MDNR April 8, 1993 (Letter from K. S. Ritchey, EPA to G. P. Keary, DOE)

CMS/CMI

CMS

- Submitted to EPA / MDNR June 30, 1994 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved by EPA / MDNR November 13, 1995 (Letter from W. A. Spratlin, EPA to D. A. Gurule, DOE)

CMI

- Submitted to EPA / MDNR October 10, 1996 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved by EPA MDNR October 29, 1996 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)

5.10.2 Work Performed

A revised Phase I RFI Report was required in February 2000 for the KCP's Southeast Parking Lot (SEPL) based on findings from a document entitled "Additional Field Investigation Report Southeast Parking Lot Area-Funnel and Gate Passive Groundwater Treatment Systems", dated May 1997. DOE was required to further evaluate the Southeast Parking Lot, Solid Waste Management Unit (SWMU 29), to establish the rate of migration and extent of groundwater contamination. MDNR would then

determine, based on review of this Report, if a Phase I1 RFI Workplan for the SEPL was required.

Groundwater monitoring well 193 was installed in July 1994. It was intended to confirm, through the absence of contamination, the southern extent of contamination in the area immediately south of the Manufacturing Support Building 13 (MSB) crossover (Figure 5.84). Initial sampling results from this well in July of 1994 detected chloroethene at 2100 µg/L and 1,2 dichloroethene (1,2 DCE) at 21 µg/L.

Contamination was also detected in the upper completion of this well but at much lower levels. The presence of this unexpected contamination was also perplexing in that the ratio of chloroethene to 1,2 DCE was from 5 to 100: 1 compared to a 1:4 ratio of chloroethene to 1,2 DCE in well 165 just upgradient (Figure 5.84).

As a result of this unexpected contamination, wells 195 through 199 were installed in the general area of well 193 and sampled for VOC's and PCB's. Sampling of wells 196 through 198 conducted in late 1994 through 1995 noted only sporadic non-confirmed contamination by TCE as described in the 1995 Annual Groundwater Monitoring Report (DOE, 1996).

Five Power Punch drive point samplers were installed as temporary wells (TW01-TW05) as a part of the continuing investigation activities in this area in 1995. All were installed in the basal gravel just above bedrock. Three were installed at the south edge of the parking lot with the remaining two installed in the east and western limits of the investigation area (Figure 5.84). These temporary wells were sampled on two occasions for VOCs and PCBs before their abandonment and in both events all were below analytical detection limits Sampling continued in 1996 with no detection of contamination in any completions of wells 195, 196, 197 or 198. Well 199 continued to exhibit low to moderate contamination (DOE 1997). The 16-inch water line shown in Figure 5.85 was again repaired in 1996.

Six additional single completion monitoring wells were installed as a part of work performed in this area identified as 203U, 204L, 205U, 206L, 207U and 208L and are shown in Figure 5.86. These wells were installed as single completion wells as opposed to the dual completion wells typical of most other monitoring wells on site.

Slug tests were performed on five of the six wells (2 upper completion wells (205U and 207U) and three lower completion wells (204L, 206L and 208L)). Two of the three upper completion wells installed here (205U and 207U) utilized 5 foot well screens placed at depths of approximately 20 to 25 feet below ground.

Other significant results of this sampling include the following:
Total VOC's in lower completion wells decreased significantly over a short distance (i.e., between wells 204 and 208). Total VOCs averaged 510 µg/L in well 204, 380 µg/L in well 206 and 39 µg/L in well 208 in the three sampling events. These wells are each located only 25 feet apart with well 208 being furthest downgradient. Wells 196, 197 and 198 downgradient of wells 203 through 208 were also sampled in 1997 and did not detect the presence of contamination.

The rapid decrease in contaminant levels in upper and lower completion wells 203 through 208 coupled with the absence of contamination in downgradient wells 196, 197 and 198 suggested that attenuation of contaminants might be occurring.

Slug tests conducted in 1997 in the Southeast Parking Lot as a part of fieldwork for the design of an in-situ iron wall calculated hydraulic conductivities from 48 to 100 ft/day (Woodward Clyde 1997b). These conductivities were significantly greater than the hydraulic conductivities calculated and utilized in groundwater velocity calculations performed in the past. To confirm these results additional fieldwork was performed in 1998 consisting of two short term pumping tests and additional slug tests.

Short term (~ 4 hours) pumping tests were conducted at existing monitoring wells 206L, and 197L (the former drilled using cable tool methods with the latter installed

using hollow stem augers). During the pumping test of well 206L drawdown data from monitoring wells 187L, 193L, 193U, 195L, 196L. 196U, 197L, 199L, 203U, 204L, 205U, 207U and 208L were collected for analysis. The test of 197L used drawdown data from wells 196L, 196U, 197U, 198L, 198U, 208L and both completions of wells 228, 229 and 230.

Slug tests were conducted in wells 187L, 193L, 195L, 197L and 199L. Slug tests were conducted to determine whether slug testing of other monitoring wells in the area might be a means of providing additional data for estimating reasonable hydraulic conductivity values.

5.10.2.1 Conclusions

The following summarizes findings and results from the study:
The hydraulic conductivities from the 1997 slug tests were too high. Both 1998 short term pumping tests and reanalysis of the slug tests in the vicinity of wells 204, 206 and 208 were in the range of 26 to 30 ft/day.

Hydraulic conductivity of the basal gravel is variable laterally being lower at the north end of the study area than the south (5.7 to 20 ft/day north versus 40 to 66 ft/day south). The average hydraulic conductivity from the pumping test at well 197L was 32.5 ft/day and 28.3 ft/day for well 206L. The maximum sustainable pumping rate from well 206L was less than 1 gpm while rates of approximately 6 gpm (the maximum rate achievable with the pump used) was noted from well 197L.

The basal gravel in the Southeast Parking Lot area is more conductive than the overlying silty clay.

Several remedial technologies were evaluated in 1999 for implementation in the Southeast Parking lot with a deliberate attempt to select one exhibiting passive treatment. However, due to the sensitive location of the plume; the fact that compliance point wells were experiencing contamination over site clean-up standards; and EPA

insistence that the plume be addressed by June 30, 1999 a decision was made to install groundwater pumping wells in the Southeast Parking Lot to return wells 197L and 198L to compliance.

5.11 Northeast Area (5, 6, 7, 8)

5.11.1 Regulatory Documents Submitted/Approved

RFI Work Plan

- Addressed under the Outfall 001 RFI Work Plan

RFI Report (Combined Northeast Area / Outfall 001 RFI Report)

- Submitted to EPA / MDNR September 23, 1993 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved by EPA / MDNR December 3, 1993 (Letter from K. S. Ritchey, EPA to G. P. Keary, DOE)

CMS/CMI (Combined Northeast Area / Outfall 001 CMS / CMI activities)

CMS

- Submitted to EPA / MDNR April 10, 1994 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved by EPA / MDNR November 13, 1995 (Letter from W. A. Spratlin, EPA to D. A. Gurule, DOE)

CMI Plan

- Approved by EPA / MDNR October 29, 1996 (Letter from K. S. Ritchey, EPA to G. P. Keary, DOE)
- Submitted to EPA / MDNR October 17, 1996 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)

5.11.2 Description of Area

The Northeast Area encompasses the northeast quadrant of the BFC. It is the only generalized area addressed under Corrective Action that is defined based purely on geographical location. It is located in what is informally called the Blue River Groundwater Flow System (BRGFS) which is defined as that area of the BFC where groundwater not captured by the groundwater pumping system or the Outfall 001 groundwater seep collection system ultimately discharges to the Blue River (Figure 5.87). It includes SWMUs No. 5 (North Lagoon), No. 6 (Old Ponds), No. 7 (North Lagoon Trench Area), No. 8 (Outfall 001 Raceway), and No. 13 (South Lagoon - See Section 5.13) and No. 44 Former Landfill (see Section 5.14). The area includes property belonging to the Union Pacific Railroad, DOE and GSA. It also encompasses

open-land formerly occupied by the Blue River. In times past, the river channel included a meander that looped to the west, in the area north of the former IRS/NARA Building known as Building 2306/2312. (Figure 5.88). The former drainage way of the Blue River is now grass-covered and undeveloped and serves as a part of a storm water retention basin. Trees are sparsely situated throughout.

As discussed in Section 4, investigation in the Northeast Area grew out of the unexpected contamination found in groundwater monitoring wells installed originally to define a clean perimeter of contamination.

An empty solvent drum and various other debris were uncovered during the closure of the North Lagoon. It was determined that some of this debris was associated with a former ditch or trench (labeled as former ditch Figure 5.89) that was reported to have extended to the Blue River. The route that this trench took to the river is unknown and is not evident in historical aerial photographs. However, it is believed to correspond to the northeast drainage ditch noted in a 1970 USACE map (Figure 5.90). The trench was filled in prior to construction of the North Lagoon. Some of the documents found during lagoon excavation indicated that the burial occurred during Westinghouse operations (operator of a portion of the plant until 1959) (B. N. Serres, AlliedSignal, Inc., personal communication to N. Korte, ORNL, September 1986).

In an aerial photograph taken in 1955, three small (from approximately 60 x 60 ft to 100 x 100 Ft) ponds are visible in the vicinity of the former north lagoon (Figure 5.92). The ponds appear to be man-made with roads leading to each pond. One pond is clearly visible on a 1952 aerial photograph, the other two are not visible. Either the remaining two were constructed after 1952 or did not contain water in the 1952 photo (Figure 5.91) , and, therefore, cannot be discerned on the aerial photo. A 1963 aerial photo (Figure 5.93) clearly shows that the ponds were removed as part of the construction of the north lagoon. The nature and purpose of these ponds is unknown (DOE 1989). Section 4 discussed how several sections of pipe were removed from the Northeast Area (Petrochem 1988). One of these, called the "northwest pipe" or "Pipe A" extended from the former north lagoon to the west. The contractor removed 198 ft. of 18 in.

reinforced concrete pipe, the pipe was open at both ends but plugged with clay - the line has never been found on any utility maps. The contractor used an auger to attempt to locate additional sections of pipe beyond those recovered. No additional pipe was discovered. A pool of liquid was uncovered below the concrete pipe. Analysis of the liquid showed 120,000,000 µg/L trichloroethene (12%) and 23 mg/kg of polychlorinated biphenyls (PCBs) (Petrochem 1988).

There were indications that the pipeline continued to the west and possibly south of the removed section. These indications include an old (brick lined), unmarked manhole about 60 ft west of the removed pipe. The manhole is ~10 ft deep and contains 2 ft of standing liquid, a pipe extends east to west from the bottom of the manhole (in original construction plans there is one reference to a concrete pipe under the road west of the area where the pipe was removed, but no indication of the source or further placement of the pipe.

5.11.3 Northeast Area RFI

5.11.3.1 Soils

Contamination sampling was performed near the former ponds and adjacent locations as part of the Northeast Area/001 Outfall RFI investigation. Drilling encountered significant TPH to the northeast of the former North Lagoon. Subsequently, further review of a historical map showed a "waste oil pit" that may have been a separate pit or one associated with one of the former ponds. Figure 5.94 presents the sample locations and the features that were targeted. The former drainage pools are locations selected from aerial photos that appeared to collect runoff in the area prior to the completion of the current roadways and parking lots. (Figure 5.94) also shows the waste oil pit as distinct from the nearby former ponds.

It was originally believed that no significant soil contamination remained at the location of the former buried pipe (Petrochem 1987) and that no additional sections of buried pipe were present. In order to define accurately the extent of contamination 42 soil borings were completed over the course of the Northeast Area RFI (Figures. 5.94, 5.95, and 5.96). Soil samples were collected using a 5-ft sampling interval or based on field

observations of obvious contamination. In a few cases samples were collected at regular intervals until the water table was encountered. Additional samples were not collected until the alluvium bedrock interface. Data from these investigations are presented in Tables 5.34 and 5.35. Results revealed soil contaminated with TPH at concentrations ranging up to 6,961 mg/kg (BH05 at 13 ft, Figures 5.94 and 5.95). BH05 is located in the southern most of the three former ponds and within the former North Lagoon. In addition to the locations of the three former ponds, petroleum hydrocarbon contamination was found to extend to the northeast and along the existing ditch east of the GSA parking lot (Figure 5.95). This ditch is believed to be a continuation of the former drainage discussed earlier. The horizontal and vertical extent of the petroleum hydrocarbon contamination identified at the site is shown on (Figures. 5.95 and 5.96), respectively.

Also reported, in addition to the petroleum hydrocarbon contamination, were trace concentrations (up to 10 mg/kg) of PCBs in several of the soil samples collected. The highest PCB concentration reported was 9.8 mg/kg (Aroclor 1260) in BH02 (adjacent to well 37) at 13 ft (Figures. 5.97 and 5.98). This contamination is all sporadic and low-level.

VOC contamination beneath the water table was expected because the Northeast Area contaminant plume underlies the investigation area. The highest concentrations of chlorinated solvents reported in the soil were found below the water table; TCE, 81 mg/kg (BH17 at 23 ft) and 1,2-DCE, 15 mg/kg (BH17 at 23 ft). Samples were analyzed on an "as received" basis. Consequently, these VOCs may be present only in the water contained within the soil sample.
Vinyl chloride and chlorobenzene were reported less frequently, but at concentrations up to 0.770 mg/kg (BH39 at 29 ft) and 0.330 mg/kg (BH31 at 22 ft), respectively (Figures. 5.99 and 5.100).

Several inorganics were reported at elevated concentrations; cadmium, 10,700 mg/kg (BH03 at 46 ft), copper, 33,090 mg/kg (BH03 at 46 ft), lead, 30,300 mg/kg (BH16 at 23

ft), and mercury, 408 mg/kg (BH16 at 23 ft). Contaminated locations are shown in (Figures. 5.101 and 5.102). Because of the elevated concentrations of metals, 13 samples were submitted for the Toxicity Characteristic Leaching Procedure (TCLP) procedure to determine if any of the samples could be classified as hazardous waste. Two of the thirteen samples analyzed following the TCLP extraction reported concentrations above the method detection limit (MDL); chromium at 0.369 mg/L (MDL = 0.25 mg/L) and barium at 5.52 mg/L (MDL = 5.0 mg/L). The TCLP regulatory level for these two elements is; 5.0 mg/L for chromium and 100 mg/L for barium. Therefore, consistent with results previously obtained for KCP soils and sludge's, all samples passed the TCLP. These results are consistent with reported results from the groundwater sampling and previously reported metals results (Tables 5.36 and 5.37) that demonstrate that these metals are relatively immobile at the KCP.

A total of twelve sediment sampling locations were selected within the outfall 001 drainage way for analysis. Samples were collected from two depth intervals; 0 to 1 ft and 1 to 2 ft and analyzed for VOCs, PCBs, and metals. Results (Table 5.38) from this initial phase of sediment sampling indicated that three locations (1, 2, and 3 on Figure 5.94) contained PCB contamination ranging up to a high of 17 mg/kg (Aroclor 1242) (location No. 2 at 0 to 1 ft.). These three locations lie along the latter portion of the drainage way, where surface water flow slows significantly, just prior to emptying into a continuation of the underground discharge pipe for the 001 storm drainage system (Figure 5.94). Also reported were several (i.e., 5 locations, Nos. 1, 2, 4, 11, and 12 on Figure 5.94), sporadic, low concentrations of VOCs; 1,2-DCE up to 61 µg/kg (location No. 12 at 0 to 1 ft), toluene up to 210 µg/kg (location No. 4 at 1 to 2 ft), 1,1,1 -TCA up to 26 µg/kg (location No. 2 at 1 to 2 ft), and xylene up to 12 µg/kg (location No. 2 at 1 to 2 ft). These may be related to VOCs in the water itself, particularly because this area is swampy such that contaminants may be sorbed by the organic-thick surface sediments at this location. Results from these shallow surface sediment samples reported no significant concentrations of metals, with the exception of a reported 255 mg/kg concentration of lead (location No. 7 at 1 to 2 ft. on Figure 5.94). Background concentration for lead has been established at 38 mg/kg (Fleischhauer 1988).

Following a review of the initial shallow surface sediment data, a second phase consisting of sediment borings was performed. Three additional sediment borehole locations (SB01, SB02, and SB03 on Figure 5.94) were selected on the northeast edge of the portion of the stream bank where the PCBs had been reported in the shallow sediments.

The purpose of these borings was to determine whether the contamination extended laterally to the stream bank and if so to what depth. The sediment borings were drilled to bedrock (approximately 12 to 13 ft.) and samples collected every 5 ft. including the surface and analyzed for VOCs, PCBs, metals and TPH (heavy). Results from these three sediment borings indicated PCBs at low concentrations; 3.0 mg/kg from SB02 at 1 ft., 6.8 mg/kg from SB03 at 4 ft., and 6.4 mg/kg from SB03 at 8 ft. (Table 5.39). Also reported were several low concentrations of TPH (heavy fractions); ranging from 24 mg/kg in SB03 at 4 ft. to 120 mg/kg in SB03 at 1-ft (Table 5.39). TPH concentrations were reported up to 9 ft. in depth from this sample set.

Based on these results, two additional sediment borings (SB04 and SB05 on Figure 5.94) were drilled and sampled (for the same parameters as the first three sediment borings) at locations selected approximately 20 ft. from the northeast edge of the stream bank to determine the extent of PCB contamination reported in SB02 and SB03. No attempt, at this point, had been made to drill on the southwest side of the stream because access is prevented by the saturated condition of the surface soils. Samples were collected from SB04 and SB05 to bedrock using a 5 ft. sampling interval, however, no surface sample was collected from either location. Results indicated only one low detection of PCB; 7.8 mg/kg from SB05 at 4 ft. and one low detection of TPH; 20 mg/kg from the same location and depth (Table 5.39).

Finally, a third set of three sediment borings (SB06, SB07, and SB08 on Figure 5.94) were drilled and sampled at the following locations; SB06 and SB07 were placed approximately 40 ft. apart on the southwest side of the stream approximately 30 ft.

from the edge of the stream bank along the stretch of the stream where PCBs were initially reported in the shallow sediments. SB08 was placed on the northeast side of the stream approximately 40 ft from the edge of the stream bank, splitting the distance between SB04 and SB05 (Figure 5.94). Again samples were collected to bedrock using a 5-ft sampling interval, along with a surface sample from each location and analyzed for VOC, PCB, metals, and TPH (heavy). Results indicated only one detection of PCBs; 36.5 mg/kg from SB07 at 4 ft. and low concentrations of TPH (heavy fraction) at five locations; 20 mg/kg from SB06 at 1-ft; 26 mg/kg from SB06 at 8 ft.; 72 mg/kg from SB07 at 1-ft; 190 mg/kg from SB07 at 4 ft.; and 28 mg/kg from SB07 at 8 ft.. No additional sediment borings were performed on the southwest side of the stream due to the obstruction provided by the steep bank leading up to the railroad tracks.

In summary, the sediment sampling located isolated pockets of TPH (heavy fraction) that exceeded 100 mg/kg and of PCBs that exceeded 10 mg/kg. The contamination is sporadic, low-level, and, therefore, most likely related to historic low-level releases in the 001 system.

5.11.3.2 Groundwater Sampling

The groundwater from the alluvial aquifer in the Northeast Area/001 Outfall has been sampled and analyzed for total metals, VOCs, semi-volatile organic compounds, TPH, and PCBs (DOE 1990a). High concentrations of TCE, 1, 2-DCE (over 15,000 µg/L), and chloroethene (over 1500 µg/L) were detected in groundwater samples. Most of the high concentrations of VOCs were found in the vicinity (within 300 ft) of well KC85-37, northwest of the former North Lagoon. The maximum concentration of TCE at the time was found in well KC85-37, with high concentrations also detected in KC87-64 and KC87-67. The highest concentration was found in the upper completion (designated by U) of KC85-37. Groundwater in the lower zone of the aquifer at KC85-37 (designated by L) had concentrations of TCE an order of magnitude less.

The highest concentration of any contaminant in the Northeast Area/001 Outfall was the 1,2-DCE concentration found in monitoring well KC85-37-U. High concentrations of

1, 2-DCE were also found in wells KC87-64-U, KC87-64-L, KC87-67-U, and KC87-67-L. As with the concentrations of TCE, the highest 1,2-DCE concentrations were found mostly within 300 ft. of the southern edge of the North GSA parking lot. As with the other VOCs, the maximum concentration of chloroethene was found in well KC85-37-U. Most of the other high concentrations were found in the vicinity of this well, for example, wells KC87-64-U C87-64-L, and KC87-67-U.

The overall configuration of the Northeast Area/001 Outfall groundwater contaminant plume has been known for several years and is routinely described and updated in the Annual Report (DOE 2013). Because of the difficult terrain (fill, swamp, steep banks), and access difficulty due to multiple land ownership, the investigations historically relied on groundwater screening with temporary wells.

Initially, groundwater screening samples were collected from twenty-seven temporary wells installed to bedrock (Figure 5.103), TWs were labeled with identification number only). This first phase of temporary well installations was used to estimate and define contaminant plume boundaries near the 001 Outfall and to aid in permanent monitoring well placement. Results of the groundwater screening program indicated TCE ranging from 6 to 1300 µg/L in 12 wells, 1, 2-DCE ranging from 5 to 5000 µg/L in 22 wells, and chloroethene ranging from 14 to 420 µg/L in 16 wells (Table 5.40). Other VOCs reported included chloroform in 2 wells), 1, 1-DCE in 2 wells, benzene and 1,1,2-trichloro-1,2,2-trifluoroethane in one well. The highest concentration of total VOCs was reported in TW-23, adjacent to KC88-77 (Figure 5.103).

