

Technical Assistance to Ohio Closure Sites

Recommendations to Address Uncertainties in Characterization and Delineation of Contamination at the Miamisburg Closure Project



**Miamisburg, OH
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EXECUTIVE SUMMARY

The Miamisburg Closure Project (MCP) requested technical assistance from Department of Energy (DOE)-Environmental Management (EM) to lend support in the following areas: 1) contamination including soils, piping, and concrete pads under WD, 38, HH, SW, and R Buildings; 2) soil and groundwater contamination; 3) buried objects; and 4) underground piping between buildings including storm and sanitary lines (see Appendix A for the technical assistance request). A technical assistance team (TAT) was assembled in October 2002 and met at the site from October 28 to October 31, 2002. On Monday October 28 the TAT met with both contractor and DOE site personnel. Site personnel briefed the TAT on each of the four areas in the request and took the TAT on a tour of the MCP. During Tuesday and Wednesday, the team reviewed baseline data and reports, asked clarifying questions of site personnel, evaluated work plans, determined critical issues, uncertainties, and recommended alternatives where appropriate. This report documents the team's findings and recommendations.

The goals for the TAT for the four areas of concern were to:

- Identify significant uncertainties or concerns that may impact overall closure budget and schedule.
- Identify opportunities for modifying current baseline approaches to either achieve cost reductions and/or technical improvements, or to address uncertainties and concerns.

The TAT identified the following critical issues, uncertainties, and opportunities:

- Site-wide strategic plan for Decontamination and Decommissioning (D&D) and associated buried infrastructure/soil removal
- Final closure verification sampling requirements and strategies
- Bedrock contamination
- Subsurface contaminated soil volume identification and estimation
- Excavation design and implementation
- Free release of the T Building
- Alternative characterization technologies
- Corroded waste transfer line removal
- Soil amendments for in situ stabilization and immobilization
- Mixed waste
- Conceptual site hydrology
- Hydrogeology support provided at a "potential release site" level and larger hydrological implications and integration are not encouraged
- Conservatism associated with "leaching model"
- Improved data interpretation for normal concentrations of analytes
- Monitored natural attenuation strategies for post volatile organic compound (VOC) pump and treat and soil vapor extraction (SVE) system

- Confirm that groundwater risk propagation model is appropriate (baseline is the Flowtube Groundwater Model [<http://www.agric.wa.gov.au/environment/tools/flowtube/>])
- Tritium issues
- Long-term stewardship issues for landfill
- Buried objects
- Sanitary sewer connection from MCP to the city of Miamisburg
- Storm sewer connections from MCP to the river

The TAT made a number of recommendations to DOE-MCP. These suggestions are briefly described below and then are presented in detail in the body of this report:

- Develop a site-wide strategy for designing and implementing building D&D along with associated soil remediation.
- Refine the articulation of soil guideline levels to include averaging area and hot spot definitions.
- Develop total contaminated soil volume estimates that explicitly address uncertainty in the estimate. Any additional pre-design data collection across the site should focus on overall uncertainty reduction.
- Revisit the soil excavation design and implementation process to encourage waste stream minimization.
- Develop a strategy for addressing bedrock with embedded contamination.
- Require locational control and logging for all soil surface radiological surveys.
- Investigate the use of soil amendments as a means for minimizing post-closure contaminant movement, and addressing embedded contamination issues for bedrock.
- Develop a more site-wide hydrologic conceptual model paradigm.
- Evaluate low levels of contaminants in the fractured rock to determine if the original exposure scenarios are valid.
- Evaluate the use of less conservative and more technically robust leaching models to back calculate soil standards for non-radioactive contaminants.
- Use rigorous data interpretation to explain unusual chemistry in a few bedrock wells and potential for above-Maximum Contaminant Level (MCL) concentrations for barium, radium, nickel, and chromium in monitoring wells.
- Consider monitored natural attenuation strategies for post VOC pump and treat and SVE system operations in Operable Unit-1 (OU-1).
- Consider a number of tritium management strategies to minimize risk and potential remediation costs.
- Consider evaluating the long-term stewardship issues associated with maintaining the onsite landfill, when all other contaminated sources are being removed from the site for off-site disposal.
- To determine where buried objects are located, consider contracting a competent geophysics contractor that could do all PRSs either in one mobilization or at least on a single contract.
- Characterize storm sewer lines by the graded approach similar to that

recommended by the previous technical assistance request for Mound and Ashtabula.

- For consideration of hookup to the Miamisburg sewage treatment system, carefully analyze historical sludge data from the onsite sewage treatment system for potential contaminants of concern and similar data from nearby city sewage treatment plants. Alternatively, DOE-MCP should also consider installation of a new package plant for onsite sewage treatment, in lieu of hooking-up to the city sewer system and the associated potential for long-term liability.

The TAT and site representatives identified a number of opportunities for continued involvement at the MCP. The TAT initially had a relatively broad scope with limited time. The commitment by DOE for technical assistance to the closure sites is to provide continuing support for a variety of activities. Examples of activities include additional technical assistance teams, assistance with deployment of new technologies, development of sampling and analysis plans, etc. The TAT identified several areas for additional assistance:

- Development of a site-wide closure strategy for concrete and soils.
- Development of cleanup values for fractured rock contamination.
- Review and recommendations of soil amendments to be added during excavation to reduce mobility of residual contaminants.
- Development of a sampling and excavation strategy for the area containing Buildings WD and HH.
- Develop dose calculation information requirements for dose modeling for T Building to support free release.
- Support evaluation of alternatives for the storm water and sanitary sewer lines including fate and transport evaluations associated with the potential for residual contaminants in sludge that is directed to land application.
- Support the evaluation of the rebound test and monitored natural attenuation implementation post pump and treat/SVE treatment for VOCs.

1.0 INTRODUCTION

The Miamisburg Closure Project (MCP, also referred to as the Mound site) requested technical assistance from Department of Energy (DOE)-Environmental Management (EM) to lend support in the following areas: 1) contamination including soils, piping, and concrete pads under WD, 38, HH, SW, and R Buildings; 2) soil and groundwater contamination; 3) buried objects; and 4) underground piping between buildings including storm and sanitary lines (see Appendix A for the technical assistance request). A technical assistance team (TAT) was assembled in October 2002 and met at the site from October 28 to October 31, 2002. Appendix B provides contact information for all participants in the meeting and Appendix C provides background information on the expertise of the technical assistance team members. On Monday October 28 the TAT met with both contractor and DOE site personnel. Site personnel briefed the TAT on each of the four areas in the request and took the TAT on a tour of the MCP. During Tuesday and Wednesday, the team reviewed baseline data and reports, asked clarifying questions of site personnel, evaluated work plans, determined critical issues, uncertainties, and recommended alternatives where appropriate. Appendix D further describes the team's Statement of Work. This report documents the team's findings and recommendations.

2.0 MCP SCHEDULE AND ACCOMPLISHMENTS

The schedule of activities associated with the four specific areas identified in the Ohio Technical Solutions Statement of Work is considered critical relative to identifying "windows of opportunity" for implementing preferred alternatives. If specific actions recommended in this report are to be taken, it is important that they be coordinated with current baseline schedules. Baseline schedules reflected here are taken from the staff briefing to the TAT on October 28, 2002 and the *Mound Exit Project Performance Baseline 2002 (PB2), Volume III, Performance Baseline Overview Summary*. The most recent accomplishments are also identified here to note progress to date for the individual projects. Accomplishments tied to schedule should provide a basis for evaluating/justifying continued technical assistance for individual projects/requests. Figure 1 (next page) is a map that shows the locations of buildings and potential release sites (PRSSs).

2.1 Building 38

Accomplishments: The A-line has successfully undergone decontamination and demolition within Building 38, allowing for Decontamination and Decommissioning (D&D) to proceed.

