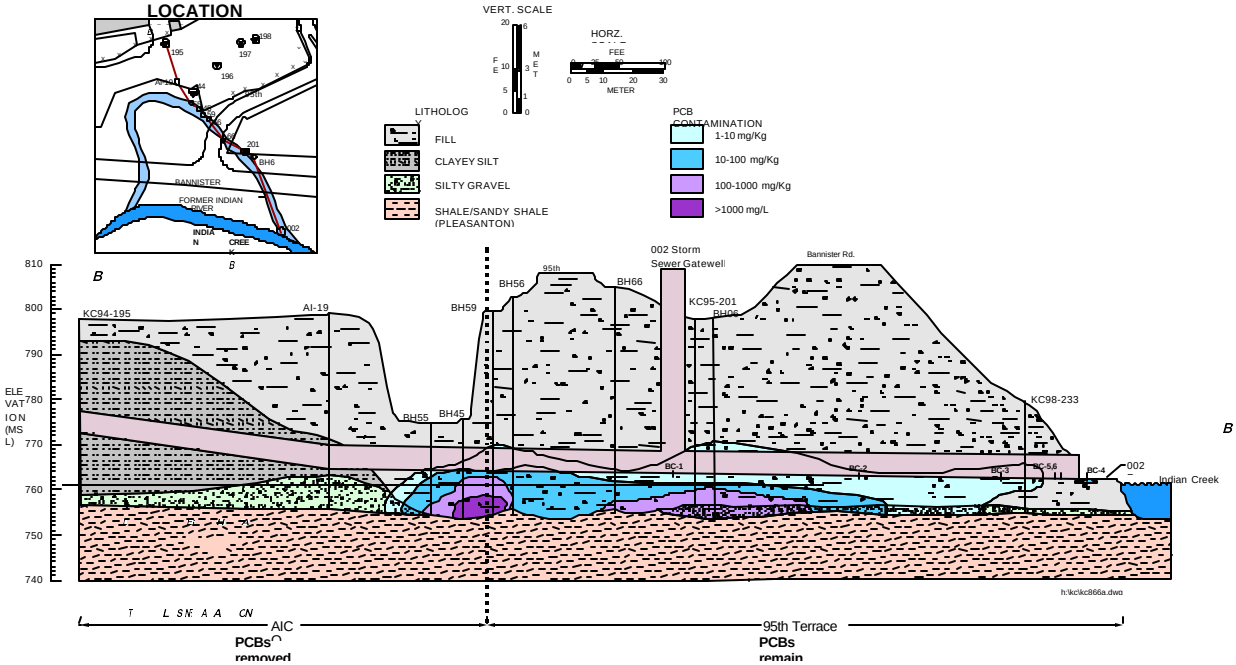
WSRC-RP-2003-00276

Department of Energy Office of Science and Technology

Technical Assistance to Kansas City Plant: Mitigation of Polychlorinated Biphenyl Discharges

Kansas City, Missouri



January 28-30, 2003

FINAL REPORT

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Kansas City, Missouri, January 28-30, 2003

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EXECUTIVE SUMMARY

Soil and storm water discharges from the Department of Energy (DOE) Kansas City Plant (KCP) contain polychlorinated biphenyls (PCBs) resulting from past spills and discharges. KCP has implemented a range of actions to mitigate the soil contamination and to reduce the measured PCB releases. These actions were permitted and overseen by environmental regulatory agencies and included: soil removal, lining and cleaning drainpipes, rerouting water, and the like. Recently, the target outfall discharge limits were lowered and additional actions to isolate and protect the storm sewer are being implemented. DOE KCP requested an independent assessment of the historical and planned activities, identification of additional short-term activities that might further reduce outfall concentrations, and identification of long-term strategies to minimize risks from past PCB spills. The independent technical assistance team (Appendix A) was assembled and completed the requested tasks.