Based on the temporary well results, two locations were selected for the placement of permanent monitoring wells; KC91-179 and KC91-182. KC91-179 was installed to assess if a separate source was the cause of the contamination detected in KC84-24 and KC91-182 was installed to better define the plume boundary to the south. Dual completion wells were installed at each location.

A second phase of temporary monitoring well installations was then performed to

determine the extent of the groundwater contamination near KC91-179. Ten temporary monitoring wells (labeled as TWs in Figure 5.103) were installed and sampledat a 200 ft distance surrounding KC91-179. Each of the temporary wells was completed tobedrock and screened over the alluvial bedrock contact. Temporary monitoring wells; TW01 through TW06 were installed first. TW01 was installed a distance of 20 ft. from KC91-179 in the upgradient direction to confirm the groundwater contamination observed in KC91-179. Analyses for VOCs were performed on groundwater samples collected -- both in the field, using a field gas chromatograph (GC), as well as in the laboratory using standard methods and a 24-h turnaround time. Results reported by the analytical laboratory for groundwater samples collected from TW01 reported; TCE at 52 , 1, 2-DCE at 230 µg/L, and chloroethene at 43 µg/L. Field GC analytical results reported similar results. Both results match the contamination observed in KC91-179. Temporary monitoring wells; TW02 – TW06 were installed in a semi-circle around KC91-179, in the upgradient direction at a distance of 200 ft. from KC91-179. Again analyses of groundwater samples were performed for VOCs utilizing both field screening techniques and standard laboratory methods with a 24 hour turnaround time. Analytical results reported by both parties (i.e., field GC and analytical laboratory) for these wells (TW02 - TW06) indicated no VOC contamination to be present. Following a review of these results, TW03 was completed as a permanent monitoring well KC91-183 to serve as an upgradient location.

Additional temporary monitoring wells were then placed in accessible locations on the downgradient side of KC91-179. A total of 4 wells; TW07 – TW10 were completed. It should be mentioned that a portion of this downgradient side was inaccessible due to railroad tracks. However, three of the temporary monitoring wells Nos. 10, 11, and 12 installed during the first phase provide information concerning groundwater contamination in this direction. Again, each of these temporary wells (TW07 - TW10) were completed, sampled, and analyzed as described above. Results reported by both the field and laboratory analysis indicated no VOC contamination to be present in any of these wells (TW07 - TW10). Soil sample results were also reported as non-detect.

The 001 area investigations enhanced knowledge of the contaminant plume location. All of the plume maps (Figures 5.104 through 5.115) demonstrate the effects of the site topography and the numerous filling and construction events. The apparent constriction of the plume as it flows through the dike area (roadway east of wells KC87-68 and KC88-83) is a prominent example.

Inorganic Contaminants

All metal concentrations in the groundwater samples are believed to be below the drinking water standards with the exception of arsenic. For example, concentrations of arsenic exceeding the standard of 0.05 mg/L were found in wells KC85-37-U, KC85-37-L, and KC87-65-L. The arsenic concentration of KC85-45 exceeds 0.2 mg/L. There does not, however, appear to be any systematic occurrence of arsenic in the groundwater samples, and the elevated concentrations of arsenic have been demonstrated to be naturally occurring (Korte 1990a, 1991).

Groundwater samples were also analyzed for PCBs, pesticides, and semi-volatile organic compounds. Traces (0.1 ppm) of certain Aroclors were reported for one sample from KC91-179U and -179L. Because these results are near the detection limit and not confirmed by subsequent sampling and analysis, the results are suspect. Otherwise, none of these compounds were confirmed in Northeast Area/001 Outfall groundwater by consistent detection in samples from the study area.

5.11.3.3 Summary

A CMS was recommended for groundwater. With respect to soil contamination, it was recommended that the only soil contamination to be addressed in the CMS was the VOC and TPH contamination that resides in localized areas above the water table. It was recommended that the CMS not address soil contamination present in the swampy area near the 001 drainage way. This contamination was noted as low-level and sporadic and the contaminants was not typically found in the 001 Outfall discharge.

It was also recommended that the sporadic localized areas where metal concentrations were elevated not be addressed in a CMS. The affected areas were small in size,

samples from the locations passed the TCLP, and metal contamination is either sporadic or low level or not present in the groundwater.

5.11.4 Corrective Measures Study

The Northeast Area CMS addressed treatment of contaminated groundwater and soil in the NEA/001 Outfall. The principal groundwater contaminants are TCE and its degradation products, 1, 2-DCE and chloroethene. The principal soil contaminant is TPH.

5.11.4.1 Groundwater

The CMS stated that the groundwater contamination in the Northeast Area posed a minimal threat to human health and the environment for the following reasons:

- although the groundwater plume discharged into the Blue River, seepage data from the RFI indicated that the plume did not affect the river water quality (DOE 1994a); and
- groundwater was not used as a water supply.

In the past, however, contaminated groundwater had seeped into a portion of the storm sewer and open drainageway of the 001 Outfall and has contaminated the outfall discharge. During 1992, the KCP installed engineering controls to capture this groundwater seepage. A portion of this seepage is treated at the groundwater treatment system. A groundwater pumping system captures a large portion of the groundwater plume. This system has been in operation since 1990. Treatment of the extracted groundwater occurs at the groundwater treatment facility. The extraction system is an effective method for containing the groundwater plume, and treatment effectively removes the contaminants so that the treated water can be discharged under a city permit to the sanitary sewer.

The CMS examined two corrective measure alternatives for the groundwater contamination:

Alternative 1, no action
Alternative 2, groundwater extraction with treatment.

Alternative 2 used the existing groundwater extraction system, the seepage capture system, and the treatment facility and included a new pumping well to capture the portion of the plume near the 001 Outfall.

Alternative 2 was the preferred corrective measure for the NEA/001 groundwater contamination. That alternative provided an effective method for containing groundwater contamination over an extended period of time and offered the potential for timely remediation of groundwater downgradient of the extraction wells. It had straightforward O&M requirements and was reliable and effective for treating the groundwater contaminants in the NEA/001.

5.11.4.2 Soil

TPH contamination of soil in the NEA/001 occurred primarily at depths greater than 4 ft. below ground surface. For this reason, excavation of contaminated soil by construction and maintenance workers was the only likely route for human exposure. Excavations in the area with contaminated soil were infrequent.

Because the soil contamination was subsurface, the only environmental threat was the potential for the contamination to leach into groundwater. However, the threat of TPH leaching into groundwater was minimal. The TPH constituents in the NEA/001 were primarily high-molecular-weight petroleum compounds that tend to adsorb to the clayey-silt soil and resist leaching. Additionally, groundwater samples show only sporadic, low concentrations of TPH constituents, which also attests to the low mobility of TPH in the NEA/001

The CMS examined Seven Corrective Measure alternatives for the soil contamination:

- Alternative 1, no action
- Alternative 2, institutional controls
- Alternative 3, treatability study of in situ treatment using deep soil mixing

- Alternative 4, excavation with on-site bioremediation
- Alternative 5, excavation with on-site thermal desorption
- Alternative 6, excavation with off-site landfill disposal
- Alternative 7, excavation with off-site incineration.

Alternative 2 was the preferred corrective measure for the NEA/001 soil contamination. Under this alternative, the contaminated soil would be left in place, and institutional controls would be established that would require any future construction or maintenance activities that excavate contaminated soil to handle the soil in accordance with applicable regulations.

Alternative 2 would be effective at limiting the potential for human exposure to contaminated soil. Although the concentrations of TPH in soil would continue to exceed the concentration limit of 100 mg/kg the institutional controls Would require any future construction or maintenance activities that involved excavation of contaminated soil to provide for treatment or disposal of the soil in accordance with federal, state, and local requirements.

Alternative 2 had favorable reliability characteristics because this alternative had no O&M requirements and would provide reliable control of the contaminated soil, provided that the institutional controls were enforced.

Alternative 2 posed no threat to the safety of nearby communities because the contaminated soil would remain on site. The only threat that the soil contamination posed to the environment was the potential for TPH to leach into groundwater.

A significant advantage of Alternative 2 is that this alternative poses minimal safety hazards to workers during implementation and both the implementation and the institutional requirements for the alternative were straightforward.

5.11.5 Corrective Measures Implementation Plan

In May 1995 additional characterization was performed to define the extent of TPH soil contamination in an area east of the GSA parking lot (Figure 5.116). Three soil borings (BH1, BH2, and BH3) were drilled adjacent to Union Pacific Railroad property to determine whether or not TPH soil contamination extended onto railroad property. Three soil samples were collected at each borehole (BH) location. The depth of each sample collected is as follows; BH1: 5ft., 10ft., and 12ft., BH2: 5ft., 10 ft., and 15ft., and BH3: 5ft., 10ft., and 15ft. The range in depth for sample collection was based on the depth of TPH contamination found in RFI samples. RFI sample results from borings 34 and 36 identified TPH soil contamination exceeding the 100 mg/kg cleanup level at depths from 1 to 7 feet.

Analytical results for soil samples collected from borings 1, 2, and 3 (May 1995) identified only one detectable TPH contaminated sample at a concentration of 13 mg/kg. This was well below the cleanup level. Therefore it was determined that TPH soil contamination did not extend onto Union Pacific Railroad property and corrective measures would not include the railroad property.

5.12. Outfall 001 Groundwater Collection Sump

Outfall 001 was formerly located at the 72-inch diameter storm sewer discharge into the southern end of the North Flood Retention Pond until it was moved to the present discharge location into Boone Creek, a tributary of the Blue River on June 1, 1987 (Figure 5.117).

The 001 storm sewer drains the north-central and northeast portions of the BFC. Historical sampling of the 001 Outfall stormwater compliance point, the Outfall 001 raceway and a railroad headwall in the area noted the presence of solvents (1, 2-dichloroethylene) contamination. Further investigation revealed that this contamination was believed to be coming from groundwater seepage. In order to help eliminate this source of contamination to the 001 surface water system, a subdrain system isolated from surface flow was constructed to capture groundwater seepage emanating from a hillside immediately west of the raceway. Groundwater seepage from the area of the west railroad headwall and the 001 raceway was routed in 1993 to a newly constructed lift station where the captured groundwater was pumped to the groundwater treatment facility for treatment. This system is referred to as the 001 groundwater seep collection system. It is discussed further in Section 6 - Stormwater.

5.13 South Lagoon (SWMU 13)

5.13.1 Regulatory Submittals/Approvals

RFI Work Plan

- Submitted to EPA / MDNR June 16, 1993 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved with comment by EPA / MDNR August 27, 1993 (Letter from M. J. Sanderson, EPA to G. P. Keary, DOE)

RFI Report

- Submitted to EPA / MDNR July 19, 1995 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved by EPA / MDNR (Nor Further Action) November 13, 1995 (Letter from W. A. Spratlin, EPA to D. A. Gurule, DOE)

CMS / CMI

- CMS Not Required November 22, 1991 (Letter from M. J. Sanderson, EPA to G. P. Keary, DOE)

5.13.2 Work Performed

Fifty-nine groundwater samples were collected as part of this RFI investigation. Preliminary samples were collected from the new wells each week following installation for four weeks, excluding KC90-143. KC90-143 was installed after the preliminary sampling had begun so only one preliminary sample was collected. Table 5.41 lists the concentrations of organic compounds detected in the groundwater samples taken at the South Lagoon. PCBs were not reported in any sample.

VOCs reported include: TCE in two samples at 7 and 13 µg/L, 1, 2 DCE in three samples from 7 to 9 µg/L, 1, 1-DCA in nine samples from 7 to 22 µg/and chloroethane in two samples at 10 and 11 µg/L TCE contamination was reported in two wells, KC90-140U and KC90-139L, while 1, 2 DCE was reported in the upper completions of KC90-137, KC90-138 and KC90-140. Chloroethane was reported only in the lower completion of KC90-138. 1,1-DCA was reported in low levels (7 to 10 µg/L in all groundwater samples collected from KC90-137-U and at 10 to 22 µg/L in KC90-138-L.

All the contamination was detected in the upper completions of wells with the exception of KC90-138-L and KC90-139-L. Both of these wells were installed near the location of the most contaminated well prior to lagoon decommissioning (KC86-50). The sporadic low-level occurrence of the contaminants is best explained by considering that the majority of contaminated sediments have been removed.

These results indicated that only low levels of various contaminants are found in the South Lagoon area. Because contaminant concentrations were low and sporadic, with the exception of 1, 1-DCA in KC90-137-U and KC90-138-L, they did not indicate any plume development.

5.13.3 Soil Contamination

Seventeen soil samples were collected during monitoring well installation as part of this RFI investigation. Nine samples, including one duplicate, were collected at the water table and eight samples were collected at the alluvium bedrock contact (Figure 5.118).

Table 5.42 lists the concentrations of organic compounds detected in the soil samples taken at the South Lagoon. PCBs were not detected in any sample. The only VOCs detected were acetone in one sample (19 µg/kg) and methylene chloride in three samples (11 to 67 µg/kg). Because both of these compounds are common laboratory contaminants and were reported in low, sporadic levels, they are considered to be the result of laboratory contamination and not an indication of soil contamination. Low levels of copper, lead, and nickel were reported in all samples along with sporadic occurrences of cadmium, beryllium, arsenic, mercury, chromium, and zinc (Table 5.43). However, the only concentrations above the KCP background range were copper in two samples (36.9 and 53.7 mg/kg), cadmium in one sample (2.8 mg/kg), and arsenic in one sample (41.4 mg/kg) (Fleischhauer 1988). These low levels demonstrate that no significant soil contamination is present surrounding the South Lagoon.

The RFI concluded and proposed that if contamination is detected above applicable standards at KC86-51, KC89-98, KC90-139, KC90-140, or KC90-141 for three consecutive quarters during the next two year monitoring period, either a CMS or an ACL for the compound exceeding the standard would be pursued.

5.14 Former Landfill (SWMU 44)

5.14.1 Previous Investigations

Numerous investigations have been conducted in the landfill area, the results of which are summarized in the following reports:

• Phase I Installation Assessment Report - Kansas City (DOE, 1986)

• Phase II Installation Generic Monitoring Plan (IGMP) - Kansas City, (DOE , 1987a)

• Phase 2a: Site-Specific Monitoring Plan for the IRS Landfill and Southeast Parking Lot Area (DOE, 1987b)

• Remedial Investigation (RI) Report, Kansas City Plant IRS Landfill and Southeast Parking Lot, June 1988, Albuquerque Operations Office, Environment and Health Division, Environmental Restorations Programs Group. United States Department of Energy (DOE, 1988).

• Remedial Investigation (RI) Report for the Bannister Federal Complex Landfill at Kansas City, Missouri, July 1997. Burns & McDonnell Engineering Company (BMcD, 1997

5.14.2 Pertinent Field Investigations

The history of the Former Landfill was discussed previously in Section 4.3.2.2 including a discussion of early investigations. The landfill was first included in the BFC permit in 2012 and is currently being addressed by the United States Army Corp of Engineers (USACE) who plan a significant investigation in 2013 (outside the purview of the Permit) under a separate remediation authority pursuant to the Formerly Utilized Defense Sites Program (FUDS). This section describes two significant historical investigations conducted after the Consent Order in 1989 that provide additional insight into investigatory activities that occurred at the landfill in the southeast part of the BFC.

5.14.3 1997 Remedial Investigation

Burns & McDonnell (BMcD) published a Remedial Investigation (RI) Report of the Old Landfill in 1997 from fieldwork conducted in October and November 1995. The

field investigation activities consisted of subsurface soil sampling, installation of five monitoring wells, and groundwater sampling of the five new monitoring wells (two located within the known landfill boundary (one upper completion and one lower completion well)) with three additional wells installed downgradient of the landfill as lower completion wells.

Available monitoring wells upgradient (north and west) of the landfill were utilized as background sampling points during the RI. The background sampling points were selected based on their proximity to the landfill Site. Subsurface soil samples, collected from soil borings within and downgradient from the landfill, were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, and cyanide. Subsurface soil samples were collected from a suspected drum and leachate burial location, located downgradient of the landfill, to determine whether this area was a separate source of VOCs in groundwater at the Site. Groundwater samples, collected from the five new and 10 existing monitoring wells, were analyzed for VOCs, SVOCs, metals, cyanide, nitrate and chloride.

The RI data indicated that VOCs, SVOCs, and metals were the primary contaminants present in soil at the Old Landfill. Based on chemical data obtained during the RI, the landfill was believed to be the source of VOC contamination detected in groundwater. VOCs were not detected in samples from upgradient monitoring wells. The highest VOC contamination was detected in the shallow monitoring well, KC95-03U installed within the landfill. VOCs were also detected in groundwater samples from downgradient monitoring wells, but the VOC concentrations in groundwater decreased with distance from the landfill.

The report concluded that the landfill surface cover would effectively minimize releases from the landfill to the air and surface water pathway if properly maintained. The groundwater pathway was the primary migration pathway of concern identified at the Site. However, a risk assessment performed as a part of the RI considered the potential for vapor migration from soil and groundwater to the ground surface and groundwater

releases to surface water in evaluating potential risks at the landfill. In the absence of remediation of the Site, the cancer and noncancer risks of exposure to a child trespasser or a parking lot attendant were stated to be within or below the range of USEPA accepted risk guidelines. Although some of the chemicals of potential concern (COPCs) were known human carcinogens, the risk assessment indicated that cancer and noncancer risks were within or below the range of EPA accepted risk guidelines.

A total of eight soil borings were drilled during this investigation. Four of the soil borings were extended to the top of bedrock, and completed as Monitoring Wells KC95-01, KC95-02, KC95-03L, and KC95-04 in the basal gravel aquifer (Figure 5.119). One shallow monitoring well (KC95-03U) was installed in the upper water-bearing unit at approximately 25 to 30 feet bgs. Three soil borings (SB-01, SB-02, and SB-03A) were drilled on the perimeter of the suspected drum burial area. Boring Location SB-03A-was drilled to replace the discarded samples collected from Boring Location SB-03.

Monitoring wells KC95-03U and KC95-03L penetrated the landfill. On October 18, 1995, gas, presumably methane, was encountered at 20 feet bgs in monitoring Wwll KC95-03L. Drilling operations ceased while gas in the borehole was allowed to vent. A combustible gas indicator (CGI) was used to continuously monitor the gas in the borehole and breathing zone during drilling operations and twice daily thereafter until the gas dispersed. Gas levels in the borehole remained above the lower explosive limit (LEL) until October 24, 1995, six days after drilling operations ceased due to the initial gas detection. Drilling operations resumed on the sixth day and no further gas pockets were encountered in monitoring well KC95-03L. During drilling operations at monitoring well KC95-03U GCI readings peaked at 2 percent of the lower explosive limit (LEL) at 20 feet bgs.

Nature and extent of contamination

Monitoring Wells KC95-03L and KC95-03U were drilled and installed within the perimeter of the former landfill (see Figure 5.119). Analytical soil samples were

collected in monitoring well KC95-03L only. Eight soil samples were analyzed for VOCs, SVOCs, CLP metals, and cyanide. Due to the location of monitoring well KC95-03L soils were expected to have greater concentrations of metals, SVOCs, and VOCs than soils at sampling points located outside of the former landfill. Soil Borings SB-01, SB-02, and SB-03A were drilled and sampled in a suspected drum and leachate burial area, located downgradient and south of the old landfill (see Figure 5.119). Although borings located in the drum and leachate burial area may be downgradient of the former landfill boundaries, sampling was performed in this area to evaluate whether it was a separate source of VOC contamination and to assess whether sludge disposal or drum leakage in this area had contaminated soil or groundwater at the Site (BMcD, 1995). Sixteen soil samples from this area were analyzed for VOCs, SVOCs, TCLP metals, and cyanide. The highest concentrations of contaminants were detected in soil samples from soil borings SB-01 and SB-02 within the upper 10 feet of overburden. Drums and black leachate reportedly buried in this area were not encountered during drilling operations.

RI soil borings located downgradient from the landfill were identified as Monitoring Wells KC95-01 , KC95-02, and KC95-04. These monitoring points were drilled and sampled at locations near the Blue River (Figure 5.119). Two subsurface soil samples were collected at each downgradient subsurface sampling location. However, one additional subsurface sample was collected from downgradient boring locations KC95-02 and KC95-04 due to the detection of elevated volatile vapor concentrations in shallow soil samples from these locations. Eight soil samples from the three downgradient soil borings were analyzed for VOCs, SVOCs, metals, and cyanide. Though monitoring well KC95-04 was believed to be outside of the landfill boundaries based on available historical information. Fill material (construction debris) was present to a depth of 20 feet in this boring.

5.14.3.1 Soil results

Volatile Organic Compounds

The VOCs detected in RI soil samples included acetone, vinyl chloride, trichloroethene (TCE), 1, 2-dichloroethene (1,2-DCE), benzene, 2-butanone, 1,1,2-trichloro- 1,2,2-trifluoroethane, and methylene chloride. As expected, based on previous studies, vinyl chloride, 1, 2-DCE, and TCE were detected in soils collected in the landfill area. However, 1, 2-DCE and TCE were also found in soils from a sampling point located outside of the presumed landfill area. Methylene chloride, 2-butanone, 1,1,2-trichloro-1,2,2- trifluoroethane, and benzene were detected in a minor number of the RI soil samples. The most prevalent VOC detected in RI soil samples, regardless of the soil sampling location, was acetone.