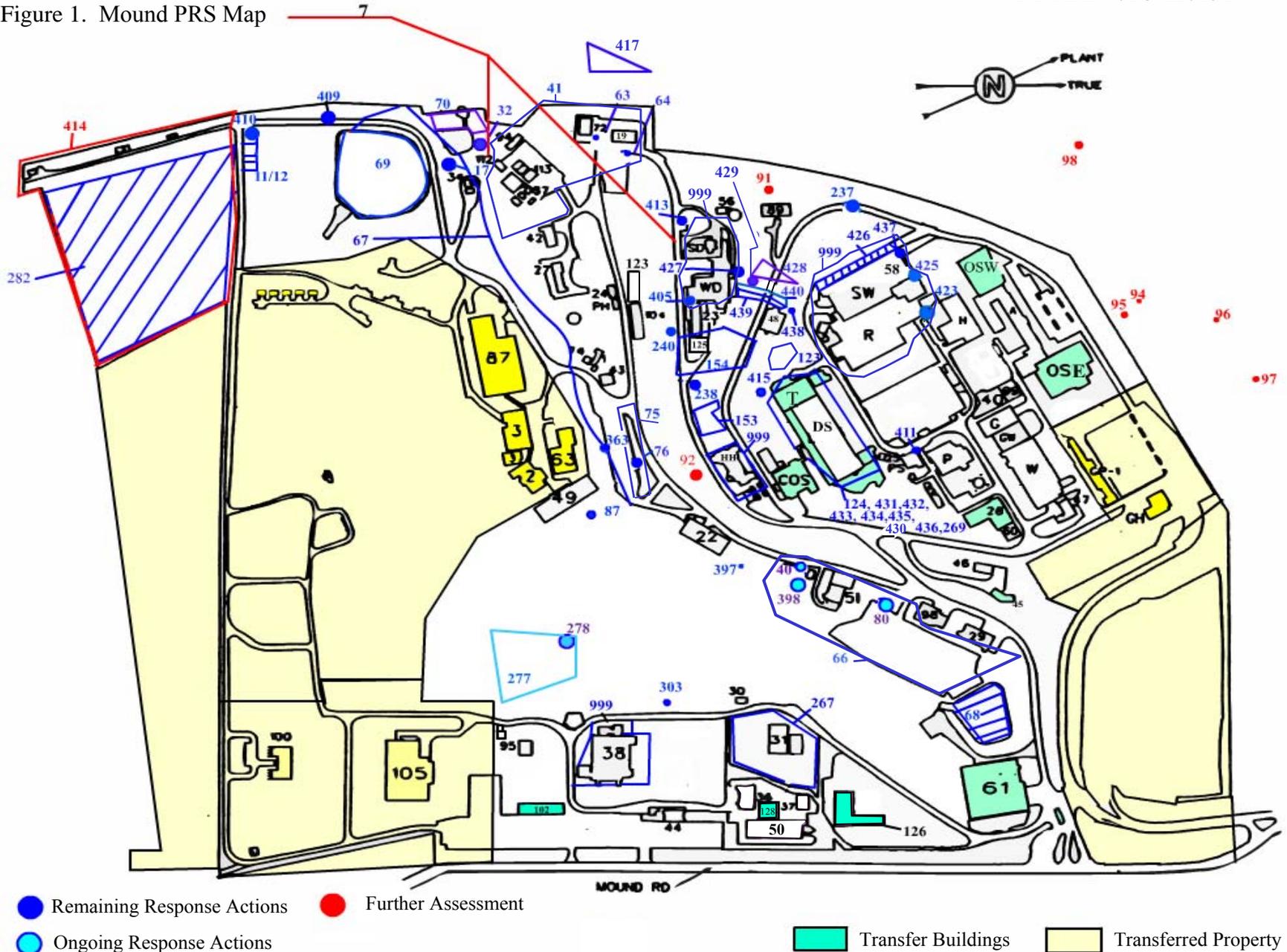
Schedule: The piping is scheduled to be removed in January-February 2003. Building D&D is scheduled to be complete in May 2003.

2.2 Building WD

Accomplishments: In 1998 an alpha treatment system was installed, thereby removing the need for WD building.

Schedule: The piping (feeder lines) is scheduled to be removed in spring of 2003. Building D&D is scheduled to be complete in 2004.

Figure 1. Mound PRS Map



Note: Drawing not to Scale

2.3 Building HH

Accomplishments: Safe shutdown is currently in progress and on schedule.

Schedule: D&D is scheduled for calendar year 2003.

2.4 Building SW/R

Accomplishments: Previous technical assistance (2001) provided by Innovative Treatment Remediation Demonstration (ITRD) supported the development of a Sampling and Analysis Plan for the building. This Sampling and Analysis Plan provided the basis for recent characterization activities by Weston (FY02).

Schedule: D&D is scheduled for 2004.

2.5 Soils

Schedules for soils (characterization and remediation) associated with specific buildings will adhere to D&D schedules for that building and, more specifically, the removal of subsurface piping and concrete slabs. Schedules referencing soils independent of buildings or soils associated with a specific PRS are not included in this report.

Accomplishments: Over 200 PRSs initially. Now, only a few remain for closure.

Schedule: Refer to individual building schedules.

2.6 Groundwater

Mound does not yet have an Integrated Groundwater Monitoring Plan, which would identify a long-term monitoring strategy.

Accomplishments: The site has met Maximum Contaminant Level (MCL) criteria for discontinuing pump and treat and will be conducting a rebound test to evaluate the potential for further source term migration into the aquifer. The site has partially resolved MCL exceedances with the regulators. The nickel/chromium, trichloroethylene (TCE), and the barium MCL exceedances have been resolved, but only for the Phase I parcel. The resolution does not apply to other parcels. In addition, the Phase I radium exceedances and TCE at Building 49 have not yet been resolved.

The site has recently issued a paper on anomalies that will be attached to the Record of Decision to be finalized this calendar year.

Groundwater remediation efforts have removed around 25 pounds of VOCs using pump and treat and 4000 pounds through soil vapor extraction (SVE).

Schedule: The only scheduled activity is that Operable Unit-1 (OU-1) pump and treat will be shut off and monitored for resurgence of volatile organic compounds (VOCs) in the groundwater (rebound test). Everything will be shut off in OU-1 during the rebound test. Currently the site is finalizing the rebound test plan by the core team. Monitoring

parameters were identified as a product of 1995 ITRD OU-1 effort. The site may need to document equilibrium for groundwater relative to the overlying source term following shut off. There is an immediate opportunity for technical assistance to review the plan and upcoming data. The groundwater schedule will possibly affect long-term stewardship.

2.7 Buried Objects

Accomplishments:Not Applicable

Schedule: PRS-11 contains buried, contaminated drums. Remediation of PRS-11 is not in the current baseline. Remediation activities will be baselined in when the new contractor takes control.

2.8 Piping (storm water and sanitary)

Accomplishments:Not applicable

Schedule: This is an infrastructure time issue. It is not a critical path item. There is a need for information by June 2003, but this is contingent on the new contractor's schedule. There is an immediate opportunity for technical assistance to support evaluation of alternatives for the lines including fate and transport evaluation associated with residuals in sludge that is directed to land application.

3.0 ISSUES ANALYSIS

The purpose of this section is to discuss issues and uncertainties associated with buildings slated for D&D at MCP, along with associated infrastructure (e.g., buried waste lines) and subsurface soils (with a focus on radionuclide contamination). The bases for the contents of this section were presentations by DOE-MCP and contractor staff, and a brief review of appropriate MCP documents, which are listed in the References section of this report. Presentations made to the TAT included the T building, the PP building (Building 38), the WD building, the HH building, and the SW/R complex.

3.1 Critical Uncertainties and Unresolved Issues

Based on document review and presentations by DOE-MCP and contractor staff, the TAT identified a set of uncertainties and/or potential issues. The majority of these issues were generic in nature (i.e., applicable to all the building D&D processes in general). A few issues were specific to individual buildings. The balance of this section is devoted to each of these issues, which are discussed in priority order. In each case the baseline approach is described where possible, and alternative or enhanced approaches are identified. In the case of alternative or enhanced approaches, their advantages, disadvantages, costs and implementation issues are discussed.

3.1.1 Site-Wide Strategy for Slab Removal/Soil Remediation/Closure

The document entitled *Work Plan for Environmental Restoration of the DOE Mound Site, The Mound 2000 Approach* (DOE 1999) lays out the overall framework for remedial activities at the site. It establishes a flexible approach based on a Potential Release Site (PRS) concept combined with Engineering Evaluation/Cost Analyses (EE/CA) for dealing with each of the many potentially contaminated areas (including buildings) included in the MCP. This document lays out what appears to be an effective strategy for identifying potential release sites and determining their ultimate fate (no further action/assessment, further investigation, or response action required). It is vague, however, regarding the strategy to be applied for implementing response actions.

Given the relative large number of D&D operations that will take place between now and 2006 closure, it is the opinion of this TAT that the site would benefit from strengthening its site-wide strategy document for how this should be done. A template for this type of document is the Site Excavation Plan in place at the Fernald Environmental Management Project (FEMP). Such a document would lay out the overall approach to be used when designing and implementing D&D efforts at buildings, and would identify, to the extent possible, the types of complications one would expect to encounter for individual buildings and the deviations that would be required to address those complications. Since some D&D activity has already taken place (e.g., the SM building), this document would presumably capture the historical experience gained. The document should be considered as a dynamic document, subject to revision and improvement as additional experience is acquired over the next several years.