The technical assistance team was impressed with the scientific quality of PCB related studies and support efforts performed by the contractor, KCP, and their collaborators over the past twenty years. These activities, and the resulting practical outcome-oriented responses, have significantly decreased PCB concentrations in Outfall 002. The team identified several notable technical items. The team was encouraged by the information provided and the site's progress in addressing PCBs in the outfall. We did identify a variety of potential opportunities and have described these and provided a summary description and a preliminary evaluation of each. We would encourage KCP to incorporate these opportunities, as appropriate, into their plans. In particular, the team was concerned with extended continuation of the existing response concept of "isolating the storm drain system from the residual PCBs" and with viewing such actions as a final protective actions. While this approach has generated good PCB reductions in stormwater discharges in the past, simple isolation is unlikely to provide the type of robust and multi-layered protection desired by facility managers/administrators and by regulators and stakeholders. The team felt that the next phase of storm drain isolation and reconfiguration activities – those activities that are currently being planned in cooperation with regulators – are generally appropriate. Importantly, the team believes that the most significant PCB reductions likely to have already been made or will result from these next activities and that significant outfall concentration reduction from future rounds of "storm drain isolation" are unlikely. Instead, we recommend that the site move toward medium-term actions that diversify protection to the storm drain system and long-term actions that consider isolation, destruction or removal of primary PCB sources in the soil and within facilities.

The team identified a few critical and unresolved issues. These included: need for a clear definition of closure and a strategy for transitioning to long-term operation of the facility as a "brownfield", role of various uncertainties and conservatism in setting standards, challenges of site specific geological limitations such as low permeability, and issues of schedule, budget and lifecycle costs. The existing KCP ER Strategy Document (Appendix B) provides a good base for resolving these issues – with additional detail

KCP could develop clear strategies that provide a comprehensive and thorough basis for closure and transitioning to long-term operation.

Short-term responses supported….

The team evaluated the past and planned storm drain isolation efforts. In particular, we support all of the short-term activities in the draft Settlement Agreement as potentially useful. The team discussed additional actions. The following ideas were considered of merit by the team and may be useful to integrate into the planned KCP Settlement Agreement actions: composite and compliance sampling, expand utilization of semi-permeable membrane sampler, reroute and reuse single pass cooling water, increase utilization of scientific support study results, remove or treat sediment, eliminate non-storm water sources to outfall, renegotiate compliance standards, and analyze chromatogram patterns periodically for evidence of attenuation. A detailed discussion of each of these topics is provided to assist KCP. Where innovative or alternative methods are proposed (e.g., recent advances in analytical methods, composite sampling, etc.), references to prior use are provided. Several of the suggestions were low cost but may provide immediate benefits. One example is addition of granular activated carbon (or other appropriate hydrophobic sorbent) to the sediment traps in the storm sewer system to minimize PCB contributions from periodically accumulated solids. The carbon would be removed and replenished along with trapped sediments according to the current maintenance schedule.

Medium-term Actions Recommended…

Past and present storm sewer protection and isolation efforts can be supplemented by a medium-term activity to attenuate the low concentrations of PCBs that bypass the protections and enter the storm sewer. Such an effort would add an additional layer of protection. By diversifying the response, the overall system can be made more robust and PCB fluxes can be more reliably reduced and stabilized. All of the proposed options would require creative and careful engineering to overcome site-specific challenges such as large storm surges and changes in water elevation in Indian Creek. All of the supplemental medium-term actions discussed by the team involve PCB attenuation in the base flow using filtration, sorption, settling or similar techniques. Large storm surges and any reverse flows from Indian Creek during storms would generally contain few PCBs and could be handled by appropriate bypass systems. The team felt that three possible systems might be viable. These were (1) a wetland treatment cell, (2) trench based treatment, and (3) a small standard package treatment plant. A variant of this strategy that uses the existing surge basin may represent a relatively low cost option. All of the medium-term options require modifications to include a lift station to deliver water, an attenuation cell or treatment unit, a system to return water to the storm sewer, and a system to handle storm events and high water. Most of the medium-term options require an analysis to make sure that increased infiltration does not adversely impact nearby levees or any existing soil contamination. The team felt that opportunistic low-cost implementation of a medium-term option will provide benefit in reducing and stabilizing PCBs in Outfall 002.