A total of 31 analytical soil samples were collected from the eight soil borings completed during the RI. Twenty-four of these analytical soil samples were collected at 5-foot intervals in soil borings SB-01, SB-02, SB-03A and well KC95-03L. Also, seven analytical soil samples were collected from soil borings located downgradient of the landfill area (monitoring wells KC95-01, KC95-02, and KC95-04) to determine the nature and extent of contamination downgradient of the landfill (Figure 5.119 and Table 5.44).

Volatile Organic Compounds

Acetone, TCE, 1, 2-DCE, and vinyl chloride were detected in soil samples from monitoring well KC95-03L which was installed within the landfill. These samples contained the highest concentrations of acetone (57 to 19,000 µg/kg) (Figures 5.120 – 5.122) and the highest PID readings recorded during the RI were obtained while screening samples from this soil boring. The highest acetone concentrations were detected in soil collected between 13 and 20 feet bgs, within the landfill material. In addition, trace concentrations of vinyl chloride and 1, 2-DCE were detected in soil from this interval. Vinyl chloride contamination in soil was not detected in soil samples from other RI soil borings. 1, 2-DCE was detected at slightly higher concentrations (110 to 160 µg/kg) in deeper soils (28 to 33 feet bgs). TCE was also

present (26 µg/kg) in the sample collected between 31 and 33 feet bgs within the landfill. 1, 2-DCE and TCE were also detected in soil samples from the downgradient soil boring at monitoring well KC95-04 at a depth of 38 to 40 feet bgs.

VOC concentrations in soil samples from the suspected drum and leachate burial location were generally low. The chemicals detected in soil samples from this area, benzene and 1,1,2-trichloro 1-,2,2- trifluoroethane, appear to be isolated to this area. Field observations, VOC data, and site hydrogeologic information suggest that the suspected drum burial area is not a source for groundwater VOC contamination at the site. The nearby landfill is the likely source of groundwater VOCs in the landfill area. Two contrasting trends in acetone concentrations were observed in soil borings in the suspected drum and leachate burial location. In soil borings SB-01 and SB-02 acetone concentrations were highest within fill material (3 to 10 feet bgs), with lesser concentrations detected in the alluvium beneath the fill. In contrast, acetone concentrations at soil boring SB-03A increased with depth, with the highest concentration detected between 23 and 25 feet bgs.

Acetone, 1, 2-DCE, TCE, and methylene chloride were detected in soil samples from downgradient soil boring locations. The trend of acetone concentrations in downgradient soil borings is consistent with that found in most soil samples collected at the site. In general, the greatest acetone concentrations were detected in soil samples from shallow depths (3-10 feet bgs) with concentrations tapering off at greater depths. Acetone was the only VOC detected in soil samples from monitoring wells KC95-01 and KC95-02. The source of the acetone detected in area soil has not been determined. Acetone is a metabolic product released by plants and animals (Howard, 1990). As a result of its widespread occurrence in the landfill, the report surmised that acetone may represent a degradation product of materials within the landfill.

Semi-volatile Organic Compounds

The SVOCs detected in subsurface soil samples from previous investigations consisted primarily of elevated concentrations of PAHs. PAH compounds may have been

produced at the landfill as byproducts of the incomplete combustion of organic materials or may also be constituents of materials disposed of in the landfill such as asphalt, construction, or demolition debris. The presence of PAHs in the landfill would be expected especially since open burning reportedly occurred at the landfill. The SVOCs detected in RI subsurface soil samples included PAHs, phenols, phthalate compounds, and carbazole.

Soil samples collected from each RI soil boring contained generally low concentrations of PAHs, primarily within the fill material that blankets the Site. The greatest concentrations and variety of PAHs were detected in soil samples from the suspected drum and leachate burial area.

Metals and Cyanide

Metals are common constituents of soil and have been detected in all soil samples obtained from the BFC. Soil samples from previous investigations within the landfill boundary reportedly contained high concentrations of copper, nickel, zinc, lead, cadmium, and chromium (BMcD, 1995). In general, low concentrations of these and other metals were detected in RI soil samples. Cyanide was not detected in any RI soil samples. Concentrations of metals detected in RI soil samples were evaluated through comparison with background metal concentrations in soils at the Site (Fleischauer, 1988) and soils in Jackson County, Missouri (Tidball, 1984) (Table 5.45). Most soil samples contained metal concentrations that are below or within the range of expected background or natural concentrations.

5.14.3.2 Groundwater Results

Volatile Organic Compounds

Past site sampling data indicated the presence of TCE, 1, 2-DCE, chlorobenzene, and vinyl chloride in groundwater at the site.

Lower Completion Wells

The highest VOCs were detected in groundwater from lower completion wells (monitoring wells KC84-17 and KC84-16). Monitoring well KC84-17 penetrated the landfill but was abandoned during levee improvement activities and monitoring well KC84-16 is a downgradient well. During the 1995 RI, the maximum 1, 2-DCE, chlorobenzene, and vinyl chloride levels for the lower alluvial aquifer were detected in groundwater from monitoring well KC-84-16. TCE was detected by the 1995 study only in groundwater from lower completion well KC95-01. A shallow monitoring well (KC95-03U) was installed in the landfill area during the 1997 RI and data for groundwater from this monitoring well indicated higher maximum concentrations of TCE, 1, 2-DCE, and vinyl chloride in the shallow groundwater.

5.14.3.3 Summary

The RI data indicated that VOCs, SVOCs, and metals were the primary contaminants present in soil and groundwater at the site. The VOCs of concern, detected in soil and groundwater samples, included TCE, 1, 2-DCE, and vinyl chloride. Additionally, acetone was detected in a majority of the site soil samples.

The highest concentrations of VOCs were detected in soil and groundwater samples from the monitoring wells within the landfill. VOCs were detected in soil and groundwater from downgradient locations but the concentrations decreased notably with increased distance from the landfill. VOCs were not detected in groundwater samples from upgradient monitoring wells.

PAH compounds were the only SVOCs identified as analytes of concern in subsurface soil and groundwater samples at the Site. PAH compounds were detected in subsurface soil samples from the landfill and downgradient locations, and in groundwater from one downgradient monitoring well.

Although PAH compounds may come from urban sources, they are also expected to be present in the landfill due to alleged past open burning activities. The RI data indicate that the landfill and urban sources have contributed PAH compounds to soil and groundwater at the Site.

During the RI, metal concentrations detected in soil samples were compared to typical background concentrations of metals in Missouri soils, and to background metal concentrations for soils at the Site. In comparison to background concentrations for area soils, potentially elevated concentrations of cadmium, cobalt, copper, iron, manganese, and nickel were present in some soil samples. These soil samples were collected in the landfill and outside of the suspected landfill boundaries in an area with abundant fill material. With these exceptions, the metal concentrations in Site soils were generally within or below the range of background metal concentrations. Previous studies report similar elevated concentrations of metals in Site soils, but these soils passed the EP toxicity test.

5.14.4 2007 Additional Investigation Report

In order to provide additional information regarding the landfill an investigation of groundwater flow was conducted which also included the installation of three new monitoring wells. In addition a passive soil vapor screening program was conducted in late 2006.

Specifically work consisted of the flowing activities:
Ten piezometers were installed to provide comparison of groundwater levels between the Blue River and KC95-02, between the city water line nearest well KC95-02 and in areas up-gradient of the water line.

Gore-Sorber™ soil vapor modules were installed in August 2006 and allowed to remain installed for approximately three weeks. The modules were placed on a grid on approximately 100 ft. centers in the area of the former landfill and down gradient locations whenever site conditions allowed (Figure 5.123).

Tetrachloroethene, TCE, cis & trans-1, 2-DCE and vinyl chloride were detected at or above the method detection limits. (Figures 5.124 – 5.127) illustrate the distribution and concentration of the reported VOCs. Field data indicated differing thicknesses and

hardness of fill material during installation of the Gore-Sorber ™ modules and the VOC concentrations as depicted on the figures were believed to be an indication of variations in the fill material rather than a specific source within the former landfill area.

Three lower completion monitoring wells (KC06-01, KC06-02, and KC06-03) were installed during the 2006 investigation. Fill material was encountered in all three borings and consisted of brown, medium to fine sand and silt with some black to grey clay . Some wood fragments were encountered in the fill material at KC06-03. There were three attempts to drill KC06-02 before the final location was chosen. The initial boring locations were abandoned because there was poor recovery of soil within the top 10 feet of each abandoned boring.

The subsurface material that was recovered during boring was consistent with previously identified deposits (BMcD, 1997). Wet, saturated materials, as observed in the recovered soil, were encountered at depths ranging from approximately 16 feet (KC06-02 and KC06-03) to 25-30 feet (KC06-01).

Water levels collected from wells and piezometers during this study noted a groundwater mound in an area that was surmised to be related to leakage from a 30-inch city water line, which runs adjacent to monitoring well KC95-02 as shown in (Figure 5.128). This mound and its purported cause was confirmed in 2013 when the water line in question ruptured in the area of groundwater mounding.

Comparison of the passive soil vapor results from the Gore sorbers and the groundwater potentiometric surface suggested a potential VOC plume traveling around the identified groundwater mounding area. Based on this information, monitoring wells installed prior to this investigation were reportedly not correctly placed to intercept all potential migrating VOCs; therefore monitoring wells KC06-01 and KC06-02 were installed to further delineate potential VOC plumes.

Additional fieldwork is to be performed by the USACE at the Old Landfill in 2013.

5.15 TCE Still Area (SWMUs 2, 4, 33, 40, 16, 3, 37 and 41)

The TCE Still Area included nine sites: the former TCE Still, Oil House, Classified Waste Burial Trenches, Department 95 (D/95), former Sales Building, former Aluminum Chip Handling Facility, Waste Transfer Spill Area, Buried Drum Site, and the Abandoned Sump. Of the nine sites investigated, only the Oil House and D/95 were in operation at the time of the RFI. The remaining seven sites ceased operation between the early 1950s and the mid-1970s.

5.15.1 Regulatory Submittals/Approvals

RFI Work Plan

- Submitted to EPA / MDNR
- Approved by EPA / MDNR July 16, 1991(Letter from M. J. Sanderson, EPA, to G. P. Keary, DOE)

RFI Report

- Submitted to EPA / MDNR September 30, 1994 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved by EPA / MDNR October 24, 1994(Letter from K. S. Ritchey, EPA to G. P. Keary, DOE)

Interim Measures

TCE Still Area Interim Measeures Work Plan

- Submitted
- Approved by EPA / MDNR September 17, 1997 (Letter from K. S. Ritchey, EPA to G. P. Keary, DOE)

TCE Still Area Interim Measures Report

- Submitted to EPA / MDNR December 17, 1998 1993 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved

Abandoned Sump IM Work Plan

- Submitted to EPA / MDNR July 1997
- Approved by EPA / MDNR September 17, 1997 (Letter from K. S. Ritchey, EPA to G. P. Keary, DOE)

Abandoned Sump Removal Interim Measures Report

- Submitted to EPA / MDNR August 3, 1998 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved by EPA / MDNR September 10, 1998 (Letter from K. S. Ritchey, EPA to G. P. Keary, DOE)

CMS/CMI (Addressed under the Multi-Site CMS / CMI)
CMS

- Submitted to EPA / MDNR November 29, 1995 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Statement of Basis, U.S. Department of Energy Kansas City Plant, Multiple Sites, Kansas City, Missouri, U.S. Environmental Protection Agency, Region VII Office, March 25, 1998.
- Approved by EPA / MDNR July 15, 1998

CMI Work Plan

- Submitted to MDNR / EPA October 28, 2000 (Letter from G. P. Keary, DOE to A. H. Groner, MDNR)
- Approved by MDNR November 6, 2000 (Letter from A. H. Groner, MDNR to G. P. Keary, DOE)

5.15.2 Description of Units

5.15.2.1 TCE Still

The former Still location, sometimes referred to as the Old Railroad Dock, was located on the east end of the MMB (DOE 1989 and 1990) (Figure 5.129). During the mid to late 1940's a railroad spur to this location was used to transport materials in and out of the plant. From 1950 to 1952, the north end of the dock was used for a solvent recovery still used to reclaim spent solvents primarily TCE. Employee interviews described past solvent spills onto the dock and the soil (Korte, Fleischhauer, and Kearl 1986).

Previous investigations

Prior to the RFI, four separate investigations examined the distribution of VOCs in soils near the former TCE Still (DOE 1990). In 1984, 11 borings were drilled in the vicinity of the former Still (labeled 1 through 11 on Figure 5.130) and were drilled to 14 ft.. VOCs were found at all depths with concentrations ranging up to 11.4 mg/kg (Table 5.46 **).**

In 1985 two borings, approximately 40 ft. deep, were drilled to bedrock (labeled TC85-01 and TC85-02 on (Figure 5.130). VOC's were found at all depths, ranging up to 290 mg/kg (Table 5.47). Also, in 1985, 5 shallow borings were performed to clear areas for construction (labeled CS85 on Figure 5.130). These sample locations are north and east of the former TCE Still. Two of the samples were analyzed for trace metals and the

results were within background. Organic analysis results showed sporadic occurrences of a few solvents - - particularly TCE (Table 5.48). None of the results exceeded 0.2 mg/kg. Indeed, most of the results were near the method detection limit.

In 1987, 8 soil borings (labeled SB1 through SB8 in (Figure 5.131) and 8 dual completion monitoring wells (KC87-69 through KC87-76, (Figure 5.132) were installed in and around the former TCE Still. With the exception of SB-1, soil samples collected from the borings demonstrated traces of contamination throughout (Tables 5.49 and 5.51). TCE concentrations from 270-2500 µg/kg and 1, 2-DCE concentrations from 82-810 µg/kg were detected in soil sample SB-1 (Table 5.49). Additionally, 19 shallow soil samples were collected at 12 locations near the former still (labeled SS#1 to SS#15). TCE or 1, 2- DCE (up to 0.08 mg/kg) was detected in 3 of the 19 soil samples (Table 5.50).

Ten additional soil borings were drilled early in 1988 (BH01 to BH10) (Figure 5.131). TCE and 1, 2-DCE were found in concentrations above the detection limits (0.5 mg/kg) in 7 out of 10 boreholes drilled at the site. 1, 2-DCE was detected in 28% of the samples ranging from 0.5 to 7 mg/kg. TCE was detected in 20% of the samples and ranged from 0.5 to 945 mg/kg. All results greater than 3 mg/kg, however, were from borehole 7 which was located on the northern end of the dock: Within borehole 7, the highest concentration of TCE was at 34 ft.
(Table 5.52).

5.15.2.2 Oil House

The Oil House (Figure 5.129**)** was primarily used to store oil in drums and cans (DOE 1990). It is currently used as a 90 day hazardous waste storage area. Occasionally, solvents have been stored at the Oil House. In the early days of its use, trenches in the floor were used to capture and contain spills. Trench overflows were directed to a gravel-filled hole on the north side of the building. Based on employee interviews, the overflow trenches were used intermittently. The trenches have been plugged for at least 30 years, and current operations are not considered a source of contamination.

Soil

During 1989, two boreholes (Figure 5.133) were drilled and 19 soil samples were collected. TCE was detected in the soil samples in concentrations ranging from 0.009 to 230 mg/kg (Table 5.53).

The highest TCE concentrations measured in the soil was found at 14 to 16 ft. Several other VOCs were detected in the soil samples: carbon tetrachloride, ethyl benzene, tetrachloroethene, toluene, and 1,1,1-trichloroethane. Other VOC concentrations in soils ranged from the detection limit to 9.9 mg/kg.

Petroleum hydrocarbons (TPH) were also detected ranging from 170 to 4900 mg/kg. The highest concentration of TPH occurred in those soil samples collected at 11 to 13 ft. below ground surface.

5.15.2.3 Department 95

D/95 was located inside the MMB as shown in Figure 5.129**.** Several entities historically occupied the D/95 area. These included Pratt & Whitney Corporation from 1943 to 1945, Hessee Carriage Company from 1948 to 1949, Westinghouse Corporation from 1949 to 1961, and the Bendix Corporation and its successors in interest Allied Corporation, Allied Signal and Honeywell FM&T from 1961 to the present.

When DOE and its predecessor's organizations acquired the portion of the plant vacated by Westinghouse, they moved the maintenance shop into the present D/95 area. Maintenance used many types and sizes of saws, lathes, and other milling machines, all of which had coolant tanks attached. Many solvent wash stations were located around the shop. After about 6 months, the DOE moved maintenance out and a machining and fabricating department in to the area. This machining and fabricating department was named Department 95 (D/95). The supervisor of D/95 from 1961 to 1976 stated that there were several degreasing tanks and parts cleaning stations in the department. The

floor was covered with wood blocks during this period. The employee recalled a particular set of machines in the area which occasionally leaked large quantities of hydraulic fluid onto the floor. These spills were large enough that the wooden floor blocks had to be taken up and the fluid pumped out. The incidents occurred in the late 1960s.

The transportation department brought coolants and solvents to D/95 in 55 gallon drums. The coolants and solvents were then pumped into holding tanks in the machinery. The waste management department pumped waste product from the equipment into small tanks on special trucks. No pipes or other distribution systems were used.

In 1989 12 soil borings were augured within the D/95 Area (Figure 5.134) (DOE 1989). Because of subsurface obstructions, soil boring 10 could not be drilled. borings were sampled at depths of 3, 6, and 9 ft. below the concrete floor. Analytical results for this soil sampling program are presented in Table 5.54. Note that acetone and tetrachloroethene were detected in some of the soil samples collected at D/95. Both compounds are believed to be laboratory contaminants; however, in the absence of duplicate samples the possibility that these compounds are present cannot be ruled out.

5.15.2.4 Sales Building

The former Sales Building (Figure 5.129) was long and narrow, about 100 ft north and parallel to the main manufacturing building and was located on what is currently DOE property. It was probably constructed between 1943 and 1945 by Pratt & Whitney, but no information is available. The building was installed as a bus or trolley stop and was not enclosed. Later the building was enclosed but detailed construction information is unavailable. The area around the building may have been covered by gravel but was not paved (DOE 1987).

The building was owned by GSA and was used to store surplus materials for public auction. Documentation on the storage and disposal of surplus materials was also not

available. The DOE took control of the building from 1962 to 1972 but they did not take possession (Allied Signal, Inc. 1987). In 1972 the building became inactive; however, it was occasionally used to store United States Marine Corp (USMC) boats and other items (DOE 1988). The building was removed in 1981.

In 1987 3 soil borings were drilled at the location of the former Sales Building (Figure 5.135) (DOE 1989). Three soil samples were collected from each boring at approximately 1, 5, and 10 ft. below ground surface. TCE was detected in the soil samples at concentrations up to 14 µg/kg.

5.15.2.5 Aluminum Chip Handling Facility

The Aluminum Chip Handling Facility was built by Pratt & Whitney to store and recycle chips from the manufacturing process (DOE 1989). The Aluminum Chip Handling Facility was apparently constructed sometime in 1944. Design drawings were dated November 20, 1943, with a last revision date of June 1, 1944. The building was located between the MMB and the former Sales Building on property (Figure 5.129).

The Aluminum Chip Handling Facility was about four stories high and contained 13 bins for aluminum chip storage. On the top floor was a conveyor system which allowed the attendant to select which bin the incoming aluminum chips would enter. One former Pratt & Whitney employee thought that the aluminum chips entering the building were wet. It is not known what liquid, if any, was associated with the aluminum chips. At the bottom was another conveyor system allowing the operator to remove aluminum chips from specified bins. On the north side of the building were four spouts about 12 ft. above the ground, designed to discharge from the four north bins directly into a truck below. A hoist on the east end of the building allowed chips to be raised to the top from below.

At the top east end of the building was a blower pipe entry which may have housed a pneumatic conveyor belt that could have been used to transfer aluminum chips into the

building. Construction diagrams show an acid tank located in the foundation near the center of the building.

The construction diagrams do not indicate what the acid tank was constructed of; however, other holding tanks shown in the construction diagram were made of concrete and lined with ironite. No information could be found on the chemical composition of ironite. None of the individuals interviewed knew what the acid tank was used for, or if it was ever used.

No solvent holding tanks, cleaning stations, or fluid separators are shown on the construction diagrams. According to interviews, the Aluminum Chip Handling Facility was last used, as designed, in 1949 when Pratt & Whitney operated the plant. Westinghouse and DOE periodically used the building to store equipment The building was removed in 1974 and the area was paved.

In 1987, three soil borings were drilled near the former Aluminum Chip Handling Facility (DOE 1989). Three soil samples were collected from each boring at approximately 1, 5, and 10 ft. below ground surface. TCE and 1, 2-DCE were detected in the soil samples up to 12 and 22 µg/kg, respectively.