A site-wide strategy document would address the following:

- Specific documentation required/expected during the course of a building D&D, and the level of review/concurrence required internally by contractor staff, DOE project managers, and the core team.
- The generic sequence of events in a building D&D process, including flow charts and key decision points/evaluation points.
- Surface and subsurface soils excavation process. Issues associated with this are discussed in greater detail later in this section.
- Approaches for handling contaminated bedrock when encountered. Issues associated with this are discussed in greater detail later in this section.
- Approaches for handling contaminated waste line removal. Issues associated with this are discussed in greater detail later in this section.
- Recommended data collection/analysis techniques applicable to contaminants of concern and particular information needs (i.e., pre-response data collection to identify and estimate contaminated soil volumes, soil excavation support, and final closure verification sampling).
- Contamination migration controls. These include tritium mobilization via leaching, and leaching/erosion concerns from contaminated run-off. Later sections in this report will discuss mitigation/remediation approaches specific to tritium in near surface soils.
- Approaches for controlling environmental health and safety concerns (particularly air quality requirements).
- Final closure verification sampling requirements and strategies. Issues associated with this are discussed in greater detail later in this section.

As with the Mound 2000 approach, the primary goal of such a document would not be prescriptive requirements, but rather the establishment of a consistent, coherent, technically defensible approach to D&D activities. This document would be particularly important in light of the expected contractor change since it would guide future contractor D&D activities to closure, guaranteeing continuity over time, consistency across projects, and the overall quality of products.

3.1.2 Cleanup Approaches for Exposed Bedrock Contamination

For most of the MCP where D&D is taking place, bedrock exists at relatively shallow depths. Past seep monitoring around the main hill has shown indications that radionuclides in addition to tritium are being mobilized through bedrock presumably by leaching of contaminated subsurface soils. Past excavation work associated with waste transfer line removal has encountered contaminated bedrock surfaces. The baseline for handling this situation appears to be bedrock excavation until activity concentration standards are achieved. This approach has several limitations. Bedrock excavation is inherently more time consuming and expensive than soil excavation. Encountering contaminated bedrock unexpectedly could have significant schedule and budget implications. Bedrock may exhibit significantly different background concentration values (e.g., higher) than native soils for some naturally occurring radionuclides. This is of particular concern for uranium, thorium and radium isotopes whose screening levels are already extremely close to reported site background values, potentially complicating closure verification.

Bedrock contamination issues are most likely to occur when removing waste transfer lines and for areas beneath the SW/R building. In the case of waste transfer lines, many of these were originally placed in cuts within bedrock, and are known in some instances to have ruptured and leaked. In the case of the SW/R building, there is evidence of high levels of contamination extending several feet beneath the concrete pad that have not been vertically bounded. The site should consider several options for dealing with contaminated bedrock that is exposed by the D&D process. These include:

- Revisiting cleanup criteria derivations. Contaminated bedrock would pose different exposure pathway scenarios than soils. It is likely that a bedrock-specific pathway analysis would result in derived cleanup guidelines significantly greater than those currently in place for soils. The site should carefully examine the appropriate exposure pathways.
- Developing pathway-specific mitigation strategies. A bedrock-specific pathway analysis would identify those pathways that contribute the bulk of incremental risk. Knowing this information may allow for the design of mitigation strategies other than simple contaminated bedrock removal. For example, if the groundwater pathway was most important, the application of a combination of soil amendments (see Section 3.1.6) with sealants such as grouting to minimize leaching and subsequent contaminant mobility may result in adequate protection. Later sections discuss options where contamination is limited to tritium-contaminated water. It is important to note that amendments will provide some measure of long-term stewardship by stabilizing and immobilizing any residual

contaminants. Not adding the amendments represents a much greater risk of spread of the residuals after the original cleanup activity.

- Developing characterization protocols for identifying bedrock contamination issues early in the D&D design and implementation process. It is not clear whether contaminated bedrock possibilities have been factored into current baseline cost and schedule estimates. For cost and schedules to be estimated accurately, contaminated bedrock liabilities will need to be identified early in the D&D design and implementation process. An opportunity to do this will be during the removal of waste transfer lines from between buildings and underneath buildings. In this case, biased bedrock sampling under known points of leakage will be sufficient to identify if a potential contaminated bedrock situation exists. For the SW/R building, evaluation of bedrock contamination potential should occur as soon as practicably possible, and should be driven by biased sampling in locations where there is the highest potential for bedrock impacts (adjacent to/underneath the Old Cave and New Cave areas).

Quantifying the extent of bedrock contamination is technically much more challenging than identifying if it exists, but may not be necessary if risk mitigation options other than removal are available.

3.1.3 Final Closure Verification Sampling Requirements and Strategies

The site appears to have an unclear set of strategies/sampling requirements for soil closure. The current Mound 2000 process documents refer to the process for deriving appropriate risk-based cleanup goals for areas, as well as the residual risk calculations that must be done as part of the closure process to ensure that those goals have been met. The general approach appears to be based on collecting samples and comparing averaged results to cleanup standards using some form of parametric statistical test. The published Mound Guideline and Screening Values for Soil and Sediment provide risk-based goals, but fail to indicate whether these are to be interpreted as wide area average goals or never-to-exceed standards. Anecdotal information suggests that these are average goals that must be achieved, but it is not clear over what area these must be applied (e.g., 100 square meters, the area of the PRS excavation footprint, or something in between).

The lack of a well-defined closure protocol for the site could have negative impacts on the overall closure process. Without a clear definition of what constitutes “clean” and how that will be measured, it is difficult to design efficient pre-design characterization programs for estimating contamination extent, or excavation support programs for determining when excavation can stop. It also is difficult to evaluate the potential performance of alternative data collection techniques. The default in this setting becomes overly conservative excavation programs that virtually guarantee standards will be met by any measure and data collection strategies based on ex situ laboratory analyses, at the expense of removing and disposing of material that might otherwise have “passed” a closure process. One option for implementing a closure process for soils at the site is to follow Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) guidance (currently in use for free-releasing buildings). Whether MARSSIM or some other approach is adopted, the principal point is having something in place that is

consistent across the site, technically defensible, and that can serve as the departure point for characterization and remedial action design.

To this end, the TAT would suggest the following be considered:

- The site develop a more explicit set of cleanup guidelines for soils that include definitions of the areas over which cleanup goals must apply, and any formal definition of elevated area or “hot spot” removal goals that might apply.
- The site develop a standard set of procedures for demonstrating that these goals have been achieved. This may be based on statistical tests (parametric or non-parametric), or it may simply be a negotiated agreement among the core group. In any case, it would represent a consistent procedure that serves as the target point of compliance for the site and the organizing focus for all data collection activities (pre-design, excavation support, and post-remediation).

3.1.4 Excavation Design and Implementation

The principal potential opportunity for cost savings to the MCP program during building D&D is the minimization of off-site contaminated disposal volumes. Waste streams will come from two primary sources: the building itself along with associated infrastructure (e.g., buried infrastructure and foundations) and contaminated soils immediately adjacent to and beneath the building. The principal mechanism for waste minimization for the building D&D process is the ability to “free release” all or portions of buildings, either leaving those portions in place or allowing greater flexibility in disposal options. The site already has a strategy in place that relies on MARSSIM protocols, although it is not clear to what extent cost analyses are carried out to determine whether it is more cost effective to attempt to clear all or portions of buildings in this fashion, or to simply D&D as contaminated.

The principal mechanism for waste minimization for the soil waste stream is to make sure that soil removal remains focused only on those soils that actually exceed site cleanup requirements. This is typically done through some form of excavation support data collection. The baseline for the site is to develop a pre-design excavation dig footprint based on existing data sets, to dig to that footprint, and then to evaluate the exposed dig face to determine if additional excavation is required. If not, the site moves to verification or final status survey data collection. Discussion of past excavation experiences suggest that excavation footprints in the past have been conservative (i.e., remove more soil than necessary). The principal reason for conservative excavation at sites like Mound is to protect the contractor (and DOE project management) from cost overruns associated with chasing contamination beyond the initial excavation footprint.

To replace the baseline approach with a more precise (and hopefully cost-efficient) excavation process requires several components:

- A methodology for balancing investments in excavation support data collection with expected reductions in disposal volumes. This requires knowing what it costs to remediate a unit volume of soil, what it costs to characterize a unit

volume of soil for free release, and what the probability is that characterizing a unit volume of soil will allow it to be classified as having met cleanup standards.

- Appropriate and cost effective methods for characterizing soils either immediately prior to excavation, or during the excavation process. This is perhaps the greatest challenge for the MCP site, with its combination of many isotopes of concern (some of which are hard to detect in the field), and relatively low cleanup standards.
- An excavation process that focuses initially on excavating only those soils that are known to be above standards, and then works out from there based on excavation support data.
- A contractual mechanism that allows for contingencies in the excavation process. Such a contractual mechanism would be a blend of a fixed price and cost-reimbursable contract. The fixed price portion would focus on the most likely contaminated soil volume.
- A means for rewarding contractors for precision in their excavation activities. There are several mechanisms for doing this. A performance award could be provided if waste characterization sampling of excavated piles resulted in a certain percentage of samples above cleanup guidelines. For example, the Buffalo Formerly Utilized Sites Remedial Action Program (FUSRAP) aims for greater than 90% of its waste stream sampling to be above cleanup standards. Alternatively, the fixed price portion of the contract could include an award for final excavated volumes that are no more than a certain percentage above the best initial estimate.