Long-Term Strategies Should be Considered….

Efforts to decrease releases of PCBs to levels that are "as low as reasonably achievable" and to minimize exceedances of soil PRL targets may require efforts to directly address the sources within facilities and in the soil. PCBs within facilities are addressed using standard operational controls, isolation methods (epoxy coatings and the like), and surface decontamination methods. Addressing high strength PCB wastes that have already been released into the soil is a significant challenge and will require additional data and careful planning – the team has generated a technology matrix that identifies key issues and uncertainties to assist KCP in this challenging stage. Some of the technologies are not well matched to the KCP site, due to the low permeability for example. Some technologies may not provide sufficient benefit to justify the cost or may in fact cause collateral damages to the environment that offset their benefits. The discussion is organized according the classes of actions that can be used to address high strength PCBs in soil: (1) institutional control and monitored natural attenuation, (2) destruction methods, (3) immobilization and isolation methods and (4) enhanced removal methods. Following the discussion, the team separated technologies into viability categories – "may be viable at KCP", "limited viability may be useful in combination with other strategies", and "not recommended". It is important to note that the PCB sources in soil at the KCP site represent a complex and significant challenge. The team identified substantial caveats and limitations for all of the technologies – even those in the "may be viable" category. The discussion of long-term options presumes that appropriate and complementary short-term and medium-term activities are also performed. We would encourage KCP to read the descriptions and caveats in the body of the report and to perform additional evaluation to determine if the technologies might actually be applicable. The various long-term technologies are listed below.

May Be Viable at KCP

Strategy or Technology	Major concerns
Institutional Control	Leaves high concentration PCB sources in place
Bioremediation (liquid) – primarily in an infiltration gallery implementation over a long period	May be difficult or infeasible to deliver nutrients throughout system
Hydraulic Controls – primarily in an upgradient geosiphon implementation	Leaves high concentration PCB sources in place, changes flow patterns

Limited Viability but May Be Useful in Combination with Other Strategies

Strategy or Technology	Major concerns
Bioremediation (gas)	May be difficult or infeasible to deliver nutrients throughout system, active system
Chemical oxidation	May be difficult or infeasible to deliver oxidant throughout system, oxidant half life precludes slow long-term delivery
Free product removal	Difficult to find, large residual, most sources do not reliably produce free product (use opportunistically)
Sheet pile wall	Cultural interferences
Electrochemical destruction	Not ready for use at this time and may be difficult to implement with KCP interferences. But somewhat applicable to clayey soils and progress of research should be monitored to determine future viability.
Excavation	Expensive and poses high risk to workers and the environment in this setting. May have limited use for small, shallow and accessible sources.
Thermal Removal (steam and six-phase)	Risk due to mobilizing high strength sources – may be difficult to capture mobilized PCBs in low permeability sediment

Not Recommended for KCP

Strategy or Technology	Major concerns
Monitored Natural Attenuation	PCBs are stable and suggestion that they are substantively attenuating is not technically justified. Similar to institutional control but implies additional mechanisms that are not justified
Chemical Reduction	Unsuitable chemistry for in situ applications and immature technology
In situ vitrification destruction	Expensive and poses high risk to workers and the environment in this setting
Freeze barriers	Effective in short-term but not on time scale of PCB source stability
Injected barriers	Difficult in low permeability – difficult to generate quality and reliability required
Permeable barriers	Not suited to low permeability and for PCBs (contaminant not delivered to barrier during it's active lifetime)
Chemical Extraction (surfactants and cosolvents)	Difficult in low permeability – high residuals likely, risk of mobilizing high strength sources