5.15.2.6 Waste Transfer Spill Area

The former Waste Transfer Spill Area was reportedly located south of Building 89 (Figure 5.129)**.** Little is known about past operating practices at the site. An employee stated that liquid wastes were brought to the site from other areas at the KCP in metal containers and transferred to two 500 to 750 gallon holding tanks (Korte and Kearl 1984). The liquid wastes transferred at this site were thought to be coolants, solvents, oil, paint, and kitchen grease. During transfer operations unknown quantities of liquids were reported to have spilled on the ground surface. The site was in operation sometime between 1955 and 1970 for an unknown duration.

5.15.2.7 Buried Drum Site

Employees interviewed reported that, in the early 1950s, approximately 20 drums were buried at a location south of the Classified Waste Burial Trenches (Figure 5.129). The drums were thought to contain water and black metal shavings from a previous manufacturing operation. Interviewed KCP personnel thought the metal shavings could be graphite, or possibly uranium. The hole the drums were buried in was reported to be approximately 10 ft. deep with a concrete slab at the bottom. The drums were stacked two high in the hole and the hole was filled by pouring sand around the drums. A concrete pad may have been poured on top of the sand.

5.15.2.8 Abandoned Sump

An abandoned sump is located between Buildings 89 and 96, just southeast of the large tank located adjacent to Building 89 (Laughlin,1990) (Figure 5.129). The sump is covered with a large concrete slab. Previous construction activities broached a portion of the sump. Those involved with the construction activities reported that the sump was filled with construction rubble and oily water. The sump did not appear to have an access point that could be used for sample collection. Interviewed KCP personnel did not know the age or previous use of the sump.

5.15.2.9 Classified waste burial trenches

The Classified Waste Burial Trenches were located in the area of the D/182 Barrel Lot, south and adjacent to Building 74 (Figure 5.129). As discussed in Section 4, little historical information on the nature of the burials is available because the project was classified and because the burials occurred in the early 1950s. In the fall of 1984, the material in the trenches was excavated and placed in barrels (Rockwell International 1985). The barrels were disposed of as hazardous waste because of lead concentrations above the maximum EP toxicity limits.

During 1985 four soil borings were drilled in the vicinity of the Classified Waste Burial Trenches (Figure 5.136) as part of remedial activities (Rockwell International 1985). Four soil samples were collected from each boring at 4.5, 9.5, 14.5, and 19.5 ft. below

ground surface. Traces of 1,1,2,2-tetrachloroethane, tetrachloroethene, benzene, and toluene were reported in these samples (Table 5.55). Samples from these borings were also analyzed for inorganic analytes (Table 5.56).

5.15.3 TCE Still Area RFI

Ninety-one soil samples were collected from 29 soil borings and 19 monitoring well borings as part of the field investigation of the TCE Still Area.

The TCE Still Area RFI field work was conducted in four phases. Phase I fieldwork was conducted in July and August of 1991. Phase II and III fieldwork was conducted in March and June of 1992. Phase IV fieldwork was conducted in March of 1993. Twenty-nine soil borings and nineteen dual completion monitoring wells were installed during the four phases of field work. Borings were completed with a drill rig using hollow-stem auguring techniques.

Elevated VOC soil contamination above the water table was found at the former TCE Still, Classified Waste Burial Trenches, and the Abandoned Sump/Waste Transfer Spill Area. VOC soil contamination below the water table is present at the former TCE Still, Classified Waste Burial Trenches, Abandoned Sump/Waste Transfer Spill Area, and D/20 Sump.

PCBs In Soil

PCB soil contamination above the water table exceeding the RFI prescribed action levels was present at the Abandoned Sump/Waste Transfer Spill Area (BH91-11 and BH92-07). PCB soil contamination below the water table exceeding the action levels is present at the former TCE Still, the Oil House, and the Aluminum Chip Handling Facility and Sales Building. None of the PCBs detected in the soil are at concentrations that exceed the 10 mg/kg guideline historically employed by the KCP. In addition to PCB soil contamination at the Abandoned Sump/Waste Transfer Spill Area, PCBs were present in the Abandoned Sump itself.

Petroleum Hydrocarbons in Soil

Soil samples collected above the water table at the Abandoned Sump during this investigation contained PHC contamination between 12 and 680 mg/kg. Soil samples collected above the water table at the Oil House contained PHC contamination up to 4900 mg/kg. Additionally, one soil sample collected at the Oil House during the RFI contained PHCs above 10 mg/kg below the water table. PHC soil contamination above 10 mg/kg was also found at the Abandoned Sump/Waste Transfer Spill Area below the water table.

Metals in Soil

Table 5.57 lists soil samples in which metal concentrations exceeded threshold values. Because of the sporadic nature of the occurrences, the soil samples that exceeded the threshold values are not believed to represent soil contamination. Additionally, there was no evidence of a metal contamination in groundwater and ample evidence that metals do not migrate at the KCP (DOE 1993d).

5.15.4 Summary and Recommendations

Soil

The soil sampling conducted during the TCE Still Area RFI identified VOC soil contamination above the water table at the Oil House, the former TCE Still, the Classified Waste Burial Trenches, D/20, and the Abandoned Sump/Waste Transfer Spill Area. PCB soil contamination above the water table was noted at the Abandoned Sump/Waste Transfer Spill Area. PHC contamination was found in soil above the water table at the Abandoned Sump/Waste Transfer Spill Area at concentrations up to 680 mg/kg and at the Oil House at concentrations up to 4900 mg/kg. This contamination exceeds both the Missouri underground storage tank closure guideline of 10 mg/kg and the KCP clean-up guideline of 100 mg/kg. The RFI recommended a CMS to address the VOC, PCB, and PHC soil located above the water table.

Soil contamination below the water table was identified at the Oil House, the former TCE Still, D/20, the Classified Waste Burial Trenches, the former Aluminum Chip Handling Facility and Sales Building. and the Abandoned Sump/Waste Transfer Spill Area. It is recommended that this contamination be addressed as part of the groundwater problem in the TCE Still Area.

Groundwater

Data collected as part of the TCE Still Area field investigation in conjunction with routine quarterly groundwater sampling indicated that groundwater contamination was present at the TCE Still Area sites although the contaminated groundwater was apparently contained by the groundwater pumping system and building footing tile drains. A CMS was recommended verify containment. In addition, routine sampling of the TCE Still Area wells were recommended to continue to further characterize groundwater quality. In lieu of providing dated groundwater information collected under the TCE Still Area RFI for such a large area of the BFC, the reader is referred to the 2012 Annual Groundwater Corrective Action for more information on groundwater (DOE 2012).

5.15.5 Additional Areas Addressed in RFI

This RFI also included an investigation of two other areas that were not identified as SWMUs but were considered areas of concern: the Department 71 area and the Department 20 (D/20 sump).

5.15.5.1 Department 71

Department 71 (D/71) is located within the MMB (Figure 5.66). KCP personnel are not certain of the historical uses of D/71. Within the last 45 years, the site has been used for storage, office space and as a parts crib. Two dual completion monitoring wells, KC89-125 and KC89-126, were installed in the immediate vicinity of D/71. Low levels of TCE and vinyl chloride have been detected in groundwater samples collected from well 125 and 126. Low level contamination in these wells suggests that a small quantity of

solvent was spilled in the vicinity of D/71. If the spill had been large, the mass of solvent would have been sufficient to break through the water-table surface and migrate to the base of the aquifer, and VOCs would be detected in the lower completion of KC89-125.

Given the proximity of well 125 to the building footing tile drains and its location relative to the groundwater plume, this contamination is captured in building footing tile drains.

5.15.5.2 D/20 Sump

The D/20 Sump was a 10-ft long by 10-ft wide by 4-ft deep concrete pit that housed a vapor degreaser unit (Figure 5.129). The vapor degreaser unit used TCE to clean parts manufactured in D/20 from the mid-1960s to mid-1980s and was known to have leaked during its use. This unit has been removed, and the sump has been filled with sand and capped with concrete.

During the TCE Still Area RFI. two dual completion monitoring wells, KC92-184 and KC92-185, were installed to characterize groundwater quality in the southeast corner of the Main Manufacturing Building in the vicinity of D/20 (Figure 5.137).

5.15.6 TCE Still Area Interim Measures

In 1997 an interim measure was performed at the former TCE Still Area to remove "shallow" soil VOC contamination above an elevation of 70'-0" (approx. 5 ft. below grade). This is the depth to which soil could be excavated while still maintaining the integrity of building column footings. Shallow VOC contamination extended horizontally in an area approximately 18 ft. wide by 85 ft. long. The contaminated soil would be excavated and replaced with backfill.

The former TCE Still Area, SWMU #2, was also referred to as the Old Railroad Dock. During the mid- to late-1940's, a railroad spur to this location was used to transport materials in and out of the plant. From 1950 to 1952, the north end of the dock was

used for a solvent recovery still to reclaim spent solvents, primarily TCE. Employee interviews described past solvent spills onto the dock and soil. Based on employee comments and the activities typical for the time period, consistent spills probably occurred on the dock and soil at this site.

The EPA/MDNR-approved, Final TCE Still Area Interim Measure Work Plan (IMWP), dated June 1997, required implementation of the following corrective action; "This remediation will provide for excavation of VOC (TCE, 1, 2 DCE) contaminated soil and debris over an area approximately 18 feet wide by 85 feet long to a maximum depth of five feet, elevation 70'0" (Figure 5.138). Excavation shall not extend beneath the minimum elevation of 70'0" in order to maintain the structural integrity of the primary building footings. Shallower secondary footings such as those supporting the overhead door columns (east wall) will be protected by maintaining a 45 degree slope away from the footing during excavation. All solid waste and contaminated debris will be shipped by a licensed hazardous waste transporter to an approved hazardous waste disposal facility, yet to be determined. Prior to excavating the contaminated soil an 8-inch thick concrete slab covering the area will be demolished and removed. A motor used to lower and raise a loading ramp will require removal and demolition of the associated concrete slab.

Underground utility piping in the area will require shoring during excavation and backfill activities. Clean backfill material from off-site will be brought in to replace the contaminated soil excavated. The clay will be placed in lifts and compacted. After clay backfill has been compacted in place it will be topped with a six-inch lift of compacted gravel base coarse."

5.15.6.1 Work Accomplished

The contractor mobilized and began remediation work on March 11, 1998. Equipment consisted of a uniloader, front-end loader, and a small track hoe with a front-end mounted blade. The gravel cover on top of the concrete was removed first. The contractor then saw cut the concrete slab to facilitate removal. Six roll-offs of non-

hazardous gravel and concrete were removed from the site. Once the gravel and concrete were removed excavation of the contaminated soil commenced. Excavation was taken to a maximum depth of 5 feet. Soil was excavated at 45 degrees from the bottom of secondary footings and grade beams (overhead door location). Two abandoned industrial waste lines were uncovered during excavation of the contaminated soil. The piping was removed to the limits of the excavation at which point the open ends of the pipes were grouted shut. Soil remediation operations continued to the excavation limits established in the Interim Measure Work Plan. Twelve (12) end-dump truck loads of hazardous waste, totaling 255 tons, were excavated from the site. Clean clay backfill was brought in from off site and was placed in compacted lifts to the pre-remediation surface elevations. Backfill operations were completed April 13, 1998. Site restoration was completed and the contractor demobilized equipment on April 14, 1998.

5.15.7 Abandoned Sump Interim Measures Resort

This Interim Measure addressed removal of contamination associated with Solid Waste Management Unit (SWMU) 37, Abandoned Sump. This Sump area was reported to be associated with liquid waste handling. Past employee interviews indicated that waste handling may have included coolants, solvents, oil, paint, kitchen grease, and construction rubble. Waste profile sampling identified residual levels of RCRA metals, chlorinated solvents, petroleum hydrocarbons, and PCBs. No construction or historical use records of the Abandoned Sump structure are available. The Consent Order also identified SWMU 3 as the Waste Transfer Spill Area. This area was reportedly to the immediate west of the Abandoned Sump. The TCE Still Area RFI concluded that no evidence of a release existed in the area to the west of the Abandoned Sump. SWMUs 3 and 37 were likely one in the same.

Deviations from workplan.

The dimensions of the excavation in South Area were different from the assumed dimensions in the workplan. (Figure 5.139) identifies the actual configuration of the South Area excavation and the abandoned walls and floor structure which were left in

place. During excavation of the South Removal Area, it was determined that a 6 inch firemain was located directly beneath the overhead pipe rack Tower 10 footing. Also it was determined that the fill material beneath Tower 10 (sand and rubble) was unstable and sheet piles would be needed to stabilize the Tower 10 footing and protect the firemain before any further excavation of the South Area. Sheet piles were installed and portland cement concrete was placed under the Tower 10 footing. This stabilized the Tower 10 footing, but rendered the soil beneath the footing inaccessible. The workplan had assumed that the footing for Tower 10 could be braced in place so that the soil beneath Tower 10 could be removed. The sheet pile system also limited the depth of the excavation in Zone B, as shown in Figure 5.139, to about 15 feet.

Groundwater monitoring well KC89-186 fell within the expanded boundaries of the South Area excavation. Layne Western Inc., abandoned this well, in accordance with Missouri rules, in August 1997 before contaminated excavation began. The PVC well casing was removed and the well cavity was filled with bentonite grout. A replacement well (KC97-209) was installed by Maxim Inc. in October 1997**.**

Excavation removed the concrete sump structure, the concrete slab, and soil beneath the slab to a depth of about four feet. A soil sample was collected from the floor of the excavation (about four feet below the ground surface) near the location of the surface concrete sump structure. Sampling data indicated that contamination still existed beyond the limits of the excavation. However, as stated in the Workplan, the limits of the excavation were confined due to adjacent utilities and structures, and available funding.

South Excavation Area: Abandoned Sump Area

Soil samples were collected from Zone A at depths of 2, 4, and 20 feet. Zone B was not sampled separately, since Zone A and Zone B are confined together within the walls of the sump structure. Zone C is outside the southern walls of the sump structure. A specific sample in Zone C was not collected. Table 5.58 summarizes the analytical data

for the south excavation area (the Abandoned Sump Area). Though trace contaminants were found within this structure, the bulk of the material appeared to be construction rubble. No evidence of hazardous waste handling or disposal was associated with this abandoned structure. The sampling results indicated that liquid waste handling was contained to the North Slab Removal Area. A photographic chronology of this excavation with narrative and pictures is provided at the end of this section.

Although the Tower 10 footing prevented removal of material in the northwest corner of the South Abandoned Sump structure, the samples collected near the bottom of Zone A indicated only trace contaminant migration from this area. The post excavation sample for the North Slab Removal Area indicates that soil contamination of the same order of magnitude as the Waste Profile Samples remained in soil beneath the excavation area. Though all contamination was not removed because of utility and structural obstructions, the soil removed successfully reduced the exposure hazard. The inaccessibility of contamination due to utilities and structures was identified in the Interim Measures Workplan. The Interim Measure construction successfully removed all accessible contaminated soil and debris.

In addition to the benefits of removing contaminated soil, the size and depth of the South Abandoned Sump structure was established as shown in Figure 5.139. This will help minimize excavation unknowns during future construction in this area. This Interim Measure construction positively established that this Abandoned Sump structure is not the Buried Drum Site. This adds further support to the conclusions stated in the TCE Still Area RFI Report.

5.16 Building 50 (SWMU 45)

Building 50 was referred to as an exotic fuel test lab, fuel components laboratory, low power components development laboratory, and engine testing facility during Westinghouse operations at the BFC. The building was constructed with concrete walls and blast-away ceilings and required large refrigeration units that were powered by a unit substation. No additional information was found regarding the use of the building. Engine testing would be expected to use relatively large volumes of petroleum products (consistent with the USTs adjacent to Building 50) and potentially solvents for degreasing. Building 50 is not shown on original site drawings. The first drawing that was identified for the building was the 1956 Sub-surface Piping Plan of Building 50. This drawing shows waste oil gutters in six areas inside the building, with waste oil collection pipes that discharged to a waste oil storage tank.

A 1961 photograph of the BFC shows two above-ground storage tanks on the northeast side of the building during a flood. No information was found regarding the contents of these tanks.

5.16.1 Other Structures in the Vicinity of Building 50

A 1961 General Development Map identifies several structures in the vicinity of Building 50, including the unit substation to the northeast, the tank farm with six (underground storage) tanks to the west, a pipe tunnel under Freedom Drive, and a pump station and cooling tower on the south side of Freedom Drive. The 1961 photograph shows the unit substation to the northeast and the pump house and cooling tower on the south side of Freedom Drive. The unit substation is present on subsequent aerial photographs through 1994.

No information was available regarding removal or closure of the USTs, but the MDNR Hazardous Waste Program, Tanks Section, issued No Further Action Letters for this site on February 17, 1994; February 24, 2000; and May 15, 2001; and confirmed that no further

sampling or corrective action was required in a letter dated June 3, 2002. The June 3, 2002, letter was issued in response to the site assessment report prepared by Kingston Environmental Services, incorporated, March 11,2002. It stated that "the residual soil contamination in the vicinity of BH4 and BH5 shall be left in-place to naturally remediated and no further sampling or corrective action is required at this time" (MDNR 2002).

5.16.2 2001 DOE Building 50 Investigation

Sampling of permitted stormwater outfalls (Outfall 003 and 004) which traverse the area of Building 50 (Figure 5.140) detected low level PCB and chlorinated solvents in 2000 and early 2001. The source of these compounds was unknown. The location and concentrations of contaminants noted within the two permitted storm sewers suggested a source in the area of Building 50. This led DOE to initially investigate the Building 50 area in 2001.

Eight geoprobe holes were completed in the area of the former Tanks as shown in Figure 5.140. Soil samples were collected at various depths and analyzed for petroleum hydrocarbons, chlorinated solvents and PCBs. Results are summarized in Figure 5.140 with a narrative description of soil collected provided in Table 5.59.

The report concluded that the former underground tank area immediately west of Building 50 was a source of petroleum contamination at levels greater than 100 mg/kg. The extent of contamination and its contribution to nearby groundwater was unknown.

A source of chlorinated solvent contamination throughout the soil profile consisting primarily of TCE, with lesser amounts of 1, 2- DCE and vinyl chloride was found immediately west of the Building 50 parking lot west of the former tank area. The source of this contamination was unknown. This solvent contamination was likely contributing to contamination noted in stormwater Outfalls 003 and possibly 004 as evidenced by sample of stormwater before and traverses the area (DOE 2011).

PCBs were not detected in any soil sample from this investigation. The source of PCBs found in stormwater in the area remains unknown but is still believed to exist in this area of the BFC Complex.

5.16.3 Kingston Building 50 investigation

Later, in 2002, Kingston Environmental completed nine (9) subsurface soil probes at the locations shown on Figure 5.141. The subsurface probes were identified as P1 through P9. The subsurface probes were completed to collect soil samples outside the building with a hand auger used to collect samples within the building interior. Soil samples were collected to a maximum depth of 35 feet below land surface (ft. bgs) or probe refusal, whichever occurred first. Kingston installed monitoring well (MW3) as part of this investigation. The boring was completed to 35 ft. bgs. Two monitoring wells were installed earlier by others. Table 5.60 provides a summary of the soil sample analytical results for the subsurface probe soil samples and the monitoring well installation soil samples.

Based on the information collected, Kingston developed the following conclusions: TCE impacted soil was present at all sample locations (for which TCE was analyzed) west of Building 50. The extent had not been defined. Figure 5.141 showed a summary of the soil sample results for this investigation (P1 through P9) and the previous investigation by DOE (BH1 through BH8). The highest concentrations of TCE impacted soil occurred in a zone from 15 to 25 ft. bgs.

The highest concentration of TCE impacted soil occurs along the east side (BH1 and BH2) of the storm sewer running from north to south along the west side of the study area.

5.16.4 Terracon Investigation October 2002

In 2002 Terracon installed thirteen (13) probes (P-1 to P-13) at Building 50 to sample soils. Groundwater was also sampled from probes P-1, P-2, P-3, and P-4. Each probe

was advanced to approximately 40 feet below grade surface (BGS), or probe refusal, whichever occurred first. Probe locations are depicted in (Figure 5.142).

5.16.4.1 Soil sampling

The soil sampling program consisted of submitting one (1) soil sample from probes P-1, P-3, and P-4, and two (2) soil samples from probes P-2, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12, and P-13 for laboratory analysis.

Elevated photoionization detector (PID) readings were detected only in soils examined from Probe P-9; therefore, soil samples from approximately 10 to 15 feet BGS, which had a PID reading of 4.8. and from approximately 15 to 20 feet BGS, which had a PID reading of 8.3, were selected for laboratory analysis.

TCE was detected above the laboratory reporting limit in the following soil samples: P-2 (0 to 5 ft.) 0.00510 mg/kg; P-5 (20 to 25 ft.) 0.0277 mg/kg; P-6 (5 to 10 ft.) 0.00740 mg/kg; P-6 (20 to 25 ft.) 0.0168 mg/kg; P-7 (15 to 20 ft.) 0.0261 mg/kg; P-9 (10 to 15 ft.) 0.440 mg/kg; and, P-10 (20 to 25 ft.) 0.00350 mg/kg (Table 5.61).

5.16.4.2 Groundwater Sampling

TCE was detected above the laboratory reporting limit in the following groundwater samples:P-2 (GW) 2.17 mg/l; and P-3 (GW) 0.00290 mg/L (Table 5.62).

Based on the results of this study additional investigation was recommended to determine the extent of the TCE impact to the soil and groundwater.