3.1.5 Subsurface Contaminated Soil Volume Identification and Estimation

One of the principal uncertainties identified by project staff was the presence and extent of soil contamination associated with soils beneath existing buildings and slabs. This uncertainty primarily impacts budget and schedule estimates. In general, the baseline estimates for subsurface soil contamination volumes are based on the assumption of two feet of contaminated soils beneath buildings, extending out to 15 feet from building foundations. For many of the buildings there currently are no sampling data to either confirm or invalidate this assumption.

Pre-remediation data collection activities to estimate sub-slab soil contamination volumes prior to soil excavation in general do not result in more cost effective response efforts. Data collection activities that can improve excavation design and implementation are discussed in Section 3.1.4. Pre-remediation data collection activities do allow for better overall cost estimation and consequently project planning. However, even in the case of significant investments in pre-design subsurface characterization, there will still be uncertainty about the amount and exact location of contaminated subsurface soils. Pre-design characterization efforts can only limit this uncertainty, not remove it. Consequently it is important for DOE-MCP to identify the level of uncertainty regarding subsurface soil volumes it is willing to tolerate as D&D moves forward, and weigh this against the costs of pre-design data collection efforts.

Because of the close proximity of bedrock to most building slabs, there is an upper bound on contaminated soil volumes that can exist beneath buildings. In some cases where buildings were basically put on top of bedrock (such as the R building), potentially contaminated subsurface soil volumes are minimal. In other cases where bedrock may be ten to twenty feet below slabs (such as the WD building), potentially contaminated subsurface soil volumes can be much more significant.

Given the above, the following modifications to the baseline are proposed:

- DOE-MCP should develop a total estimate of contaminated soil volumes using current knowledge, aggregating individual building estimates. In the case of some buildings (such as the PP building), this may be no more than an educated guess. In other cases (such as the WD building), there may be data to support the estimate. In each case, individual building estimates should include an estimate of the uncertainty associated with the volume, as well as an estimate of the upper bound (defined by depth to bedrock).
- Given the uncertainty that is present in the subsurface soil volume estimate and the costs associated with pre-design sampling, DOE-MCP should balance possible investments in pre-design data collection with expected uncertainty reductions. This balancing can be done by developing confidence levels around contaminated soil volume estimates, and evaluating the effects of sample numbers on those confidence levels.
- DOE-MCP should weight any additional investments in pre-design data collection for individual buildings by their contribution to the overall uncertainty associated with the cumulative contaminated soil volume estimate. For example, if the SW/R building contributes half of the uncertainty in contaminated soil volumes, a relatively large portion of any additional investments in pre-design characterization work should go to the SW/R building footprint.
- Where additional investments in pre-design data collection are warranted, sampling programs should consist of two components. The first would include the selection of a handful of locations that represent areas most likely to yield contaminated subsurface soils (e.g., adjacent to buried sump locations, known release points, or waste lines). In the case of waste lines, obvious times to sample include after lines have been pulled, leaving exposed subsurface soils with relatively easy access. The second would include systematic sampling on a sparse triangular grid placed over the planning footprint associated with the building. The results from this work should include not only sample analytical results, but also depth-to-bedrock information.
- In some cases, based on existing information, the conclusion may be that soils likely meet cleanup criteria and so no further remediation will likely be necessary. In such cases, additional pre-design data actually would constitute the verification or final status survey, in which case sample numbers and locations would be driven by verification needs.

The question of whether to perform pre-design sampling before or after slabs are removed is a logistical issue. Waiting until after slabs are removed simplifies access and will reduce characterization costs, but the associated delay in obtaining the desired information may be intolerable and/or reduce the value of the information to the overall program.

3.1.6 Soil amendments for in situ stabilization and immobilization

Any excavation of contaminated soils from beneath buildings has a certain amount of uncertainty associated with the removal of contaminants to background or even acceptable risk levels. Given this uncertainty it would be good practice to add amendments to backfill material that might further stabilize or immobilize any residual contaminants. These additions would be quite inexpensive, provide a better margin of safety, and enable more rigorous long-term stewardship of the site. The level of risk of spread of residuals increases if amendments are not added. Stabilization amendments such as apatite, proprietary phosphate products such as EcoBond™, biostimulators, and zero-valent iron (ZVI) have been shown to be effective at reducing the leachability of actinides from contaminated soil. The various treatments react with the actinide in soil pore water, producing mineral precipitates with very low solubility products. These mineral phases then adsorb on the soil matrix, thereby removing them from the leaching transport pathway.

Stabilization amendments may be applied both in situ and ex situ. In the case of apatite, phosphate bonding agents and ZVI, the simplest application would be to amend the clean fill soil as it is added to excavated areas. The general action of dumping, spreading and grading would result in sufficient mixing to ensure proper treatment. Most stabilization amendments provide treatment at ambient soil moisture levels. The additional water applied for dust control during excavation and grading activities will ensure complete contact of the actinide with the treatment media. The large amount of iron debris being disposed of at the site could in fact be used for ZVI type of reactions that would bond the actinides to the soil.

All of the remediation strategies considered for soil at the site could benefit from in situ stabilization since the amount of leachable actinides could be significantly reduced, thus improving the long-term stewardship of the site. In the case of contaminated bedrock, these types of amendments may be part of the overall remediation strategy. In the case of VOC-contaminated soils, amendments may also result in at least partial remediation of the contaminants of concern through either enhanced biological or geochemical processes. If electron donors (carbon sources) are added (e.g., lactate), these electron donors could become depleted before all of the VOCs are destroyed, thus requiring addition of more electron donors. Additional electron donors may also be required to deplete alternate electron acceptors that prevent the complete reduction of VOCs to ethene. However, if the VOCs reached a sufficiently low level then natural sources of carbon could act as an electron donor to degrade the remaining VOCs, or the VOCs could be degraded co-metabolically. Note that a single application of stabilization amendments does not necessarily guarantee that all the VOCs will be degraded and that they will be completely mineralized; further MNA may be required.

Appendix E is a technology remediation matrix that compares various technologies to address VOC-contaminated soil.

3.1.7 Free Release of the T Building

The T building is the only known impacted building that will remain in place. The current baseline for the T building is to basically remove all existing interior contents, leaving the shell of the building behind. The site identified the possibility that not all portions of the interior actually require removal based on the dose standards the site needs to achieve (15 mR/hr). What is required to leave these portions in place, however, is a technically acceptable closure protocol that demonstrates that the dose standard has been achieved.

The principal contaminant of concern from a closure perspective for the T building is tritium. Tritium contamination within the T building is volumetric in nature, and presumably includes both tritiated water and other tritiated materials. In this setting, the vast majority of dose to potential building users would be in the form of inhalation of tritiated water vapor. Given the half-life of tritium, and the expected slow but steady removal of tritiated water through natural processes, the maximum dose to a receptor would presumably be at time zero, when the building is free released. An exception to this would be cases where there are significant tritium reservoirs beneath surfaces that might be exposed later in the life of the building. For this to be of concern, however, requires a historical contamination event that would have resulted in this kind of “entombed” tritium contamination.

There are basically two options for establishing compliance with the dose standard proposed for the building. The first is to use some form of pathway analysis software (such as RESRAD-Build) to model dose scenarios. The requirements for this type of model include an estimate of the volumetric contamination present in the building, its current state (e.g., tritiated water fraction, versus fractions in other tritiated forms) and spatial distribution, and fundamental parameters characterizing transport of tritium in this environment. A more straightforward approach would be measuring tritiated water vapor levels currently present in particular portions of the building (along with flux information from exposed surfaces), and translating these into equivalent dose levels. In this case, the primary question is whether these tritiated water vapor levels would be representative of conditions post-closure.

3.1.8 Acceptability of In Situ or Alternative Characterization Techniques

The site currently relies primarily on ex situ gamma or alpha spectrometry analyses for the bulk of its soil characterization work, supplemented by Field Instrument for Detecting Low Energy Radioactivity (FIDLER) systems for surface scans. The issues associated with the ex situ sample analysis techniques are their relatively high cost, low throughput, and long turn-around times. The principal issue with the FIDLER systems currently employed are their ineffectiveness for several key contaminants of concern (e.g., Pu-238) and their questionable effectiveness for Th-232 at the required screening levels (1.47 pCi/g). Pu-238 is by far the most prevalent soil contaminant of concern across the MCP site. Th-232 appears less frequently, but is also fairly wide in its spatial distribution. In

addition to these two contaminants of concern, there are a large number of other isotopes that are of concern at more limited, specific locations.