5.16.5 TCE investigation Report Building 50 SCS Engineers

During this 2004 investigation, eight probe locations were advanced for the collection of soil and groundwater samples. Because of the potential risk of exposure to children and workers in the buildings, air monitoring was conducted inside both buildings. The

report stated that on the basis of the analytical data from the air samples collected in Building 50 and 52, no TCE or DCE was detected in either building.

5.16.5.1 Work performed

The probes were pushed to depths between of 16.0 and 28.0 feet bgs using a pneumatic hammer and hollow, 2-inch diameter probe rods in lengths of five feet. Continuous soil cores were collected using a continuous-barrel sampler five feet in length. The eight probe locations (SP1 through SP8) were all advanced within ten feet of the outside walls of Buildings 50 and 52.

Two soil samples were collected at each probe location: one at 3 feet bgs and one immediately above the capillary fringe. Groundwater was encountered at all of the probe locations between depths of 14.5 and 26.0 feet bgs.

Table 5.63 summarizes the results of soil sample analyses.

Probe locations SP3, SP5, and SP6 reported TCE concentrations between 0.0083 to 0.059 mg/kg. These TCE detections occurred in soil samples collected between approximately 14 to 26 feet bgs. TCE concentrations were below analytical detection limits in the remaining soil samples and probe locations.

Table 5.64 summarizes the results of probe groundwater sample analyses.

The highest concentration of TCE was 19 mg/L detected in the groundwater sample from SP3, which was located on the northeast corner of Building 50 (Figure 5.143). Lower concentrations were detected in groundwater samples from locations east and south of this probe. 1, 2-DCE was detected in groundwater samples from three sample locations (SP3, SP4A, SP5, SP6 and SP7).

Hexachlorobutadiene was detected at three sample locations (SP1, SP5, and SP8) between 0.0023 to 0.0046 mg/L. Hexachlorobutadiene concentrations were below analytical detection limits in the remaining probe groundwater sample locations.

Ethylbenzene was detected at SP8, and xylene at probes SP4A and SP8. Other VOCs were not detected above analytical detection limits in any of the probe groundwater samples.

The report recommended no additional remedial action for groundwater in the vicinity of Building 50, but did recommended additional groundwater investigation be conducted in the vicinity SP3 to attempt to further delineate the potential source in that area.

5.17 GSA Preliminary Assessment Site Investigation (PASI)

SCS Engineers (SCS) was retained by GSA to complete a combined Preliminary Assessment (PA) and Site Inspection (SI) for the GSA managed portion of the BFC. The decision to perform the PA/SI was based on historical use of the property as an aircraft engine manufacturing facility and on the need to further characterize areas of contamination identified during previous investigations. The PA/SI included review of site historical data and reports, initial site assessment visits, compilation of pathway and target population information, preparation of a site inspection work plan, collection of SI environmental samples, and preparation of a report.

The text below, extracted from this report discusses pertinent areas on GSA property germane to the Permit and corrective action. A description and history of Building 50 was provided in Section 5.16 and though addressed in the PASI was not discussed here. However, additional investigations as a part of the PASI at Building 50 are discussed in this section. The text below briefly describes the pertinent area and type of data collected during the site investigation (SI) and the results found.

The following areas believed germane to corrective action at the BFC were included in the PASI.

- Building 1: Stains soil along the railroad tracks
- Building 1: Utility Tunnel
- Building 1: Oil Water Separators
- Building 4: Crawl Space
- Building 4: Former Vehicle Maintenance.
- Building 50: Documented PCB contamination in storm sewer
- Building 51: Former unit substation and associated abandoned high voltage line

5.17.1 Building 1: Stained Soil Along Former Railroad Tracks

Railroad tracks were previously present on the north and west sides of the MMB. Remnants of the tracks remain, and stained areas were observed during the SI along the abandoned railroad tracks on the west side of the building.

A surface soil sample and duplicate were collected from stained soil observed along the former railroad tracks on the west side of Building 1. Concentrations of analytes detected in these samples are summarized in Table 5.65.

5.17.2 Building 1: Utility Tunnel between Buildings 1 and 50

A sediment sample was collected in the utility tunnel between Building 1 and Building 50 and analyzed for PCBs and TPH. PCBs. Aroclor 1260 was detected at a concentration of 1.89 mg/kg. No other PCBs were detected. TPH-ORO and DRO were at 1,190 mg/kg and 211 mg/kg, respectively. It was recommended that the area be cleaned; however, because of the small size of the stained area, limited exposure, and lack of migration pathways, no further assessment, investigation, or remediation of this area was stated to be warranted.

5.17.3 Building 1: Oil/Water Separators

Although the oil/water separators shown on the 1942 drawings could not be located, shallow hydraulic probes were pushed adjacent to the locations of these structures as approximated from dimensions on the drawings. No evidence of contamination was observed during probing. Soil samples were collected from 7 feet bgs in probe SP-21 and 8 feet bgs in SP-22. Both soil samples were analyzed for PCBs and TPH-ORO/DRO. No PCBs were detected in either sample. Low levels of TPH-ORO/DRO were detected in both samples. TPH-ORO was detected at 67.1 mg/kg in SP-21 and 37.3 mg/kg in SP-22. TPH-DRO was detected at 88.9 mg/kg in SP-21 and 82.4 mg/kg in SP-22.

5.17.4 Building 4 : Former Vehicle Maintenance

Building 4 housed the main mechanical shop for several decades. All types of automotive repair took place in this building, and gas pumps were located on the east side of the building Three probes were pushed in the vicinity of Building 4 to evaluate potential contamination from vehicle maintenance activities in this area. Probes SP18 and SP19 were pushed to 25 feet bgs and probe SP20A was pushed to 30 feet bgs. Soil samples were collected at 7-9 feet in SP18, 8-10 feet in SP19, and 10-12 feet in SP20A. Groundwater samples were also collected from the probes. The soil and groundwater samples were submitted for analysis for VOCs, TPH-GRO, PAH-SIM, TPH-DRO/ORO, and RCRA metals. Analytes detected in the soil and groundwater samples from the three probes are summarized on Tables 5.66 and 5.67.

Arsenic was detected in the soil samples from SP18 and SP20A while lead was detected in the soil samples from all three probes. The concentrations of arsenic detected in the soil samples are well below the previously discussed recommended background level. The lead concentrations are also below previously discussed lead background concentrations in the report.

With the exception of selenium in the sample from SP20A, all the metals were detected in all the groundwater samples from all the probes in excess of their respective DTLs. Several PAHs were detected in the soil sample from SP18 of low concentration. Several PAHs were also detected in the groundwater sample from SP20A, and one PAH was detected in the groundwater sample from SP19. The PASI concluded that a release of metals and polynuclear aromatic hydrocarbons (PAHs) may have occurred from a source in the vicinity of Building 4. Groundwater flow in the area was not fully defined, but appeared to be toward Indian Creek. Data were insufficient to evaluate whether contaminated groundwater in this area was migrating off the BFC

With the exception of low concentrations of acetone in all the soil samples, no VOCs or TPH-DRO/ORO/GRO were detected in any of the soil or groundwater samples at this location.

5.17.5 Hydraulic Probes Northeast of Building 50

Six hydraulic probes were pushed northeast of Building 50 to evaluate VOC contamination in the area. The probes were continuously sampled, logged, and field screened using a PID. Probes SP9, SP13, SP16, and SP17 were terminated at 28 feet, SP-10 at 28.5 feet, SP-11 at 30 feet. Because no VOCs were detected by the PID in soil above 15 feet bgs, no soil samples were collected for VOC analysis.

Groundwater samples were collected from each of the probes using a bladder pump. A head space evaluation was conducted on groundwater samples from all six probes using the Color-tec screening method. The following concentrations were detected in the headspace: SP10—100 parts per million (ppm), SP9—4 ppm, SP11—21 ppm, SP16—5 ppm, and SP17—0 ppm. Duplicate groundwater samples for laboratory analysis for VOCs by SW-846 Method 8260 were submitted from probes SP10, SP9, SP11, and SP17. Probes SP13, SP16 and SP17 were added on the basis of the field screening results to delineate the extent of TCE contamination in groundwater in this area.

5.17.6 Building 51: Former Unit Substation and High Voltage Line

The former Unit Substation located east of Building 50 and identified on historical drawings as Building 51, has been suggested as a potential source of PCB contamination because of the likely use of PCBs in electrical equipment. A abandoned high voltage line running to the south from that building was also identified as a potential source of PCBs. As previously discussed, several investigation activities were implemented to investigate these areas, including hydraulic probing and test pits.

Five probes (SP12 through SP16) were pushed in the area of the former unit substation to evaluate the presence of contaminants from possible sources associated with that building. That report stated that because no VOCs were detected by the PID and no visible evidence of contamination was observed, soil samples were collected between 6 and 10 feet bgs in all five probes for PCB analysis. No PCBs were detected in any of the samples. Since no evidence of PCBs was observed in the soil probes, two test pits

(Test Pits 5 and 6) were excavated in the area of the former substation at the same time as the test pits along the storm sewer. Because no evidence of contamination was observed during excavation, one sample was collected from the bottom of each test pit and submitted for analysis for PCBs and VOCs. No PCBs or VOCs were detected in either sample.

Ten shallow probes (SB101 through SB110) were also pushed along the high voltage line south of the former unit substation (Figure 5.144). Since no evidence of contamination was observed during probing, one soil sample was collected from between 1 and 2 feet bgs in each of the probes and submitted for analysis for PCBs. PCB Aroclor 1260 was detected in the samples from probes SB104, SB105, SB106, and SB108. Concentrations detected in probes SB105 (0.479 mg/kg), SB106 (0.0397 mg/kg), and SB108 (0.0953 mg/kg). The concentration of 293 mg/kg detected in the sample from SB104. No PCBs were detected in the soil samples from SB101, SB102, SB103, SB107, SB109, and SB110.

The abandoned high voltage line extends south from the former unit substation into the portion of the facility north of Building 1. It is likely that a junction box is located on the DOE property. On the basis of the relatively high concentration of PCBs detected in the soil sample from SB104, the report recommended that further investigation of the line be conducted.

5.17.7 Building 41 Underground Structure

In 2005, GSA investigated and closed in place an underground structure located in the parking area adjacent to Building 41, northeast of Building 1 (Figure 5.145). The structure is shown on a historical drawing as an oil separator north of the High Power Components Development Lab.

Concentrations of total petroleum hydrocarbon (TPH)-gasoline range organics (GRO) and TPH diesel range organics (DRO); TPH-oil range organics (ORO); benzene, toluene, ethyl benzene, and xylenes (BTEXs); oxygenates; polynuclear aromatic

hydrocarbons (PAHs), and lead in soil and groundwater samples collected around the structure were all below Missouri Risk Based Corrective Action (MRBCA) storage tank DTLs. The liquid in the structure was disposed of as a nonhazardous waste and the structure was filled with inert material. Since the structure was determined to be an oil/water separator, no closure report was submitted to the MDNR. On the basis of the investigation and closure of this structure, the report stated that no further assessment or investigation of this unit was warranted.

5.17.8 Hydraulic Probes in the Vicinity of the Storm Sewer

Eight hydraulic probes were initially pushed in the vicinity of storm sewer Manhole C30R-01 to evaluate the presence and potential source of PCBs detected in the manhole. Probe SPMH01 was pushed to refusal at 9 feet bgs and SPMH01A was pushed to 15 feet. All remaining probes were pushed to 10 feet bgs. The probes were continuously sampled, logged, and screened with a PID.

All probes were pushed in all four quadrants surrounding the manhole, because no evidence of contamination was observed in any of the probes. One soil sample was collected for analysis of PCBs only by SW-846 Method 8082 from each probe, because no VOCs were detected by the PID. Soil samples were collected at the following depths: SPMH01—8.5 feet, SPMH01A—9 feet, SPMH02—8 feet, SPMH02A—9 feet, SPMH03—9 feet, SPMH03A—8.5, SPMH04—8.5 feet, SPMH04A—8.5 feet.

5.17.9 Test Pits

When no contamination was observed and no PCBs detected in the probes pushed in the vicinity of the storm sewer and the former unit substation, GSA requested that test pits be excavated in these areas to attempt to locate the source of the PCBs in Manhole C30R-01. The proposed scope of work included up to four test pits along the storm sewer and up to two test pits in the vicinity of the former unit substation. Each test pit excavation was anticipated to be approximately 3 to 4

feet wide, 4 to 6 feet long, and approximately 8.5 feet deep. The depth was based on the depth of the bottom of the storm sewer pipe at the manhole. Soil samples were collected from the excavator bucket to minimize trench safety issues associated with personnel entering the excavation. Dry decontamination was performed on the excavator bucket between test pits.

Test Pit 1was excavated February 14, 2007, to the northwest of Manhole C30R-01, as shown on Figure 5.144. The excavation was 3 feet by 6 feet and 8.5 feet deep. Excavation was continued until granular bedding material was observed, at which point a small amount of water began infiltrating the excavation. No evidence of contamination was observed in the test pit. A soil sample was collected at the base of the excavation.

Test Pit 2 was excavated on February 15 on the east side of the catch basin northwest of the manhole. This catch basin is south of the parking lot where the former USTs were located west of Building 50. The pipe also collects storm water from a catch basin inside the parking lot. Test Pit 2 was 5 feet by 5 feet and approximately 6.5 feet deep. This depth corresponded to the depth of the bottom of the clay pipe exiting the catch basin to the storm sewer. Some soil discoloration, but no odor or oil was observed in the test pit. A soil sample was taken at the base of the excavation from the discolored material.

Test Pit 3 was excavated on the north side of the storm sewer, approximately 110 feet west of the manhole. This test pit was approximately 3 feet wide by 9 feet long. The first two feet bgs were filled with gravel, with two feet of clay and fill below that. Pieces of wood were encountered at several depths. Bedding material was encountered at 8 feet bgs and the excavation was terminated at 8.5 feet, when water began entering the excavation. A soil sample was collected from the bottom of the excavation. No evidence of contamination was observed.

Test Pits 4, 5, and 6 were excavated on February 16. Test Pit 4 was excavated on the southeast side of the manhole at the recommendation of GSA. It was 3 feet by 8 feet and 9.5 feet deep. Water began entering the excavation at 8.5 feet, and the soil sample was collected from this depth. Fill material and wood were also observed in this test pit.

Test Pit 5 was oriented from northeast to southwest to the southwest of the former unit substation. The location was based on the locations of former subsurface utilities that were believed to be potential conduits for source material from this area. The test pit was approximately 3 feet by 8 feet and 8 feet deep. No contamination was observed, and the soil sample was collected from the bottom of the excavation.

Test Pit 6 was oriented from east to west within the footprint of the former unit. The test pit was approximately 3 feet by 8 feet and 5 feet deep. The excavation was terminated above the target depth, because granular fill material began caving into the test pit. No contamination was observed, and the soil sample was collected from the bottom of the excavation. A test pit log was not completed for this excavation.

All the soil samples were submitted for analysis for PCBs by SW-846 Method 8082 and VOCs by Method 8260B. The test pits were backfilled with clean crushed limestone fines, and the paving repaired to match the existing surface.

5.17.10 Building 50: Documented PCBs in the Storm Sewer

In 2004 an oily substance was identified leaking into Manhole 3C0R-01 from between the sewer pipe and the liner. PCBs, TCE, several chlorobenzenes, and some PAHs were also detected in samples from the manhole.

Aroclor 1260 was detected at a concentration of 3,500 µg/L in the water sample and 1,500 mg/kg in the sediment sample. TCE was detected at a concentration of 1,700 µg/L in the water sample. 1,2,4-Trichlorobenzene (TCB) was detected at a concentration of 2,000 µg/L in the water sample and 290 mg/kg in the sediment sample.

Sampling of a Building 50 deluge tank and the utility tunnel between Building 50 and Building 1 by DOE in 2004 did not identify the source of the material entering the manhole.

The objective of the probes (SPMH01 through SPMH04A) and test pits (Test Pits 1 through 4) in this area was to locate source material and trace it back to the source. As previously stated, no indication of the black oily source material was observed in any of the probes or test pits, although a small area of discolored soil was observed in Test Pit 2. One soil sample was collected from between 8 and 9 feet in each of the eight probes and from the bottom of each test pit. The samples from the probes were analyzed for PCBs only, while the samples from the test pits were also analyzed for VOCs. With the exception of 0.0554 mg/kg of Aroclor 1260 in Test Pit 2, no PCBs were detected in any of the samples from either the probes or the test pits. Test Pit 2 was located near the catch basin south of the parking lot where the former USTs were located. As previously stated, slight soil discoloration, but no odor or oil was observed in the sample location. Acetone was also detected at a concentration of 0.0423 mg/kg in the sample from this test pit.

TCE and 1, 2-DCE were detected in the soil samples from Test Pits 1 and 4. TCE was detected at a concentration of 0.210 mg/kg in Test Pit 1 and 0.0738 mg/kg in Test Pit 4. 1, 2-DCE was detected at a concentration of 0.0124 in Test Pit 1 and 0.0131 mg/kg in Test Pit 4.

The samples collected along the water pipeline are also relevant to this area. Those samples were collected primarily to evaluate potential worker exposure during a planned future pipeline replacement. No other compounds were detected in any of the samples, with the exception of 0.058 mg/kg of TCE in the sample from SB205 and 0.55 mg/kg Aroclor 1260 in SB206 (below the DTL of 1.11 mg/kg). No evidence of a potential PCB source was observed in the probes along the water line and were analyzed for PCBs and VOCs.

5.17.11 Building 1 Utility Tunnel

PCB Aroclor 1260 was detected in this tunnel. The PASI recommended that the area be cleaned; however, because of the small size of the stained area, limited exposure, and lack of migration pathways, no further assessment, investigation, or remediation of this area was recommended .

5.18 Miscellaneous PCB Sites (SWMU 35)

An RFI report written in late 1989 addressed three areas known as the PCB sites. The three sites included the Oil House, East Boiler House, and the Sanitary Sewer Lift Station. The Oil House site was later addressed in the TCE Still Area RFI. This discussion addresses the East Boiler House and the Sanitary Sewer Lift Station as addressed in this document.

5.18.1 Regulatory Submittals/Approvals

Interim Measures

Interim Measures Work Plan

- Submitted to EPA / MDNR May 26, 1994 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved by EPA / MDNR with comment August 12, 1994 (Letter from K. S. Ritchey, EPA to G. P. Keary, DOE)
- Submitted to EPA / MDNR September 11, 1994 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Addendum #1: Submitted February 23, 1996 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Addendum #1: Approved by EPA / MDNR March 4, 1996 (Letter from K. S. Ritchey, EPA to G. P. Keary, DOE)

Interim Measures Report

- Submitted to EPA / MDNR February 13, 1997 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Approved by EPA / MDNR March 20, 1997(Letter from K. S. Ritchey, EPA to G. P. Keary, DOE)

5.18.2 Description of Units

5.18.2.1 East Boilerhouse/ Substation 23

The original East Boilerhouse site, described from an employee interview, was determined not to exist. Instead, a review of plant records and additional employee interviews led to the investigation of a transformer spill at nearby Substation 23 (Figure 5.146). A lightning strike in the mid-1970s caused the transformer to rupture and spill approximately 34 gallons of PCB fluid onto the concrete surface.

5.18.2.2 Sanitary Sewer Lift Station

The Sanitary Sewer Lift Station had been subject to periodic overflows of sewage that stained the surface of the surrounding soils. Sampling locations were selected in order to evaluate whether contaminants had accumulated in a small ravine that drained the site. Eight samples were collected from four locations and analyzed for PCBs, selected metals, and petroleum hydrocarbons. The results demonstrated that PCBs, metals, gasoline, and low-boiling fuel hydrocarbons were not present in significant concentrations.

Surface and shallow subsurface soil samples were collected in the RFI from four locations at this site (Figure 5.147). The sample locations were downgradient from the lift station overflow pipe along a drainage flowing northeast from the site. Sampling was performed to identify any surface accumulation of contaminants resulting from discharges through the overflow pipe in comparison to the original sampling above.

The investigation site occupied an area of approximately 2000 square ft, which consisted of a sloped bank directly below an overflow pipe and a drainage path leading from the site. Two sampling locations were placed on the bank and two along the drainage path (Figure 5.147). Samples were collected from each location between 0 to 0.5 and 0.5 to 1.0 ft (Figure 5.148). Sample results indicated only trace amounts of PCBs and lead (Table 5.68). Sample results indicated that this site was not contaminated with metals and PCBs. Elevated petroleum hydrocarbons were found in one sample, but the data demonstrated that there was no migration and that the contamination had a very limited extent. The RFI concluded that no further action was required.

5.18.2.3 Substation 23

Shallow subsurface soil and surface wipe samples were collected from several locations within the Substation 23 containment building. The soil sampling locations were located under cracks and joints in the concrete flooring. There were four soil sampling

locations: three along a crack adjacent to the north wall and one along a floor joint just southwest of Substation 23 (Figure 5.149).

Five surface wipe samples (Figure 5.150) were collected from two stained areas on the north and south walls. Two wipe samples were collected from each wall. The fifth wipe sample (background) was collected from a clean area on the east wall. Both showed contamination.

A corrective Measures Study was recommended. However it was subsequently decided to address the area under Interim Measures This activity is described below.

5.18.3 Miscellaneous PCB Sites Interim Measures

The approved, Final Miscellaneous PCB Sites Interim Measures Work Plan (IMWP), dated September 1994, required implementation of the following corrective actions (CA); CA #1: removal and disposal of the PCB contaminated electrical transformer at Substation 23, CA #2: demolition and disposal of the Substation 23 containment building except for the concrete floor slab, south wall, and remaining portion of the east wall which were to be decontaminated to a PCB concentration less than 100 µg/100cm^2 and encapsulated, CA #3: removal and disposal of abandoned PCB contaminated electrical cables at substation 23 and manhole No.8, and CA #4: plugging of empty electrical conduits in manholes No. 7 and No. 8 that were identified with PCB contamination.

5.18.3.1 Work Accomplished

Substation 23 contained an electrical transformer that was de-energized and drained of askarel liquid insulation. This transformer was taken out of service prior to the IM fieldwork. The drained transformer was removed from the Substation 23 containment building and sent off-site for disposal.

CA #2: All work was completed except for decontamination of superficial PCB contamination on the concrete floor slab and east wall footing**.** PCB concentrations

were successfully reduced to less than 100 µg/100cm^2 on the concrete block portion of the east wall. However, PCB concentrations remained above 100 µg/100cm^2 on the concrete floor and east wall concrete footing (first 1.8 inches of wall). Encapsulation was implemented as the corrective action for superficial PCB contamination on the concrete floor slab and east wall footing when a IMWP Addendum No. 1 was approved.

CA #3 : Underground high voltage cables, in 4-inch conduit, encased in concrete had been abandoned in place between manhole No. 8 and Substation 18, and between Building 48 (East Boilerhouse) and Substation 23. Previous samples of the cables had identified PCB concentrations as high as 965 parts per million (ppm). These abandoned cables were pulled from the conduit and cut to manageable lengths. The cut cables were placed in PCB waste drums for transport and disposal. Two cables approximately 70 feet in length were pulled from between Building 48 and Substation 23, and two cables approximately 65 feet in length were pulled from between manhole No. 8 and Substation 18.

CA #4: Several empty electrical conduits for high voltage cable terminated in manhole No.8. Wipe samples were taken from inside five empty conduits and sample results indicated low level PCB contamination. The maximum PCB concentration in the empty conduits sampled was 140 µg/100cm^2. Each of the five empty conduits were plugged to eliminate the exposure pathway and thereby the health risk associated with exposure to PCB contamination. The empty conduits from manhole No.8 were also plugged where they terminated in manhole No.7. PCB warning signs were affixed at manhole No. 7 & 8.

DOE proposed encapsulation of the remaining superficial PCB contamination in a letter issued to the EPA in July 1995 (Attachment 1 to “Miscellaneous PCB Sites”, IMWP, Addendum No. 1, dated February 1996). EPA issued a letter to DOE in response on October 31, 1995 (Attachment 2 to “Miscellaneous PCB Sites”, IMWP, Addendum No. 1, dated February 1996) requesting additional information in the form of a modification

to the interim measures plan. In the letter, EPA noted that the Resource Conservation and Recovery Act (RCRA) Corrective Action program will allow encapsulation of PCB-contaminated concrete until final management of that concrete at a PCB permitted hazardous waste managed facility. However, the EPA and Missouri Department of Natural Resources (MDNR) requested additional information before the proposed encapsulation could be approved. DOE issued Addendum No. 1 to the approved Final Miscellaneous PCB Sites Interim Measures Work Plan, dated September 1994, which was developed under the Consent Order. Addendum No. 1 addressed the additional information requested with the following five items:

1) Additional samples were taken verifying that PCB contamination was limited to the exterior surface of the concrete block wall and did not penetrate to the interior surface.

2) The proposed encapsulation of PCB-contaminated concrete would eliminate the only remaining direct exposure pathway which would come from contact with the superficial contamination. After encapsulation a potential pathway could be created from penetration (core drilling, saw cutting) and/or demolition of the concrete. This potential pathway is addressed in Item 5.

3) Encapsulation would be accomplished by applying industrial coatings to the concrete block wall and concrete floor. Contrasting colors would be used on the first and second coats to serve as a wear indicator. When required an additional coating would be applied to maintain effective encapsulation.

4) Signs would be used to identify PCB-contaminated areas.

5) Institutional controls were already in place that would protect against contamination exposure due to maintenance or construction activities in the PCB-contaminated area through the administration of Safe Work Permits.

<u>Addendum No. 1 -Work Accomplished</u>

A concrete curb was constructed around the perimeter of the floor slab prior to proceeding with final encapsulation of superficial PCB contamination at the Substation 23 site. The concrete floor slab, east wall, and south wall were then cleaned and prepared for application of the paint primer coats. The east and south walls were primed with Sherwin Williams, Heavy Duty Block Filler, B42W46 Series, white in color. The top coat on the walls consisted of two coatings of Sherwin Williams, Industrial Enamel, B54 Series, Tower Gray in color. One coat of Sherwin Williams, Concrete Terrazzo Sealer, B44V22 Series, white in color, was applied to the concrete floor slab. At this point a field decision was made to provide a more permanent encapsulation of the floor by constructing a concrete cap in lieu of applying two coats of industrial enamel paint. A 4-inch thick concrete cap was poured over the floor slap level with the containment curb. Signs were attached to the east and south walls and the concrete cap. The signs identified encapsulated PCB contamination and provided a phone number for additional information.

The signs on the wall requested a call to extension 7205 if the white primer coat began showing through the gray finish coat. It should also be noted that the walls and floor had all been previously encapsulated with EET's encapsulation material providing additional insurance against superficial PCB exposure.

5.19 Underground Storage Tank History/Status

When the original manufacturing facility at the BFC was constructed as an aircraft engine manufacturing plant during 1942, a number underground storage tanks (UST) were installed. Several of the original tanks were used during operation of the KCP. In addition, a number of additional USTs were later installed during operation of the KCP. There are no remaining in-service USTs at the facility as all USTs have either been removed or abandoned in place in compliance with regulations existing at the time of closure. Table 5.69 provides the location, size, contents and disposition of these USTs with (Figure 5.151) providing the location of the tanks in map view form.

The largest concentration of USTs was in the northeast area of the facility where the Tank Farm and associated pump house (Building 15) was located (Figure 5.151). The Tank Farm, installed during 1943 while Pratt & Whitney occupied the facility, consisted of 22 steel and 6 concrete tanks. In 1987, shortly after leaking tanks were discovered, the USTs associated with the Tank Farm were closed and all tanks and related materials were removed from the ground (including associated piping, stored fuels, coolants and solvents, concrete support, etc.). The excavation was backfilled with uncontaminated soil and covered with a clay cap, topsoil, and vegetation (see also Section 6).

According to a 1984 Historical Survey, 30 additional USTs were identified outside of the Tank Farm that were used to store fuels, solvents, and wastewater, and ranged in size from 500 to 250,000 gallons (Figure 5.151). These tanks were installed between 1943 and 1982. A number of tanks were also associated with the former aircraft engine test cells, Building 50 and the West Power House.

During 2005, the last remaining in-service underground storage tank (Tank #5), a 940-gallon diesel-tank used for emergency power generation, was removed and closed in accordance with MDNR regulations. There is no history of any product-release from this tank. The tank was tightness tested and the cathodic protection system was tested in early 1995.

As noted in Table 5.69, many of the USTs at the KCP were closed prior to December 22, 1988, by emptying the tank, filling with sand and grouting tank openings. MDNR UST guidance applicable at the time UST closures were reported to MDNR stated that "an owner or operator must report information on any UST taken out of service prior to January 1, 1974, if there is any evidence of a release" – *Underground Storage Tank Closure Guidance Document, January 1992.* Regardless of whether or not there was evidence of a release, all known USTs have been reported to the MDNR. Additionally, MDNR UST guidance states that there are no regulatory requirements to follow if a tank closed prior to December 22, 1988, was closed with acceptable fill material and all tank openings were sealed with cement or concrete grout.

The Facility Information Report and Owner Information Reports from the MDNR UST data base are provided as a supporting document to this report. However, the MDNR data base does not provide a complete listing of all USTs historically installed at the KCP. (Note: The tank numbers provided in the partial MDNR listing of tanks do not, in all cases, align with the tank numbering scheme provided in this document.) Table 5.69 lists a number of additional tanks that were either closed prior to December 22, 1988, or taken out of service prior to January 1, 1974, and are therefore, likely not listed on the MDNR UST data base. However, as stated above, all tanks at the facility were closed in accordance with regulations applicable at the time.

Table 5.69 provides information related to the closure documentation, sample results and volume of material removed during closure activities.

(Note: The historic tank numbering scheme has not been consistent within facility records. Therefore, if historic files are reviewed that are not included in this write-up caution must be exercised to ensure the tank number used as an identifier correlates with the tank in question.)

5.19.1 Underground Storage Tank Farm (SWMU 1) UST #s 10-15 and 43-64

The steel and concrete tanks located within the underground storage tank farm at this site had contained several types of liquids in the past 40-50 years of service. A closure plan was formulated by Bendix for the removal of contaminated soils, piping, concrete and steel tanks.

Closure regulations given in CFR 40 were used as closure requirements. Activity at the site began on August 10, 1987. Initial activity involved the removal of surface dirt and piling of the dirt in segregated piles for sampling and analysis. On August 21, 1987, asbestos was found on the site. As directed in the Technical Provisions, Bendix then took charge of the removal of the asbestos. Asbestos removal was completed on September 26, 1987.

As the soil was removed, analysis. showed it to be contaminated to such a level that all soil was considered hazardous and disposed of in an approved hazardous waste landfill, located in Emelle, Alabama. The concrete and steel tanks were excavated and disposed of in the following manner:

21 steel tanks were cleaned and sent to National Compressed Steel for recycle scrap. The tanks were sufficiently damaged to render them un-usable or to be repaired.

1 steel tank was sent to Chemical Waste, Emelle, Alabama. This tank had collapsed and could not be sufficiently cleaned.

6 concrete tanks were broken and transported with contaminated soils for disposal at Chem Waste, Emelle, Alabama.

A total of 1,636 tons of fly ash obtained from Walter Handy Company and Midwest Fly Ash Company were used to stabilize soils and solidify liquids in the excavation area.

Clean soil was brought to the site to backfill the excavation site. Utilities were replaced and the site graded to provide sloping for runoff. The backfill was tested to meet permeation and compaction requirements.

REMOVED MATERIALS

A total of 1,144 truckloads of contaminated material was removed from the site. This translates into 23,577.10 tons or 18,136.23 cubic yards of material. The material consisted of pipe,

concrete and soil. An average density was used to convert weight into volume, as specified in the Technical Provisions.

A total of 16,903.75 cubic yards of soil was hauled in for backfill.

The soil was tested as clean at the initial selection of the soil source. The soil analysis indicated that it consisted of light brown silty clay with a coefficient of permeability of 5.7 x l0-8cm/sec and a maximum lab dry density of 97.3 lbs/cubic foot. The existing permeability of the soil under the excavation site was not determined because the existing soil consisted mainly of sand, placed there at an earlier date. Analysis was conducted by Professional Services Industries, Inc., of Kansas City, Kansas. Thirty-nine compaction tests were conducted over a period of twenty-five days to determine if field compaction met specifications. Two tests failed to meet specifications and after re-compaction, tested to meet specifications. Successful compaction tests indicated densities ranging from 91.5 to 105.4 lbs/cubic foot.

Construction of the clay cap was accomplished by the placement and compaction of all backfill throughout the length and width of the excavated basin to form a single layer to the depth of excavation. This resulted in the entire filled and compacted basin acting as a single unit cap, thus exceeding the 40 CFR regulations. After completion of backfill, compaction and grading, this single unit cap will meet an in place density of 95%, and obtain a permeability of less than or equal to 1 X 10^{-7}cm/sec. and all other requirements as described in 40 CFR 264.301 and 265.310 (a).

The final pre-topsoil grading was surveyed by Anderson Survey. The surface drains water from the site to the Northeast corner of the site where a pre-existing drainage ravine carries the water away from the site. Final top soil and cover has not been installed as of this date due to inclement weather.

5.19.2 Miscellaneous USTs Removed - UST #s 1, 3, 4, 5, 6, 7, 8, 9, 23, 24, 27, 28, 32, 33

A summary report describing initial characterization sampling and post removal sampling was submitted to the MDNR Tanks Section in a June 3, 1992 Underground Storage Tank Closure

Report. Actions taken during these removal actions are summarized in Table 5.69. This report provided information related to the following tanks:

- West Power House - Tanks 1, 23, 24, 27, and 28
- East Power House - Tanks 3, 4, 32, and 33
- Building 15 - Tanks 6, 7, 8, and 9
- Emergency Generator Tank 5, which was in service at the time of this report and subsequently closed per MRBCA.

5.19.3 Department 27 Outside (SWMU 30) UST #s 29, 30, and 42

Three USTs were located in the area known as Department 27 (D/27) Outside. This area housed the Therminol system for D/27 which included two USTs, tanks 29 and 30, which served as storage and surge tanks for the PCB based mold heating and cooling system used in D/27. In addition, there was a 500 gallon gasoline UST (tank 42) located in this area. The above USTs were removed during 1985. Four soil samples collected during the 1985 tank removal action were collected for PCB analysis. Three samples were non-detect for PCBs and one sample detected 2.5 mg/kg of total PCBs (DOE 1990). The D/27 Outside Interim Measures project (DOE 1992) addressed remaining areas of PCB contamination associated with SWMU 30.

5.19.4 Test Cell Tanks (SWMU 43) UST #s 35, 36, 37 and 66

Interim Measures Work Plan - November 1997

Interim Measures Report - Letter from G. P. Keary, DOE, to K. S. Ritchey, EPA, dates February 18, 1999.

This Interim Measure construction activity removed three (abandoned and sand filled) USTs in the Test Cell area (10,000 gallon UST #35, 10,000 gallon UST #36, and 1,000 gallon UST #37) identified as Solid Waste Management Unit (SWMU) #43, at the Department of Energy Kansas City Plant. These tanks had been abandoned and sand filled by the previous owners.

The horizontal and vertical extent of contamination associated with this site has been discussed in the MAINTENANCE VEHICLE REPAIR SHOP SUMP RCRA FACILITY INVESTIGATION REPORT, NOVEMBER 1995 (MVRSS RFI Report). The health based risks associated with this site are discussed in the MULTISITE CORRECTIVE MEASURES STUDY FOR THE DEPARTMENT OF ENERGY KANSAS CITY PLANT, NOVEMBER 1995 (CMS Report).

Three abandoned steel tanks and associated piping, within the areas excavated, (335 cubic yards) were removed and shipped for direct burial at the RCRA Landfill at Lone Mountain, OK. Liquid waste (groundwater and cleaning rinse water) was contained and shipped to a licensed Hazardous Waste Incinerator. Three shipments went to Trade Waste Incineration (TWI) in Sauget, IL, and one shipment went to Chemical Waste Management (CWM) in Port Arthur, TX.

TEST CELL TANKS WASTE DISPOSAL QUANTITIES

The resulting void spaces (from removing the tanks) were filled with a self-leveling grout mixture composed of sand, water, fly ash, and Portland cement. A fourth underground storage tank location (1,000 gallon, UST #66, at post location TD48-1/2) was investigated as part of the February 1997 effort. No visible free product or odor was detected from samples collected from Tank #66. Analytical results for Tank #66 were below detection for PCBs, RCRA metals, petroleum hydrocarbons, volatile organics, and semi-volatile organics. Therefore no action occurred, and no further action is planned at the Tank #66 site.

TEST CELL TANKS WASTE DISPOSAL QUANTITIES

	Cubic Yards	Tons	Cubic Meters	Metric Tons	Final Disposition
RCRA Solid Waste	322	484	248	440	Safety Kleen Inc. , Lone Mountain, OK
Non-Haz. Waste	5	10	4	9	JCSL, Olathe, KS
Excavation and Cleanup Water (17,369 Gallons)	86	72	66	65	TWI, Sauget, IL CWM, Port Arthur, TX

In accordance with the U. S. DEPARTMENT OF ENERGY KANSAS CITY PLANT MULTIPLE SITES STATEMENT OF BASIS issued by the U. S. Environmental Protection Agency, institutional controls will address residual soil contamination associated with the following areas previously investigated and discussed in the MAINTENANCE VEHICLE REPAIR SHOP SUMP RFI REPORT, NOVEMBER 1995.

1) Solid Waste Management Unit 17-Building 54.

2) Solid Waste Management Unit 36--Motor Vehicle Repair Shop Sumps within Bldg 54.

3) Solid Waste Management Unit 43--Test Cell Area, including a Reported Underground Tank outside and south of Bldg. 54.

The test cells were originally constructed in 1942 to support aircraft engine manufacturing performed by the Pratt and Whitney Corporation supporting the war effort. After World War II, test cell operations ceased until approximately 1949, when the Westinghouse Corporation began testing jet engines in this facility. Jet engine testing continued through 1961, when the lease terminated. No historical use records of these abandoned tanks are available. Limited construction drawing information is available.

The tanks are labeled "waste oil" in the original construction drawings. It is likely that the waste contents of these tanks may have included fuels, oils, and degreasing solvents, and residual metals from machining or engine operations. Since 1961, the test cell area has been used primarily for storage of office and manufacturing equipment and tools. The tanks were reportedly emptied and sand filled after the engine testing operations ceased in this area.

5.19.5 Plating Building Waste Oil Tank (SWMU 10) UST #34

See Section 5, Plating Building, Waste Oil Tank Interim Measures.

5.19.6 GSA Controlled USTs - UST #s 70-81 (KCPERA 379)

5.19.6.1 NARA Building - UST #70

This 1,000 gallon gasoline UST was closed in place during 2008 under MDNR's MRBCA program.

5.19.6.2 Building 50 - UST #s 71-76

Documents variously refer to Building 50 as a fuel test lab, fuel components laboratory, low power components development laboratory, and engine testing facility during the period that aircraft/jet engines were manufactured at the plant. The building was constructed with concrete walls and blast-away ceilings and required large refrigeration units that were powered by a unit substation (GSA 1956). No additional information was found regarding the uses of the building. Engine testing would be expected to use relatively large volumes of petroleum products(consistent with the USTs adjacent to Building 50) and potentially solvents for degreasing.

Building 50 is not shown on the original 1942 Plot Plan for the Aircraft Engine Plant. The first drawing that was identified for the building was the 1956 Sub-surface Piping Plan of Building 50 (GSA 1956). This drawing shows waste oil gutters in six areas inside the building, with waste oil collection pipes that discharged to a waste oil storage tank.

UST pads show up on the aerial photograph in 1985, but are not present in the 1988 photograph (Aerial Photographs 1984, 1985, 1988, 1994, 1997, Date Unknown). Support documentation for removal and closure of the USTs was not available, however, a drawing from 1984 provides specifications for removal of six fuel oil storage tanks (including a waste oil tank), and capping and abandoning in place of some of the associated piping (Unknown Author 1984). In a letter dated June 3, 2002, the MDNR stated that "the residual soil contamination in the vicinity of BH4 and BH5 shall be left in-place to naturally remediate and no further sampling or corrective action is required at this time" (MDNR 2002).

5.19.6.3 Building 4 UST #77

The 8,000-gallon gasoline UST located east of Building 4 was closed in place in 1993, as reported in *MDNR Closure Report Parts A and B, for Underground Storage Tank, Contents: Gasoline, 8000 Gallon Capacity, Owner General Services Administration* (GSA 1993). According to the closure report, closure included washing and rinsing the tank, filling the tank

with clean sand, and plugging the vent and both ends of the fuel line with concrete. Concentrations of petroleum hydrocarbons and BTEXs detected in soil samples were below cleanup levels required at the time (GSA 1993) and also below current MRBCA DTLs. The closure was approved by MDNR (MDNR 1994).

5.19.6.4 Building 1 UST #78

The 3,000-gallon diesel UST on the northwest corner of Building 1 was removed in 1999, as reported in *Closure Report for Removal of Underground Storage Tank General Services Administration Bldg. 1, 1500 E. Bannister Road, Kansas City, Missouri 64131* (Kingston 1999). Approximately 200 gallons of product and water were removed from the tank and disposed of by energy recycling. One 55-gallon drum of sludge was disposed of as a RCRA hazardous waste. The tank was recycled and fuel lines and vent pipes were removed and disposed of. No TPH gasoline, TPH-diesel, BTEXs, or MTBE was detected in any of the soil samples from the excavation. The closure was approved by MDNR (MDNR 2000).

5.19.6.5 Building 7 UST #79

The 1,000-gallon UST located south of the Building 7 was closed in place in 2000, as reported in *Underground Storage Tank Closure Assessment Report, Bannister Federal Complex, Building 7, 1500 E. Bannister Road, Kansas City, Missouri 64131-3088* (Cape Environmental 2000). No VOCs (with the exception of acetone), PAHs, TPH, or PCBs were detected in the soil and groundwater samples collected around the tank. TPH and PCBs were detected in the tank contents. Tank liquid was disposed of as a non-hazardous waste, while sludge was disposed of as a RCRA hazardous waste. The tank was cleaned and backfilled. Its use was not determined, but piping appeared to be connected to the building floor drains (Cape Environmental 2000). The MDNR approved closure of the tank (MDNR 2001).