The site has actively considered other technologies to supplement or possibly replace the existing baseline technologies. These have included a gas proportional counting system for direct Pu-238 detection in soils, in situ High Purity Germanium (HPGe) measurements, and the large crystal mobile NaI systems in use at Fernald. Aside from the technical concerns regarding performance for these systems at the MCP site, there are additional concerns about their acceptability from a regulatory perspective (i.e., would their introduction actually allow the site to lessen its dependence on ex situ analyses to some degree, and so accrue cost savings).

MCP is at the stage in its closure process where data collection for soil contamination is primarily limited to either pre-design characterization work to better identify the location of contamination and estimate its extent, excavation support data collection, and closure or verification data collection. Regulatory acceptance of alternative data collection technologies should only be an issue with closure or verification data collection. For pre-design and excavation support data collection, the only question for the site should be whether alternatives provide technically acceptable results at reduced costs.

Beyond what has been or is being considered, there are two additional technological additions to the site's data collection technology mix that may provide at least incremental benefits over the baseline. These are:

- Coupling radiological scans with Global Positioning Systems (GPS) and data loggers (or some alternative position control system such as laser tracking system). Radiological scans are currently conducted at the site using FIDLER systems without data logging or locational control. Adding locational control and data logging provides for the following benefits:
 - Improved QA/QC control over scanning. This includes both identifying incomplete spatial coverage for scans, and potential system malfunctions through a review of logged data.
 - Post-data collection data analysis. This can include a number of techniques that can significantly lower practical detection limits for these systems.
 - Documented results. Logging data collection allows the generation of data sets that are available for review by stakeholders and preservation from a closure perspective. This availability can significantly improve acceptability and use of scan information from a closure perspective.

Adding locational control and data logging to scans is a bit more expensive, but the benefits far outweigh the additional costs. Because of these benefits, the use of this type of equipment has become standard operating practice for the FUSRAP program.

- NaI-tipped GeoProbe systems for subsurface investigations. The current baseline for the site is to screen removed subsurface soils with FIDLER systems. NaI-tipped GeoProbe systems work by pushing a NaI probe into the ground and recording gross activity readings as the probe is advanced. Typically this is done down a hole created by the retrieval of a soil core. The principal advantage of this

approach is an improvement in detection limits. This is primarily a result of much larger sample support for the measurement being taken. This type of system is currently being tested at the Ashtabula site for their uranium issues and has been used at Columbus for Cs-137 characterization. While the detection limits of this system will not be sufficiently low to meet screening levels for the radionuclides of concern (with the exception of radium-226 and potentially thorium-232), they are low enough to assist in potential hot spot identification and identification of potential environmental safety and health concerns. This could be a particularly important consideration for additional subsurface characterization at the SW/R building complex.

Detection limits are a general issue for the site given the relatively low guideline values in place. Poor detection limits for alternative data collection technologies, however, do not prevent these methods from potentially contributing to the overall remediation effort. For example, if contamination is in general at levels significantly above cleanup guidelines where contamination exists, the alternative data collection technology need only have a detection limit sufficient to detect existing levels of contamination. If the site has a hot spot or elevated area criteria, an alternative data collection technology may have sufficient detection limits to efficiently screen for hot spot concerns.

3.1.9 Corroded Waste Transfer Pipe Removal

The waste lines beneath the SW building are believed to be cast iron. Because of the caustic nature of the wastes these lines carried and their age, it is believed that many of these lines are probably in poor condition. In addition, preliminary investigation indicates that these lines are likely almost completely filled with highly contaminated sludge material. All of these lines must come out. The concern is that the baseline approaches for pipe removal may compromise pipe integrity, resulting in breakage that could spread contamination over adjacent areas and/or pose environmental safety and health risks to workers.

The TAT identified two possible alternative approaches to pipe removal that might mitigate the concerns raised about waste transfer pipe integrity during removal. These included:

- Wrapping pipes in Tyvek-like material as they are unearthed to both provide additional structural support to the pipes and prevent contaminated sludge loss in the event that pipes rupture during removal. This may be particularly effective when pipes are placed in backfill material or native soils.
- Encasing pipes with grout after exposing them and prior to removal. This may be particularly effective for pipes that have been laid in bedrock cuts, providing a natural mold for grouting.

3.1.10 Mixed Waste

Significant volumes of mixed waste have not been encountered to date at the site; however, given the abbreviated schedule for building demolition and soil removal, the

site may encounter soil underneath the buildings with low levels of radionuclides and hazardous waste (chlorinated VOCs). The other Ohio sites have encountered similar types of mixed waste contaminated soil problems. The following is just for consideration in case such waste is encountered.

The waste acceptance guidelines (WAG) for Envirocare (Envirocare 2001) and Nevada Test Site (NTS) (DOE 2002e) were reviewed carefully. In addition, the WAG entities at NTS were contacted and asked about the question of treating mixed waste prior to shipping so that it could be classified and disposed of as low-level waste. Envirocare, by permit conditions with the state of Utah, cannot allow material that had ever been classified as mixed waste and treated or recertified as low level, to be disposed of in their facilities as anything but mixed waste. The NTS also appeared to be problematic, as “State of Nevada regulations require that waste regulated as hazardous in the state-of-generation must be regulated as hazardous when brought into the state of Nevada therefore, such waste shall not be accepted for disposal.” MCP personnel verify that the TCE, for example, that was used at MCP is classified RCRA ‘characteristic.’ According to Low Level Radioactive Waste facility manager (personnel communication Pat Matthews, Bechtel NTS) ‘characteristic’ waste could be treated at the site and be reclassified as Low Level Radioactive Waste before shipment to NTS. (Note: The treated waste soil also needs to meet the universal treatment standards for any defined underlying hazardous constituents and concentrations; from what is currently known of the contaminants present, this should not be a problem). Overall, this solution has the potential to save MCP large amounts in terms of acceptance by the disposal facility as LLRW instead of mixed waste. The treatment of the TCE in the excavated source material in a staging area could be accomplished in a manner of weeks using a simple SVE system. A similar system was designed and priced for similar mixed waste at Fernald in a recent technical assistance effort (DOE 2002d).

3.2 Specific Recommendations

The TAT makes the following recommendations pertinent to building D&D and the remediation of associated soils:

- DOE-MCP should develop a site-wide strategy document for designing and implementing building D&D and associated soil remediation.
- DOE-MCP should develop and articulate closure standards for the site that include averaging areas over which compliance must apply, hot spot definitions if deemed necessary, and the means for demonstrating compliance with those standards.
- DOE-MCP should develop strategies for identifying potentially contaminated bedrock (assumed to be primarily associated with waste transfer lines and beneath the SW footprint), and risk mitigation approaches other than just removal.
- DOE-MCP should develop a cumulative estimate of potentially contaminated subsurface soil volumes based on existing information for individual buildings. These estimates should include estimates of uncertainty, along with an upper

bound based on depth to bedrock information. DOE-MCP should identify an appropriate investment in pre-design characterization that balances the costs of that characterization with the expected uncertainty reduction. DOE-MCP should distribute pre-design data collection investments across buildings by their contribution to the overall uncertainty.

- DOE-MCP should revisit the soil excavation design and implementation process with the goal of minimizing waste streams. This revisiting should include an explicit cost analysis balancing characterization investments with expected reductions in waste streams, and a mechanism for encouraging and rewarding contractors for superior waste minimization performance.
- DOE-MCP consider developing and implementing a closure process for portions of the T building that are likely to meet site closure dose standards. The most promising approach, assuming tritium is the dose-driver, is direct measurement of tritiated water vapor within portions of the building.
- DOE-MCP require that all scanning of exposed soil surfaces be done with the means for providing locational control and logging of scan results.
- DOE-MCP should investigate the inclusion of soil amendments in its overall remediation and closure strategy, both to assist in addressing potential contaminated bedrock issues, and to improve overall performance of backfill operations from a residual risk and long-term stewardship perspective.

4.0 GROUNDWATER

4.1 Conceptual site hydrology

Mound Plant is located at the southern border of the city of Miamisburg and about one half mile from the Great Miami River. This river and tributaries/seeps in the drainage basin of this river serve as the primary discharges for groundwater in the vicinity of the Mound Plant. The 306-acre site is located on a ridge complex that overlooks the city. Within approximately one mile of the facility are the Miamisburg Mound State Park, many residences, five schools, Miamisburg's downtown, and six city parks. Currently, the facility is being readied for use as a public technological and industrial park – the Mound Advanced Technology Center. This transition is facilitated by core teams of local government, environmental protection, and Mound Plant representatives. The industrial park will be implemented through a public-private partnership known as the Miamisburg Mound Community Improvement Corporation (MMCIC).