This structure was closed in accordance with UST regulations, but on the basis of the drain connection, it may have been an oil/water separator. However, its location does not match either of the oil/water separator locations shown on the 1942 drawings.

5.19.6.6 Building 17 UST #80

In 1993 GSA removed a 500-gallon heating tank from the area of the former Yard Master's Office. Concentrations of analytes in closure samples were below current MRBCA storage tank DTLs, and MDNR approved the tank closure in a letter dated November 23, 1993 (Huntington 1993 and MDNR 1993). The 500-gallon heating oil UST in the area of former Building 17 was removed in 1993, as reported in *MDNR Closure Report Underground Storage Tank Removal for General Services Administration, 1500 E. Bannister Road, Kansas City, Missouri 64131* (Huntington 1993). The tank was recycled. Concentrations of TPH and BTEXs in soil samples from below the tank and the sidewall were below cleanup levels required at the time and also below current MRBCA DTLs. The closure was approved by MDNR (MDNR 1993).

5.20 Closure of Hazardous Waste Storage Lots

5.20.1 Background

The KCP continued to store RCRA hazardous waste in tanks and containers for greater than 90 days through the late 1980's in accordance with its Part A permit application. Numerous draft RCRA Part B permit applications were drafted and submitted to EPA and MDNR in the 1980s through the mid 1990's to keep abreast with facility and regulatory changes to the program. The Part B applications were to allow for the long term storage of waste in tanks and containers. In 1998, the MDNR formally notified DOE that they would soon be issuing the Part B permit for the KCP and for DOE to submit one final revised application. Roughly concurrent with this activity the KCP determined that it would be in its best interest to cease storage of hazardous waste over 90 days and simply conduct post closure care of the three closed RCRA land disposal units (the two former lagoons and tank farm). This was accomplished with the issuance of a Missouri Hazardous Waste Management Facility Permit by the MDNR in October 1999.

In 1998, the KCP formally closed all remaining >90 day storage areas in accordance with approved closure plans. The closures consisted of sampling concrete within each the lots and soil underneath the lots for the presence of contamination indicative of the wastes managed on the lots. All lots were cleaned to contaminant levels allowed by the state of Missouri for industrial use. Once closures were completed and approved by MDNR, many of the former storage areas continued to be used for other (industrial use) purposes.

5.20.2 Summary of Closures

In general closure plans consisted of the removal of all waste and or waste storage tanks from the lot. High pressure water cleaning of the lot was then performed. Sampling of concrete through chipping it from the surface of the lot utilizing a grid pattern within the lot itself was then performed. Contamination identified from sampling the concrete chips was compared to site clean-up standards provided in the EPA final Decision and Response to comments for the RCRA Multi-Site Corrective Measure Study dated July 15, 1998 (DOE 1998). Additional compounds found for which standards were not provided in the multi-site CMS were calculated utilizing EPA approved methods. If concrete chip samples were over prescribed

clean-up standards, the area was scarified through shot basting to remove the contamination and the area resampled to confirm that concentrations were below the site standard. Figures showing concrete chip sampling locations and a table of the maximum concentrations found in chip samples compared to site clean-up standards are provided as an Appendix to this report. A figure of soil boring locations along with a table of results is also provided.

5.21 Multiple Sites Corrective Measures Study

This Corrective Measure Study (CMS) addresses contamination of soil at the TCE Still Area, Plating Building Area, Maintenance Vehicle Repair Shop, Department 26 (D/26) (inside), and Department 27 (D/27) (inside). The CMS also addresses groundwater contamination in the Indian Creek Groundwater Flow System (ICGFS).

A health-based cleanup goal was established by "back-calculating a health protective contaminant concentration, given a target risk which was deemed acceptable, and using realistic intake factors. The document stated that it was important to note that the concept of the "cleanup goal" inherently incorporated the concept of exposure reduction, which allowed corrective actions to be flexible.

5.21.1 Regulatory Submittals/Approvals

CMS

- Submitted to EPA / MDNR November 29, 1995 (Letter from G. P. Keary, DOE to K. S. Ritchey, EPA)
- Statement of Basis, U.S. Department of Energy Kansas City Plant, Multiple Sites, Kansas City, Missouri, U.S. Environmental Protection Agency, Region VII Office, March 25, 1998.
- Approved by EPA / MDNR July 15, 1998

CMI Work Plan

- Submitted to MDNR / EPA October 28, 2000 (Letter from G. P. Keary, DOE to A. H. Groner, MDNR)
- Approved by MDNR November 6, 2000 (Letter from A. H. Groner, MDNR to G. P. Keary, DOE)

5.21.2 Corrective Measures Evaluation – Soil

This section presents the justification for the recommendation of a single soil alternative to address contamination at the SWMUs addressed in this CMS. Only those SWMUs which contain contaminants of concern above the health-based cleanup goals in soil from the depth interval of 0 to 15 feet are addressed in the soil alternatives of the CMS. A flow chart for the grouping of these SWMUs is provided as Figure 5.152. Soil contamination below the water

table in the area of the SWMUs in this CMS is addressed by the Corrective Measure Alternatives for groundwater. Other SWMUs require no action and are not addressed in the recommended alternative.

The SWMUs which do not contain contaminants of concern above the health-based cleanup goals

include:

SWMU 4 - Classified Waste Trenches

SWMU 16 - Sales Building Site

SWMU 17 - Building 54

SWMU 32 – D/27 (inside)

SWMU 36 - Maintenance Vehicle Repair Shop Sump

SWMU 39 – D/95

SWMU 40 - Chip Handling Building Site

SWMU 41 - D/20 Degreaser Pit

The eight SWMUs listed required no further action and were not addressed by the recommended alternative.

The SWMUs which contain contaminants of concern above health based cleanup goals were addressed by each clean –up alternative that underwent the detailed evaluation in the CMS. Maximum soil concentrations at these SWMUs compared to the health based clean-up goals are provided as Table 5.70. These SWMUs included:

SWMU 2 - TCE Still Site

SWMU 3 - Waste Transfer Spill Area

SWMU 9 - Acid and Alkaline Tanks

SWMU 10 - Waste Oil Tank

SWMU 11 - Substation 18

SWMU 12 - D/26 (outside)

SWMU 31 - D/26 (inside)

SWMU 33 - Oil House

SWMU 37 - Abandoned Sump

NA - Buried Tanks at Test Cells

Each of the five soil alternatives evaluated in the CMS proposed corrective actions for the ten SWMUs listed above. SWMUs were grouped based on location and contaminants of concern and the groups of SWMUs were evaluated for each alternative. The five soil alternatives and SWMU groupings in each are presented below:

Alternative 1- No Action (SWMUs 2, 3, 9, 10, 11, 12, 31, 33, 37 and Buried Tanks at Test Cells)

Alternative 2 - Institutional Controls SWMUs (2, 3, 9, 10, 11, 12, 31, 33, 37 and Buried Tanks at Test Cells)

Alternative 3 - Excavation and On-Site Treatment (SWMUs 3, 9, 10, 11, 12, 37), Institutional Controls (SWMUs 2, 31, 33 and Buried Tanks at Test Cells.)

Alternative 4- Excavation and On-Site Treatment (SWMUs 3 and 37), Excavation and Off-Site Landfill (SWMUs 9, 10, 11, 12), Institutional Controls (SWMUs 2, 31, 33 and Buried Tanks at Test Cells.)

Alternative 5 - Institutional Controls (SWMUs 2, 3, 31, 33, 37 and Buried Tanks at Test Cells), Excavation and On-Site Treatment (SWMUS 9, 10, 11, 12)

-Detailed descriptions of these alternatives are presented in the CMS along with a detailed evaluation against EPA mandated criteria

The five general decision factors include:

- Long-term reliability and effectiveness
- Reduction of toxicity, mobility, or volume of wastes
- Short-term effectiveness
- Implementability
- Cost

Each soil alternative component was evaluated and scored against each of these criteria in the CMS.

5.21.2.1 Recommended Alternative - Soil

Based on the results of the detailed evaluations of corrective action alternatives for soil presented in the CMS, Alternative 2 was the recommended alternative for soils.

Alternative 2 proposes institutional controls at SWMUs 2, 3, 9, 10, 11, 12, 31, 33, 37, and the Buried Tanks at Test Cells. Alternative 2 received the highest score for the detailed evaluation factors and the remedy selection decision factors. Alternative 2 meets the objective of minimizing exposure to soil containing contaminants of concern above the health-based cleanup goals developed in this CMS.

Implementation of institutional controls at the SWMUs with contaminants of concern above health-based cleanup goals would involve leaving the contaminated soil in place. The institutional controls would limit exposure to these contaminants and protect human health. Leaving the contaminants in place would have limited environmental impact, based on site conditions. The majority of contaminated soil is present below depths of four feet and is covered by buildings and pavement. The contaminants of concern above the cleanup goals include TPH, PCBs and VOCs. TPH and PCBs are relatively insoluble in water. VOCs are present in the vadose zone above health-based cleanup goals at SWMUs 2 and 33 only. VOCs

are present in SWMUs 3, 9, 10, 11, 12, 31, 37, and Buried Tanks at Test Cells but at levels below the health-based cleanup goals. Much of the VOC contamination at the site has already migrated into the groundwater and further releases of VOC's from the vadose zone are not likely to have a major impact on site groundwater contamination in the long- or short-term.

The corrective action objectives for groundwater in the ICGFS include containment of the contaminated groundwater within the facility boundaries. Remediation of groundwater to meet media cleanup standards is technically impractical due mostly to the presence of DNAPL already in the saturated zone. Also, no complete exposure pathway for site groundwater was identified in the risk assessment. Due to the conditions described above, soil contamination at SWMUs 2, 3, 9, 10, 11, 12, 31, 33, 37, and the Buried Tanks at Test Cells above the water table pose minimal risk to human health and the environment.

5.21.3 Corrective Measures Evaluation - Groundwater

This CMS also proposed corrective action alternatives for groundwater in the ICGFS. Alternatives were proposed and evaluated to meet the corrective action objectives for groundwater which included:

- Protection of human health and the environment by preventing exposure of potential receptors to groundwater contaminants in excess of the proposed protection standards for groundwater.

- Containment of the leading edge of the groundwater plume in the ICGFS having contaminants of concern which exceed the proposed groundwater protection standards within the property boundaries.

Alternatives were described and evaluated in this CMS to meet the above objectives. The alternatives for groundwater included:

Alternative 1 - No Action (a baseline for comparison)

Alternative 2 - Institutional Controls (Groundwater Monitoring); Groundwater containment in the ICGFS by collection in the Building Tile Drain System; Treatment of Water with the On-Site; Discharge to the POTW

Alternative 3 - Institutional Controls (Groundwater Monitoring); Groundwater containment in the ICGFS with the Pumping Wells; Treatment with the On-Site treatment system; Discharge to the POTW

5.21.3.1 Recommended Alternative for Groundwater

Based on the detailed evaluation of the corrective action alternatives, Alternative 2 was the recommended alternative for groundwater in the ICGFS.

Alternative 2 involves groundwater monitoring, containment of groundwater in the ICGFS utilizing the building tile drain system, treatment of collected water with the UV/Oxidation system and discharge to the POTW. Treated water from the UV/Oxidation system will be discharged to the POTW.

5.21.4 Summary and Conclusions of the Multi-Site CMS

The Multi Site CMS addresses soil contamination in the 0- to 15-foot depth interval at 17 soil SWMUs and one potential release site at the KCP. These SWMUs addressed in this CMS include:

SWMU 2 - TCE Still Site

SWMU 3 - Waste Transfer Spill Area

SWMU 4 - Classified Waste Trenches

SWMU 9 - Acid and Alkaline Tanks

SWMU 10 Waste Oil Tank

SWMU11 - Substation 18

SWMU 12 - D/26 (Outside)

SWMU 16 - Sales Building Site

SWMU 17 - Building 54

SWMU 31 - D/26 (Inside)

SWMU 32- D/27 (Inside)

SWMU 33 - Oil House

SWMU 36- Maintenance Vehicle Repair Shop Sump

SWMU 37 - Abandoned Sump

SWMU 39 - Department 95

SWMU40- Chip Handling Building Site

SWMU41 - Department 20 Degreaser Pit

N/A -Buried Tanks at Test Cells

Soil sampling data from the RCRA Facility Investigation for these SWMUs were compared to the health-based cleanup goals developed in this CMS. Only those SWMUs which contained contaminants of concern above the health-based cleanup goals in the 0- to 15-foot depth interval were evaluated for corrective measures.

Based on the results of the detailed evaluations of corrective action alternatives, Alternative 2 was chose as the recommended alternative for soils.

Alternative 2 proposes institutional controls at SWMUs 2, 3, 9, 10, 11, 12, 31, 33, 37, and the Buried Tanks at Test Cells. Alternative 2 received the highest score for the detailed evaluation factors and the remedy selection decision factors.

Alternative 2 meets the objective of minimizing exposure to soil containing contaminants of concern above the health-based cleanup goals developed in this CMS.

Implementation of the institutional controls described above are designed to protect human health by minimizing exposure to soils at SWMUs 2, 3, 9, 10, 11, 12, 31, 33, 37, and the

Buried Tanks at Test Cells. Access to these areas will be controlled and all excavation and other intrusive activities would be completed utilizing appropriate health and safety procedures and in compliance with OSHA regulations related to excavation of contaminated soil designed to protect excavation personnel. Excavation is the only complete exposure pathway identified in the Risk Assessment.

Implementation of institutional controls at the SWMUs with contaminants of concern above health-based cleanup goals would involve leaving the contaminated soil in place. The institutional controls would limit exposure to these contaminants and protect human health. Leaving the contaminants in place would have limited environmental impact, based on site conditions. The majority of contaminated soil is present below depths of four feet and is covered by buildings and pavement. The contaminants of concern above the cleanup goals include TPH, PCBs and VOCs. TPH and PCBs are relatively insoluble in water. VOCs are present in the vadose zone above health-based cleanup goals at SWMUs 2 and 33 only. VOCs are present in SWMUs 3, 9, 10, 11, 12, 31, 37, and Buried Tanks at Test Cells but at relatively low levels. Much of the VOC contamination at the site has already migrated into the groundwater and further releases of VOC's from the vadose zone are not likely to have a major impact on site groundwater contamination in the long- or short-term.

The corrective action objectives for groundwater in the ICGFS include containment of the contaminated groundwater within the facility boundaries. Remediation of groundwater to meet media cleanup standards is technically impractical due mostly to the presence of DNAPL already in the saturated zone. Also, no complete exposure pathway for site groundwater was identified in the risk assessment. Due to the conditions described above, soil contamination at SWMUs 2, 3, 9, 10, 11, 12, 31, 33, 37, and the Buried Tanks at Test Cells above the water table pose minimal risk to human health and the environment.

The corrective action objectives for groundwater in the ICGFS include containment of the contaminated groundwater within the property boundaries of the BFC. Any contaminants released from the soils would also be contained within the boundaries of the BFC to protect the environment. All the groundwater exposure pathways for groundwater from the ICGFS were identified as either minor or incomplete exposure pathways which would pose little or no threat

to human health. Soil contamination at SWMUs 2, 3, 9, 10, 11, 12, 31, 33, 37, and Buried Tanks at Test Cells is mostly located under buildings, concrete or other structures which limit surface water infiltration in these areas.

Routine construction in the area of SWMUs 2, 3, 9, 10, 11, 12, 31, 33, 37, and Buried Tanks at Test Cells which contain contaminants of concern above health-based cleanup goals will likely be required in the future. The institutional controls for Alternative 2 include procedures to ensure appropriate management of excavated soil, debris, or other waste materials. All contaminated materials excavated in these areas will be managed (treated, disposed) according to the applicable EPA, State, and local standards.

This CMS also proposed corrective action alternatives for groundwater in the ICGFS. The corrective action objectives developed for this groundwater include:

Protection of human health and the environment by preventing exposure of potential receptors to groundwater contaminants in excess of the proposed protection standards for groundwater.

Containment of the leading edge of the groundwater having contaminants of concern which exceed the proposed groundwater protection standards within the property boundaries of the BFC.

Based on the detailed evaluation of the corrective action alternatives, Alternative 2 is the recommended alternative for groundwater in the ICGFS. Alternative 2 includes containment of the groundwater plume in the ICGFS. Containment of the plume will prevent discharge to surface water bodies downgradient. No potential human receptors of contaminated groundwater were identified for the ICGFS groundwater.

Groundwater from the ICGFS is not used as a water supply for any purpose. As long as the contaminated groundwater is contained, no human health risks to employees of the KCP or surrounding communities are identified. There is currently no identified reason that groundwater in the ICGFS would be used as a water supply. All the groundwater exposure pathways for groundwater from the ICGFS were identified as either minor or incomplete exposure pathways which would pose little or no threat to human health.

Operation of the building foundation drains and treatment system benefits the environment by containing the groundwater plume. Containment of the plume within the property boundaries will protect downgradient groundwater and control the size of the contaminated plume. Alternative 2 would result in the removal and treatment of an estimated 30 million gallons of contaminated groundwater per year. Treatment of the groundwater will be done utilizing the UV/Oxidation system already in place at the site. This system destroys the contaminants of concern in the groundwater. It is not known whether or not the removal of this contaminated groundwater would result in any detectable decrease in the levels of contaminants in the groundwater in the ICGFS.

For the KCP, the evaluation of groundwater and the risk assessment show that the groundwater plumes do not pose a present risk to human health and are unlikely to pose a future risk because groundwater is not used as a water supply. The Corrective Action Objectives for groundwater were developed based on conditions at the site. Restoration of groundwater plumes to media cleanup standards (MCLs or ACLs) may not be achievable due to the limitations of available remediation technologies and the presence of DNAPLs. The presence of DNAPLs is difficult to locate and remove from the subsurface, and they provide a continual source of dissolved groundwater contamination.

DNAPLs are believed to be distributed throughout the saturated zone at the KCP as discontinuous ganglia that would be continuing sources of groundwater contamination. Remediation of the ICGFS to media cleanup standards (MCLs or ACLs) is impractical because of the fine-grained nature of the aquifer at the KCP and the presence of DNAPL in these areas. Contaminated groundwater at levels above the proposed protection standards for groundwater in the ICGFS will be contained on-site.

The source control evaluation includes the control of sources of releases so as to reduce or eliminate, to the extent practicable, further releases that may pose a threat to human health and the environment. Several potential sources of groundwater contamination still exist at the site. Soil contamination exists in the vadose zone at various SWMU locations in the ICGFS. Potential sources of groundwater contamination also exist in the saturated zone especially

along the top of the bedrock surface. This contamination is a potential ongoing source of groundwater

Contamination in the ICGFS. All the groundwater exposure pathways for groundwater from the ICGFS were identified as either minor or incomplete exposure pathways which would pose little or no threat to human health. Further releases to groundwater from these sources would pose a minimal threat to human health and the environment. Sources of contamination of soil at the KCP have been addressed by past actions and are no longer present. There are no identified human receptors for groundwater and contaminated groundwater poses no threat to human health. Much of the contamination is under buildings and other permanent structures, making removal of the contamination at the bedrock surface in these areas technically impracticable.

Groundwater collected in the building drains will be treated utilizing the on-site UV/Oxidation system. Treated water will be discharged to the POTW under a discharge permit with the City of Kansas City, Missouri. Treated water is required to meet the discharge limits of the permit prior to discharge. The UV/Oxidation system destroys the contaminants of concern without producing any secondary waste products.

5.21.5 Multiple Sites CMS: Summary of EPA's Final Decision

EPA Issued a Final Decision and Response to Comments after review and in consideration of Public Comments received after the Public Notice of the Multi-Site CMS.

In its Final Decision, EPA established cleanup levels for 33 contaminants of concern found in soil at the Multiple Sites. EPA divided the 18 SWMUs into three groups, based on degree of soil contamination and location.

Group 1 includes SWMUs where none of the contaminants of concern exceed the soil cleanup levels. Since the cleanup levels are based on human exposure to the contaminants of concern through industrial land use, the Final Decision requires that industrial land use be maintained at the Group 1 SWMUs. No other action was required at Group 1 SWMUs.

Group 1 Solid Waste Management Units

No.	SWMU Name
4	Classified Waste Trenches
16	Sales Building Site
17	Building 54
32	Department 27 (Inside)
36	Maintenance Vehicle Repair Shop Sump
39	Department 95
40	Former Chip Handling Building
41	Department 20 Degreaser Pit

Group 2 consists of SWMUs where some contaminants of concern are present at concentrations greater than the cleanup levels, and where the contaminated soil is located beneath buildings.

Group 2 Solid Waste Management Units

No.	SWMU Name
2	TCE Still Site
31	Department 26 (Inside)
33	Oil House
43	Buried Tanks at Test Cells

Group 3 consists of SWMUs where some contaminants of concern are also present at concentrations above the cleanup levels, but the contaminated soil is not covered by buildings.

Group 3 Solid Waste Management Units

No.	SWMU Name
3	Waste Transfer Spill Area
9	Acid and Alkaline Tanks
10	Waste Oil Tank
11	Substation 18
12	Department 26 (Outside)
37	Abandoned Sump

EPA's Final Decision requires the following risk management activities for SWMUs in Group 2 and 3:

Soil contamination in the unsaturated zone was addressed by leaving the contaminated soil in place, maintaining current or comparable engineering controls and implementing appropriate institutional controls to minimize infiltration of rainwater or surface water and to prevent

current and future human exposure to contaminants of concern in the soils and groundwater." (The unsaturated zone is the soil above the water table.)