Morphologically, the Mound Plant consists of two hills (the “Main Hill” and the “SM/PP Hill”) steeply sloping down into a central-surficial valley feature. The Mound Plant is underlain by unconsolidated glacial deposits within a deeper bedrock valley. The glacial deposits are a highly heterogeneous mixture of till and outwash that partially fill the bedrock valley and that range from a few feet to about 60 feet thick. The surface topography of the facility has been further modified over the years by filling as needed (to level areas for construction and roads for example).

Depth to water near the Mound Plant ranges from a few feet near the discharges to about 40 feet on the Main and SM/PP Hills. Within the Mound Plant site, the saturated thickness of unconsolidated sediment ranges from about 30 to 140 feet depending on the depth to water and the specific location in terms of the shape of the underlying bedrock valley and amount of fill. The unconsolidated till and outwash supplies water both onsite and offsite and is commonly called the Buried Valley Aquifer (BVA).

The bedrock valley itself is a layered sequence of shale and limestone. The upper portion of the bedrock contains secondary permeability in the form of bedding plane and vertical fractures. The fractured bedrock zone can participate in the regional and subregional flow system. The thickness of the fractured portion of the bedrock is reported to be a few tens of feet thick and is underlain by bedrock that has low primary permeability and low fracture frequency.

It is clear from the summary that the situation at the Mound Plant is complex and that each of the potential release sites will be unique in terms of its hydrogeologic conditions. Nonetheless, a general cross section (while not specifically applicable to individual locations) can assist in developing an overall concept of the water flow pattern. Figure 2 is an example of such a cross section. This cross section suggests the general patterns of zone thicknesses in different areas of the site as well as depicting the expected physical controls for groundwater.

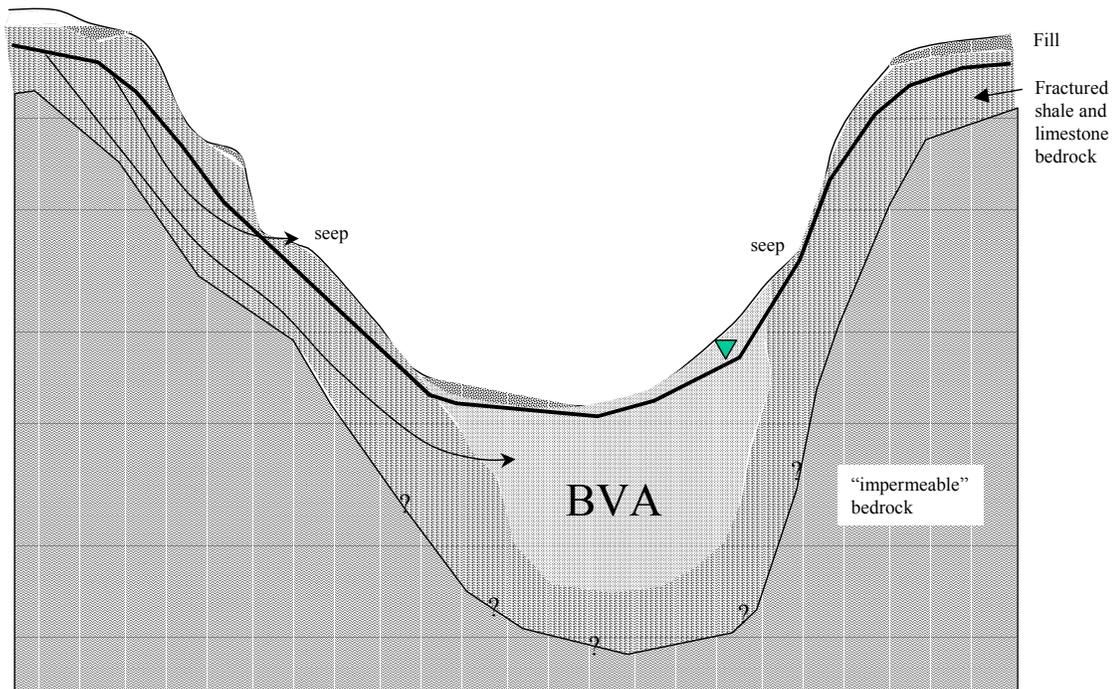


Figure 2. Simplified cross section across the Mound Site (not to scale)

Water enters the subsurface of the Mound Plant primarily through recharge from rainfall. Over the years the amount and location of the infiltration has been modified by human activities. Buildings, roads, caps, and the like serve as a barrier to infiltration. Water in ditches and ponds will focus infiltration and anthropogenic water sources (leaking domestic and process water and fire lines) will modify flow patterns and accelerate flow through the system. Water entering the subsurface moves vertically in the vadose zone and into the water table. Once in the water table, flow is both lateral and vertical (downward) in recharge areas, eventually curving upward as groundwater drains to outcrops (seeps and surface water). Thus, in some areas flow trajectories will reach their maximum depths in the complex fractured rock zone (but limited by the relatively impermeable underlying bedrock). These deeper flow paths are generally toward local seeps and may reach the BVA and ultimately the Great Miami River. In areas near the hill margins, flow will be more local – toward local seeps – and entirely in the fractured aquifer zone and unconsolidated fill and BVA sediments. From a site-wide perspective this subregional flow appears radial toward the receiving seeps. Opportunities suggested by this conceptual model include:

- Overall plume migration can be reduced by relatively low cost modification of large scale hydrologic driving forces.
- Monitoring can be optimized based on the expected three-dimensional plume structure.
- Transient groundwater impacts from mobile contaminants currently in the vadose zone beneath building vadose can be minimized by maintaining infiltration-limiting covers and/or amendments to backfill to stabilize residual contaminants.
- Groundwater flow direction and rates of flow will be altered significantly and dynamically during building removal, slab removal, pipe removal, backfilling, and more frequent monitoring of hydrological parameters and frequent updating of flow paths to downgradient wells and seeps.

Groundwater activities will require attention to the hydrological implications of planned decommissioning and transition activities – integration of potential groundwater issues/impacts into the projects and contract and continued monitoring will be needed throughout the remaining period prior to the turnover to the MMCIC.

4.2 Groundwater Issues and Recommendations

Several groundwater and groundwater-related soil issues were identified by MCP for the technical assistance team to address. These were supplemented by additional issues that the team identified during the meetings with MCP and technical support personnel and during the site tour. The issues are identified below. Because of a less restrictive schedule and modest projected costs relative to building demolition and radionuclide contaminated soil issues, the groundwater issues are of moderate to low priority. Each groundwater issue is followed by a synopsis of the technical assistance team discussion and consensus. As with the other topics, the team felt that the technical personnel at the site are already addressing several of the groundwater issues in a technically appropriate fashion. In some cases, we have provided supplementary technical information, resources

or references. In some cases, the recommended actions represent an alternative to the current baseline.

4.2.1 Hydrogeology support is provided at a PRS level and larger hydrological implications and integration are not encouraged

Overall groundwater and plume control opportunities are possible if a site-wide hydrologic conceptual model is strengthened. Plume migration can be reduced by relatively low cost modification of large-scale hydrologic driving forces. Examples include: (1) maximizing runoff by improved and more aggressive stormwater diversion off the hill, (2) selecting vegetation for green spaces that have relatively high evapotranspiration rates, (3) repairing leaking domestic and process water lines, (4) understanding the implications of turning off water production wells and groundwater pump and treat wells on the overall pattern of groundwater flow, (5) accounting for hydrological changes caused by building demolition, and others. Importantly, several of these recommendations reduce the driving force on contaminant plume migration without even pumping, handling, or treating contaminated water. This concept can be thought of using the simple conceptual model that that each gallon of water that is eliminated from recharge/infiltration represents a gallon of groundwater that is not moving through the subsurface away from the Mound Plant. Also, the team felt that low levels of contaminants in the fractured rock should be evaluated to determine if the original “brownfield” industrial worker exposure scenarios are valid.