"DOE will continue to evaluate innovative treatment technologies for remediating contaminated soil and groundwater at various sites at the DOE Kansas City Plant and may later propose additional remedies."

"DOE is to refrain from using any real property that it owns or controls at or near the Kansas City Plant in any manner that would interfere with or adversely affect the integrity or protectiveness of the corrective action measures to be implemented at the Multiple Sites pursuant to this final decision. DOE shall incorporate land use restrictions and conditions for the Multiple Sites into the current DOE Kansas City Plant security and internal land use permitting system." The land use restrictions apply to all of the Multiple Sites SWMUs and include preventing public access to contaminated soil, managing risks posed by excavation of contaminated soil, maintaining current or equivalent cover over contaminated soil, not using the groundwater as a water supply for any purpose, and using the Multiple Sites for industrial purposes only.

"To ensure the protectiveness of corrective measures in the event of a transfer of custody and control from DOE to another federal agency or a conveyance of a real property interest to some non-federal person or entity, institutional controls will have to continue. Compliance with the institutional controls will have to be enforceable against whoever might have ownership, possession, or custody and control of the real property."

To provide for continuation of institutional controls, the Final Decision required DOE to implement the following proprietary controls:

- DOE is to file a notice with the Jackson County, Missouri Recorder of Deeds that notifies all future title holders to any or all of the Multiple Sites that the Multiple Sites contain hazardous waste and hazardous waste constituents, are subject to the corrective measures described in the Final Decision I, and that use of the real property is restricted.

- Before the ownership of any or all of the Multiple Sites is transferred to another governmental agency or a private entity, DOE is to give written notice to the potential transferee of the regulatory history and status of the Multiple Sites.

- DOE shall provide for the continuation of appropriate institutional controls if the ownership or custody and control of any or all of the Multiple Sites is transferred to another governmental agency or a private entity. An access easement and a land use restriction easement will be filed prior to, or upon the conveyance of the property or transfer of custody and control thereof. The access easement will allow access to the Multiple Sites by DOE and MDNR. The land use restriction easement will prevent public access to contaminated soil, require management of risks posed by excavation of contaminated soil, maintain current or equivalent cover over the soil, prohibit the use of groundwater as a water supply for any purpose, and require use of the Multiple Sites for industrial purposes only.

5.22 Long Term Operations Maintenance and Monitoring Plan

The Long Term Operation Maintenance & Monitoring (LT OM&M) Plan outlines ongoing corrective action activities that are occurring at the BFC.

The LTOM&M plan contains a variety of subdocuments. These are the plans that serve to comply with the Permit as well as complying with the final remedies at SWMUs at the BFC that have completed Corrective Action. Documents included in the LTOM&M Plan are described below:

5.22.1 A Groundwater Treatment System Operations and Maintenance (O&M) plan

The BFC is required to treat contaminated groundwater collected from various sources throughout the Bannister Complex. The groundwater treatment system at the BFC utilizes advanced oxidation processes to destroy volatile organic compounds (chlorinated solvents). Sixty kilowatts of ultraviolet light and hydrogen peroxide (H_20_2) are used to treat contaminated groundwater. Two treatment units are in place, however, only one is operating at any given time. The treated wastewater is discharged to the sanitary sewer under the provisions of a pre-treatment permit. The O&M plan addresses operation of this system.

5.22.2 Excavated Soil Management Procedures.

To facilitate the repair and maintenance of utilities on site that may be in areas of contaminated soil identified as a listed RCRA hazardous waste (40 CFR 260.32), the permit allows a special procedure to be followed so that the soil may be returned to the excavation from which it was derived as opposed to being removed for disposal.

5.22.3 Sitewide Sampling and Analysis Plan

This plan describes the sampling and analysis methods for collection and chemical analysis of environmental media at the BFC (soil groundwater surface water) along with corresponding reporting requirements. Inspection, maintenance and upkeep requirements for groundwater monitoring and pumping wells are provided.

5.22.4 Site-wide Institutional Controls Plan

The master document that describes the comprehensive system of institutional controls at the facility is the Site-wide Institutional Controls Plan. It is the resource utilized for all application of institutional controls at the facility arising from environmental clean-up activities. A revised version incorporating GSA operations and covering the entire BFC is under review as a part of a previously submitted LTOM&M required by the modified permit.

Within the broad scope of institutional controls described in the plan, there are "procedural controls" and "proprietary controls." Procedural controls are rules and procedures that an organization imposes upon it. Proprietary controls are those based in property law, and may include land use restrictions, easements, and deed notices. These components are described below.

5.22.4.1 Procedural Controls

The KCP has an extensive system of written procedures to assure quality and consistency in its enterprise, and sound environmental management. The quality system, certified under IS0 Standard 9001 ensures that all activities at the KCP are planned, are performed in a predetermined manner, and that there are clearly defined channels for communicating information and instructions. The environment, safety, and health (ES&H) management system, certified under IS0 Standard 14001, ensures that consideration is given to human health and the environment in plant activities, and communicates ES&H requirements to plant workers. Several of the procedural controls influence compliance with environmental regulations and protection of plant workers and the public. These procedural controls are applied to many types of activities at all locations at the KCP.

The procedural controls described below work to minimize exposure of workers involved in excavation and other intrusive activities at the BFC.

There are eight procedural controls that affect excavation at the BFC:

1. HAZWOPER (Hazardous Waste Operations and Emergency Response) determination
2. Preliminary hazard analysis FHA)
3. Excavated Soil Management Procedure
4. Construction waste assessment
5. Design review process
6. Construction safety plan
7. Excavation permit system
8. Internal Work instruction on excavations in areas subject to institutional controls

The first four controls are exercised when a construction project is in the conceptual stage so that any special requirements related to worker safety, waste management, and environmental protection are addressed in the design, contract documents, and project budget. Personnel in the KCP HS&E Departments exercise the first control during review of construction design documents to ensure that concerns have been addressed in the documents. The sixth, seventh and eighth controls are exercised when projects enter the construction phase.

5.22.4.2 HAZWOPER Determination

The HAZWOPER determination is performed to identify construction projects (or portions of projects) that are subject to the requirements of 29 CFR 191 0.120. This regulation is an OSHA standard that focuses on worker safety when handling hazardous wastes, performing environmental remediation, and emergency cleanup of spilled hazardous materials. Engineers responsible for managing construction projects at the BFC have received the "HAZWOPER Application Manual". The manual contains a flow chart that was developed from 29 CFR 191 0.120(a)(l) and adapted to fit conditions at the site. Anyone planning to excavate must use a qualified contractor who complies with 29 CFR 19 10.120 unless it can be shown that the work would not expose workers to health hazards.

5.22.4.3 Preliminary Hazard Analysis

The Preliminary Hazard Analysis (PHA) is a systematic process that provides a formal review of proposed changes to the KCP that has the potential to affect the safety and health of people, or to create discharges to the environment. A PHA is required for all construction projects, new production processes, and any other new activity that will generate waste. In the case of a construction project that will require excavation at the BFC, the project engineer will initiate the PHA review by completing a form called a PHA Checklist. The checklist is used to identify project activities that could have HS&E consequences. The completed checklist is submitted with supporting information such as construction drawings or a written description of the work to be performed. HS&E personnel review the checklist. If excavation is noted on the checklist, an HS&E reviewer will check the excavation location for presence of soil contamination by reviewing the various reports associated with the. If the excavation is to occur in such an area the reviewer will list action items and/or recommendations related to the soil contamination on the PHA report. Excavations within covered areas will require dialogue with MDNR through the submission of a workplan or if related to the maintenance and repair of utilities implementation of the excavated soil management procedure. The PHA report will be returned to the project engineer, who must complete the action items (including submission of appropriate information to the HS&E employee to be provided to MDNR) and consider the comments and recommendations provided in the report before the project begins.

5.22.4.4 Excavated Soil Management

Repair and maintenance of utilities at the BFC may require excavation of contaminated soil. The excavated soil management procedure allows the Permitees, with MDNR approval, to use some or all of the contaminated soil to refill the excavation. This practice reduces the amount of regulated waste produced, and is consistent with the chosen corrective measure.

As noted in the preceding section, HS&E personnel review construction project plans during the PHA. If excavation of contaminated soil is indicated on the plans, a reviewer will determine if the excavated soil management procedure could be utilized. If so, the reviewer researches the, facility environmental records for sampling data used in prior RCRA Facility Investigations in the immediate area to be excavated. If no data is found, sampling and analysis

of the soil to be excavated is performed. The sampling data and a site map are submitted to MDNR at least 15 days prior to the work, requesting reuse of contaminated soil as backfill material. The map shows the location and depth of excavation, the locations and depths of soil samples, and the locations of regulated units, SWMUs, and/or releases from such units. If MDNR approves the request, reuse of the contaminated soil will be reflected in the construction waste assessment and the construction documents (specifications and drawings). As a minimum, the top four inches of backfill material must be clean (no contaminants above background concentrations). Any excavated material not reused in the excavation must be managed in accordance with applicable local, state, and federal requirements.

Depending on the SWMU or area of soil contamination to be excavated a workplan or notification is required to be submitted to MDNR for approval.

5.22.4.5. Construction Waste Assessment

This procedural control assures that any waste generated from excavation at the BFC is managed appropriately. One of the PHA reviewers is a waste classifier, who studies the PHA Checklist and supporting information to determine what types of wastes will be generated by the construction project. On a construction project that involves excavation of soil at contaminated areas under institutional controls, the waste classifier will examine available sampling data (i.e., an RFI report and/or sampling done to determine the classification of any waste that may result from the project). If necessary, additional samples are obtained and analyzed.

If the soil would be classified as a hazardous or special waste, the classifier prepares a waste profile. The profile is submitted to licensed disposal sites to assure that the waste will be accepted there. If necessary, arrangements are made for new disposal contracts. The classifier also prepares a waste identification table for the manager of the construction project. The waste identification table provides the waste classifications and instructions for handling the waste before it leaves the KCP, such as segregation of waste streams and the type of waste containers to use.

5.22.4.6 Design Review

The design review process provides for examination of construction documents (specifications and drawings) by several KCP departments. Among the departments that review the construction documents are those responsible for HS&E matters. The purpose of the review is to assure that concerns of the various departments are addressed by the documents. If a construction project requires excavation at an area under institutional controls the design review will assure that the construction documents contain requirements for compliance with environmental and waste management regulations, worker safety and health protection, and environmental protection.

Several copies of the construction documents are made and distributed to the reviewing departments. In most cases, two weeks are allowed for the review. The review period may be shorter or longer, depending on the size and urgency of the project. Reviewers write comments on a form and return them to the manager of the construction project. The manager also conducts a review meeting to allow face-to face discussion of the comments. The manager writes responses to the review comments on the same forms and returns copies of the forms to the reviewing departments so the reviewers can see what actions will be taken as a result of their comments. The manager of the construction project then revises the construction documents in accordance with the comment responses.

5.22.4.7 Construction Safety Plan

Each construction contract issued at the KCP requires the construction contractor to prepare a project-specific safety plan for the company's employees and subcontractors. The construction safety plan must be reviewed and accepted by a KCP safety professional prior to the start of construction. Construction safety plans are required to describe the safety, health, fire, and environmental hazards anticipated by the contractor as well as the contractor's plans for eliminating or minimizing those hazards. For projects that include excavation at areas under institutional controls the construction safety plan will also address levels of personal protective equipment, decontamination areas, work zone boundaries, site controls, material safety data sheets, and emergency notification procedures per the HAZWOPER standard (29 CFR 1910.120).

5.22.4.8 Work Instruction

An internal work instruction exists in the DOE'S command media system outlining activities that must occur when excavating in areas subject to institutional controls. The work instruction provides a map showing the exact locations of areas subject to institutional controls and the information that must be supplied to the subject matter expert so that the appropriate excavated soil management, workplan or notification may be submitted. This work instruction follows excavation requirements provided in the Permit. A copy of this work instruction is provided as a part of the LT OM&M plan. It includes specific requirements for work on all areas of the BFC including those areas owned by GSA.

5.22.4.9 Excavation Permit

The excavation permit system is a safeguard; an opportunity just before excavation begins for KCP personnel concerned with environmental protection and worker safety to assess the planned excavation procedures and equipment. The permit system assures that the construction contractor intends to perform the excavation work safely and in accordance with the environmental protection aspects of the construction specifications.

A site environmental specialist, a safety engineer, the manager of the construction project, and the contractor's safety representative must sign the permit form before excavation is allowed to begin.

5.22.5 Deed Restrictions and Restrictive Covenants

Introduction

Deed, access and land use restrictions exist at the BFC as a result of the implementation of corrective measures. As discussed previously, in certain areas of the facility contaminated soil remains above risk based clean-up levels requiring continuing controls to prevent unauthorized access and/or use. In addition, contaminated groundwater also remains at the facility above permit mandated clean-up standards. To assure unauthorized access and/or use of soil and

groundwater is prevented, a series of institutional and engineering controls are in place. An institutional control is a non-physical control that is exerted through legal documents, laws, ordinances, or the internal rules of an organization. They are used to limit human activities at a contaminated site to protect human health and the environment from exposure to the contaminants of concern, for as long as the contaminants remain above levels that would allow unrestricted use of the property. Engineering controls are man-made barriers that prevent exposure to contaminants of concern where they lie, or inhibit migration of contaminants of concern to remote points of exposure. Exposure, in this context, means that conditions are right for the contaminants of concern to enter the body by ingestion, inhalation, or absorption through skin contact. The permit includes specific requirements that these controls must meet and the documents that must be written to memorialize the processes created to implement the controls.

The permit also includes provisions related to deed and access restrictions. Specifically, the permit requires documentation to be filed with the Jackson County, Missouri Recorder of Deeds. Some documents have already been submitted while other documents (revised deed and access restriction required by the modified permit) are still undergoing review at MDNR. This section describes these documents, including when and why they are required and the specific information they contain.

5.22.5.1 Restrictions and Covenants related to the permit

The permit requires that land use restriction notices, access restrictions and environmental covenants be recorded with the Jackson County Recorder of Deeds to assure that future owners and/or operators of the facility are aware of the nature and extent of contamination that exists at the facility; the restrictions placed on the use of the land; the processes in place to prevent unauthorized access that must be continued; and any agreements to allow authorized personnel (e.g., regulatory officials) access to the facility.

5.22.5.2 Documents Previously Filed

DOE filed a land use restriction notice and a survey plat with the Recorder of Deeds of Jackson County, Missouri in early 2000 as mandated in the original 1999 HWMF permit. The information was submitted for all regulated units for which levels of contamination in the

subsurface soils and/or groundwater exceeded background concentrations and/or other applicable regulatory thresholds at the time of closure of the units. The survey plats show the location and dimensions of each regulated unit with respect to permanently surveyed benchmarks. Specifically, these notices and survey plats were filed for the North Lagoon, South Lagoon and Underground Tank Farm.

In addition, a land use restriction notice and two figures drawn to scale were filed with the Recorder of Deeds for Jackson County, Missouri, in 2000 illustrating the approximate boundaries of each Solid Waste Management Unit for which levels of contamination in the subsurface soils and/or groundwater exceeded background concentrations and/or other regulatory thresholds at that time. One figure illustrates soil contamination, and the other illustrates groundwater contamination. The type, location, and concentrations of hazardous waste and/or hazardous constituents are noted on the figures.

The filing of the land use restriction notice provides notice to any potential purchaser of the property that: The land has been used to manage hazardous waste and/or hazardous constituents; and a formal, legal record showing the type, location, and concentration of hazardous wastes and/or hazardous constituents remaining in the subsurface soils and/or groundwater.

5.22.5.3 Documents Yet to Be Filed

The permit requires that an access easement, land-use restriction easement, and restrictive covenants be filed and recorded in the Recorder's Office of Jackson County, Missouri, and to be written to run with the land and be enforceable under Missouri law. As discussed above, a Land Use Restriction notice has been filed with the County of Jackson County for the three RCRA land disposal units (North and South Lagoon and Tank Farm) along with maps of soil and groundwater contamination as listed above. The permit also requires that the Deed Notion and/or Deed Restriction requirements be updated to include all SWMUs contained in the modified permit that had completed the corrective action process. This has been performed and remains at MDNR and EPA under review.

The Permitees have provided the required restrictive covenants, land use restriction and access easement in accordance with the Missouri Environmental Covenant Law (MECL). The MECL allows environmental covenants to be created for real property that is or has been the subject of environmental remediation. The covenants are standardized voluntary agreements in which parties with an interest in the real property ensure that restrictions on site usage required by the remediation are maintained. The Permitees submitted a draft of the Missouri Environmental Covenants Act language tailored specifically to the BFC and specific requirements outlined in the permit as a part deliverables that were 60 days after completion of the Permit modification. This included an access agreement component and restrictive covenants. A summary of specific components included in the submission is provided below.

Permit Mandated Land Use Restrictions

Institutional controls, access restrictions, and stringent security measures are currently in use at the BFC. The institutional controls provide that any real property at the BFC not be used in any manner that would interfere with or adversely affect the integrity or protectiveness of the corrective action measures to be implemented. As stated in the permit, the institutional controls incorporate the following land use restrictions:

- Public access to all contaminated soil shall be prevented by appropriate means such as fences and other security measures.

- Any future construction or maintenance activities involving excavation of contaminated soil shall include internal controls consistent with Occupational Safety and Health Administration (OSHA) requirements regarding appropriate worker exposure protection and shall provide for the management of the soil according to federal, state, and local regulations.

- Buildings, structures, and pavement that currently cover contaminated soil shall not be removed or altered unless alternative corrective measures to protect human health and the environment are provided and have the prior approval of the MDNR. An exception to this is repair and maintenance of utilities provided for by the Excavated Soil Management Procedures

found in the permit. Alterations that are subject to this provision are limited to those that result in exposing presently covered contaminated soils.

- Groundwater from the BFC shall not be used as a water supply for any purpose.

- Unless previously approved by the MDNR, the areas with institutional controls may not be used for any purpose other than industrial use. Industrial uses are those that result only in exposure of adult workers in industrial, construction, and maintenance activities consistent with the exposure assumptions in the Multiple Contaminated Sites Corrective Measure Study (CMS) and the exposure assumptions in the 95th Terrace Site CMS.

- The Sitewide Institutional Controls Plan includes proposed drafts of the access easement, land-use restriction easement, and restrictive covenants.

- The draft easements and restrictive covenants retain or grant the access easement rights and the right to enforce the land use restriction to the United States, on behalf of DOE, GSA and their representatives and to the state of Missouri and its representatives.

- The EPA is a third party beneficiary of the rights and benefits conveyed to the grantees in the easements and restrictive covenants, including the right to enforce the easements and restrictive covenants. The state of Missouri may opt to be a third party beneficiary or a grantee of the easements and restrictive covenants.

- The easements shall be free and clear of all prior liens and encumbrances (except as approved by the MDNR), and be acceptable under the U.S. Attorney General's Title Regulations promulgated pursuant to 40 U.S.C. 255.

5.22.5.4 Permit Mandated Access Easement Components

The access easement includes a grant of a right of access to the real property for the purpose of conducting any activity related to the corrective measures provided for in the Permit. In order to comply with BFC (DOE) site security requirements, regulatory representatives must be U.S. citizens, be accompanied by a DOE or DOE contractor escort, and if entering any DOE exclusion area, shall have a DOE Q access authorization. Activities allowed under this easement include, but are not limited to the following:

- Monitoring the work.
- Verification of data or information submitted to MDNR and EPA.
- Conducting investigations relating to contamination at, near, or migrating from the facility.
- Obtaining samples.
- Assessing the need for, planning, or implementing additional response actions at the facility.
- Implementing work pursuant to conditions set forth in a final remedy or this Permit.
- Inspecting and copying records, operating logs, contracts, or other documents maintained or generated by DOE or its agents.
- Assessing DOE's compliance with this Permit.
- Determining whether any property at the KCP is being used in a manner that is prohibited or restricted.

5.22.5.5 Institutional Controls for Soil Not on KCP Property

Much of the contamination at the 95th Terrace site is present below 95th Terrace (street) at depths greater than 30 feet. Although deep borings were not completed below Bannister Road and its embankment, PCBs are present within the old Indian Creek channel. This channel now houses the current 002 storm sewer box culvert. Some PCB containing soils were left in the area of the 002 Raceway following remediation in 1988. The EPA allowed PCBs to remain in the soil at approximately 1 mg/kg to 4 mg/kg provided that the area was covered with approximately 4 feet of clean fill. This area is not on KCP property. That portion of the 95th& Terrace Site including Bannister Road (95th Street) and land just to the south of Bannister road running to

Indian Creek is owned by the Missouri Department of Transportation (MoDOT). Institutional controls described for the BFC property are not applicable to off-site property.

MDNR, GSA DOE, and the Missouri Department of Transportation (MoDOT) will discuss deed restrictions and controls on construction that could be implemented in cooperation with MoDOT to minimize intrusive activities that could potentially disturb PCB-contaminated soil on MoDOT property. The majority of soil contamination associated with the 95th Terrace site that is off the BFC property is present at depths of 30 feet or greater and would not be encountered during routine maintenance activities on 95th Terrace or Bannister Road.

SWMU History and Status
on the following pages