4.2.2 Conservatism associated with leaching model

Current protocols at the site utilize a simplified leaching model to back calculate soil standards for nonradioactive contaminants based on target groundwater levels (nominally the Maximum Contaminant Level (MCL) allowed in drinking water). The current approved model is a single layer single material leach model specifically developed to support EPA risk assessments (e.g., VLEACH). At some sites, the use of such a model generates significant conservatism in setting allowable soil limits – resulting in cleanup goals that may be unnecessarily low. The value of such models is the simplicity of implementation and the ability to use them with a straightforward-approved set of transport parameters. Alternative more complex models are available that account for layering and more complex boundary conditions. An example of such a model that has been used and approved by regulators is SESOIL. While the standard setting process can often be improved by adding appropriate complexity to a model, such models are significantly more difficult to implement and document. Specifically, technical personnel supporting MCP indicated that previous SESOIL modeling had proven difficult to implement at MCP and they expressed interest in alternatives. Regulator-accepted models with intermediate features – between VLEACH and SESOIL – are available. The Vadose Zone Containment Migration Modeling program (VZCOMM) is an example of such a model. It was developed to support DOE and is approved for all soil related CERCLA activities at the Savannah River Site. The model is a simple Excel spreadsheet system with the CERCLA reference data preloaded and sheets to enter appropriate site-specific data. Importantly, the “system” implements a layered variant of the standard EPA vertical leach model and can reduce unnecessary conservatism in appropriate cases. An information sheet for VZCOMM (as an example of an available model that may be useful to MCP technical support personnel) is provided in Appendix F. Importantly,

none of the models discussed so far incorporate what, over the long term, may represent important processes – biological and chemical transformations and other natural attenuation mechanisms. If these added processes are important, then alternative models that incorporate and quantify them will be needed (e.g., Bio Redox, BIOSCREEN, BIOPLUME). Close coordination with Ohio EPA and other stakeholders will be required to assure acceptance.

4.2.3 Improved Data Interpretation

Several issues of general data interpretation identified by MCP and the team included unusual chemistry in a few bedrock wells, potential for barium, radium, nickel, and chromium in monitoring wells, the requirement for strict use of all old and new data in decision-making, and the need for field screening instrumentation for chemicals as well as radionuclides. Each of these issues is discussed briefly below.

There is a potential in installing bedrock monitoring wells below the active hydrologic system and sample connate water (original water trapped in the rock) rather than meteoric (recent and actively) flowing groundwater. Such water would have a highly unusual chemistry that would be unrelated to Mound Plant operations. Because of the nature of the bedrock, connate formation water would be brine modified by a predictable pattern of solution diagenesis. The possibility of connate water or alternative sources of brine, such as road salt leachate or other Mound related activities could be identified using well understood chemical signatures and indicators. Connate water and Mound related brines would be expected to have a high specific conductance, high sodium and chloride, but connate water would contain lower activities of anthropogenic radionuclides (e.g., ^3H and ^{238}Pu). Moreover, since Mound has calcium rich bedrock systems, the suite of trace elements normally associated with such rocks (barium, strontium, and the like) would be expected to be elevated in groundwater in both brines. The presence of natural uranium in the rock would generate equilibrium compositions of radium isotopes (above MCL) in both types of brine – the actual radium concentration controlled by solubility chemistry. There is a significant body of information on the solution diagenesis of brines that evaluates the expected changes in trapped seawater/saltwater due to mineral dissolution, osmotic effects, and radionuclide equilibration. Key observations that distinguish the natural geochemistry connate water scenario from a Mound Plant contamination scenario (e.g., the release of a high concentration brine moving downward and accumulating deep in the fractured rock system) would be: (1) low levels of anthropogenic radionuclides, (2) study of key isotopic ratios (see below), (3) measurement of solution concentrations and follow on thermodynamic calculations, (4) study of the rock to confirm the presence of natural source minerals and follow on diagenesis evaluation, and (5) examination of well construction details and any pattern of such wells versus potential source facilities. Several isotopic ratios would be useful in resolving the source of unusual bedrock chemistry since these have been studied in the literature and related to this specific topic. These are often used to age date water or to look at similarities to various sources (meteoric water, sea water, etc.). The most valuable ratios for this site are $^{87/86}\text{Sr}$ along with detailed uranium isotopes. Other potentially useful stable isotopes are $^{16/18}\text{O}$ and $^2/1\text{H}$. Other standard calculations used for characterizing formation and connate waters include Mg/Ca ratios, Sr/Ca ratios, SO_4/Ca ratios and the like. Importantly, connate water in the deep fractured bedrock system would be expected and (1) is well documented in the scientific literature and (2) such connate water has been observed in

Ohio. Organizing this background information will be an important first step in interpreting data from deep bedrock wells with unusual chemistry results. Barium and radium are discussed in more specific detail below.

Barium has been detected above the MCL in monitoring well data at Mound (e.g., 3 to 6 ppm in bedrock well 0445 versus the MCL of 2 ppm). Sporadic hits of barium are seen in many monitoring well systems throughout the country. Barium is the 14th most abundant element in the earth's crust (circa 500 ppm) – more abundant than sulfur or carbon. The reason that concentrations are not generally observed in groundwater is the low solubility of key barium minerals. For example, the K_{sp} of barite ($BaSO_4$) is 10^{-10} , so that low concentrations of sulfate will often limit barium concentrations. Nonetheless, there are several sources that can contribute barium to groundwater samples. Barium can result from natural geochemistry, well construction issues, contamination from site operations, or from combinations of these factors. For example, calcium rich minerals (feldspar, mica, shale, limestone) and/or Gorceixite (a barium-aluminum-phosphate) are common at some sites. Gorceixite will dissolve in some acidic groundwaters, releasing barium. Also, in very high ionic strength solutions (such as those described above), the activity coefficients of the barium and sulfate ions are reduced and measurable concentrations of barium may be observed in some connate water even in the presence of sulfate. This is a straightforward calculation that can be performed to determine if ionic strength is a causative factor in barium observations. Another example contributor to barium “hits” is residual barium associated with additives used during well installation. Such additives are common (but are not generally used in Mound drilling) and may persist for extended times in poor producing wells that are not fully developed. A survey of regional geochemistry in wells completed in equivalent geologies and with varying construction may assist in determining the probable source of the few hits of barium observed in Mound monitoring wells. Also measurement in well 0445 of supporting geochemistry (e.g., pH, sulfate and other barium controlling factors in the water and mineralogy and elemental probe of the rock) might help determine if the barium is geochemically derived.

Mound reported that a few wells show hits of radium. As with barium, radium (^{226}Ra and ^{228}Ra) is naturally present in groundwater and will vary depending on the geochemistry and geology of the source rock. At Mound, radium was also handled and groundwater observations may also be associated with contamination. Similar to barium, a survey of regional geochemistry in wells completed in equivalent geologies may assist in determining the probable source of the hits of radium observed in Mound monitoring wells. For example, a study of water production wells in a ten county area in South Carolina (Price and Michel, 1989) showed natural levels of ^{226}Ra ranged from <0.2 pCi/L up to 2.8 pCi/L and ^{228}Ra ranged from <0.5 pCi/L up to 2.3 pCi/L. In their study, aquifer type and geology (rock type) appeared to be important influences on observed radionuclide activities.

According to Mound personnel, the chromium and nickel hits at Mound may be associated with stainless steel well screens. This hypothesis is based on the construction of the particular wells that exhibit elevated chromium and nickel. Recently pump tests were performed to help resolve the issue. Preliminary pump test information supports the concept that the stainless steel screens are the likely source of chromium and nickel. If further confirmation is needed, creative studies using alternative ground electrodes and

“cathodic protection” may be possible (depending on well construction details). In this follow on test, the response of chromium and nickel to alternative conditions would be diagnostic. The site and their core teams should also consider the geochemistry of chromium when performing risk assessments. As shown below, Cr(III) is the thermodynamically stable form in many (most) natural aqueous environments and the blanket assumption that the Cr(VI) comprises all of the chromium may not be appropriate. Filtration before analysis will exclude much of the Cr(III) oxides if present and this should be done if it is not already.

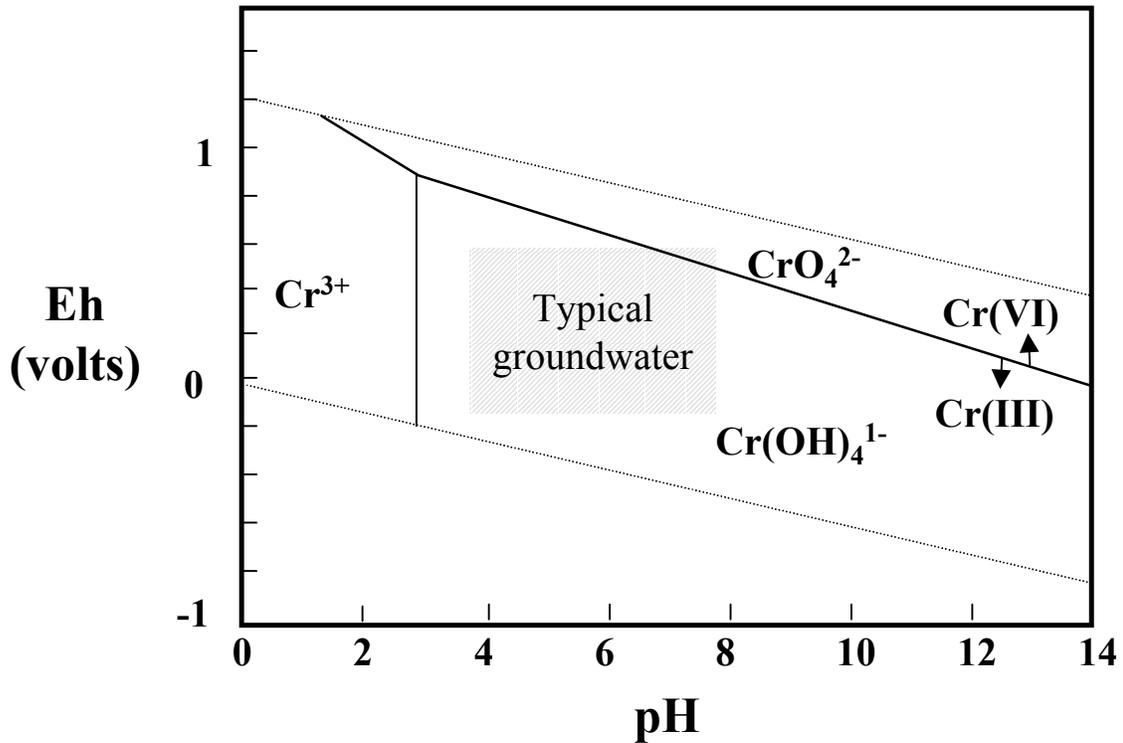


Figure 3. Eh pH diagram

Mound Plant technical personnel expressed interest in technical support associated with field screening of VOCs. Similar to widely accepted radionuclide (e.g., thorium) screening methods, the capability to screen for VOCs can be useful in focusing the more expensive confirmatory and certification laboratory analyses. A proposal exists to use the Oak Ridge Ion Trap Mass Spectrometry and associate technical support at Mound to provide some of the limited VOC screening needed onsite. This is an appropriate solution. A wide range of alternative instruments and support concepts also appear viable including field GC, field GC/MS, SAW GC, and various screening instruments. A notable VOC screening instrument is the photoacoustic infrared spectrometer (INNOVA). This is a simple and robust instrument for gas or headspace analysis but it may not be able to measure concentrations at low enough detection limits to meet the conservative target values being set at Mound.

4.2.4 Monitored natural attenuation strategies for post VOC pump and treat and SVE system

Monitored natural attenuation (MNA) is defined as the stabilization and long-term shrinking of a contaminant plume (as defined by the isoconcentration contours) by natural processes such as biodegradation or chemical reduction. In general, MNA is considered applicable to dissolved plumes only. This technology has been the subject of active research throughout the world with investment by universities, companies, and all relevant federal agencies. The Department of Defense, Environmental Protection Agency, United States Geological Survey and DOE, in particular, have invested in the study of MNA for hydrocarbon contaminants. More recently, MNA has been studied for chlorinated solvents; however, there have not been any protocols developed for metals or radionuclides. The data suggest that MNA can play a role in a long-term strategy for responsible environmental cleanup for these more challenging contaminants at appropriate sites (i.e., sites with the potential for anaerobic dehalogenation or aerobic co-metabolism and perhaps even stabilization of metals and radionuclides in naturally reducing environments). It is likely that MNA would be acceptable to the stakeholders or the regulators.

MNA is ultimately the strategy that should be used on any dilute plumes at the site. MNA will be particularly acceptable since the site has already done a risk assessment showing that the MCL criteria used for groundwater can be safely raised to levels that are acceptable for an industrial use site. Since a deed restriction prohibits the use of groundwater at the site for all parcels that have transferred to date, treatment to industrial standards should be all that is required and MNA should be able to easily meet these goals. MNA will also require a background characterization that has already been done and can use the monitoring system already in place for the pump and treat system.

MNA is always more viable to the stakeholders and regulators as a follow on technology after an initial more aggressive treatment of the plume, like the pump and treat/SVE remediation that has already taken place. Serious consideration should be given to a phased approach on the plume, consisting of aggressive engineered *in situ* treatment, followed by passive treatment strategies, and then MNA.

4.2.5 Confirm that groundwater risk propagation model (baseline is a “flowtube” model) is appropriate (especially for fractured aquifer)

Once a contaminant is assigned to the groundwater through various source assumptions, the resulting plume is propagated to potential receptors using a groundwater model. A large number of various alternative models have been used and are available including MODFLOW (typically with public domain and proprietary extensions for data input/manipulation and transport calculations), alternative single domain flow and transport models, dual domain flow and transport models, and simplified pathway analysis flow tube models. Each of these models has advantages and disadvantages. Furthermore, problems associated with modeling typically are not associated with model (i.e., mathematical solver) selection. Rather, these problems normally result from lack of data or poor selection of model input parameters, poor conceptual understanding of the groundwater system, and lack of critical common sense validation. Model problems are particularly acute in systems where flow is substantially through a fractured zone, as is

the case for many of the PRSs at Mound. Fractured flow and transport models are often modeled using a dual domain model (e.g., TOUGH) that attempt to describe the processes as a coupled model – flow in the fractures and secondary permeability interacting with the diffusion into and out of the rock. Such models tend to be complex to implement and run and they require large amounts of data and estimation of parameters that are difficult to measure (transfer parameters between the fractures and rock matrix, complex geochemical parameters, estimated releases from the source, etc). Further, for relatively mobile contaminants (e.g., tritium), dual domain models are not demonstrably superior to simple models. This is particularly true for highly heterogeneous flow and flow to discreet discharges such as local seeps. In fact, for such contaminants and boundaries, a simple flow tube model is probably the best selection. The technical personnel at the Mound Plant indicated that such a flow tube model is currently being used for calculating risks by propagating assumed groundwater contaminants. The TAT generally supports this selection with the important caveat that more sophisticated modeling may be justified on a case-by-case basis. In particular, a dual domain model may be appropriate to examine the sequestration of low activities of less mobile contamination (e.g., ²³⁸Pu) in the fractured rock zone. If needed, such modeling should probably be done on a Mound-wide basis (rather than to support each PRS) and the results used to document that proposed restoration and turnover concepts are reasonable and protective. Whatever model(s) are selected, it will be crucial to measure and use seep data to calibrate these models. Further, if such seeps are shown to receive the discharge from a particular contaminated source area, this knowledge should be considered an opportunity to optimize any necessary environmental response. This response might include a permeable barrier near the discharging seep.

4.2.6 Tritium Issues

The TAT encourages consideration of the unique character of tritium in performing the activities needed to decommission historical Mound Laboratory and Mound Plant facilities and transition to a future industrial and technology park. While there is a potential for solid tritides and other unusual tritium containing species to be present, data from many sites throughout the world suggests that most of the tritium released to, and moving through, the environment should be in the elemental (T₂ or HT) form or in the form of an oxide/water (e.g., T₂O or HTO). Some of this tritium may be in the soil / vadose zone beneath the buildings and some is moving through the subsurface hydrologic system -- exiting at seeps and other downgradient boundaries. As suggested in the bullets below, tritium's characteristics provide both challenges and opportunities.

In general, the TAT encourages:

- Continued use of creative ideas for characterization. In particular, gas phase sampling beneath the buildings and slabs should be used as needed. This method has been used in past studies at Mound. Significant development work on this method has been done at the Savannah River Site demonstrating that: (1) the logistics are straightforward, (2) the resulting tritium measurements are relatively accurate, (3) the gas based approach is more sensitive to tritium and easier to implement than some traditional vadose zone sampling techniques (such as suction lysimeters), and (4) the volume of soil being sampled can be understood and estimated based on flow rate and time considerations.

- There is a potential for transient tritium impacts to groundwater and downgradient seeps during building demolition as shown in Figure 4 (on page 26). The figure shows typical flow lines before and after a slab removal. Importantly, the vadose zone will be relatively dry so the potential for transient tritium transport to the groundwater may be best viewed as one of total activity (Bq or Ci) rather than “concentration” (Bq or Ci per L of soil water).
- If necessary, creative tritium removal systems based on dehumidified air and or heat are possible for soils that contain tritium (elemental or oxide). These systems, applicable beneath buildings or slabs, flush and dry the soil -- removing tritium as a gas (typically in the humidity). The PRS project teams may want to consider the potential levels of tritium beneath facilities, the potential for an undesirable transient pulse to the groundwater and the need for mitigation. In most cases, no mitigation will be required. In some cases, the evaluation may suggest that a desirable course of action (with respect to tritium) would be to leave a slab (or partial slab) in place. In such cases the relative impacts of tritium versus low activities of Pu and other radionuclides should be weighed – the core team for a PRS may decide to perform a partial slab removal (only retrieving suspect lines and adjacent soil) while leaving the remaining slab. Such a scenario may be most interesting for sites that will ultimately be below grade such as the HH Building. If other options are exhausted, tritium removal systems based on dehumidified air and heat (if needed) have been designed on paper and more specific information can be made available to Mound.
- Tritium is currently moving in the groundwater beneath Mound and is measured in seeps, both onsite and offsite, above the MCL. While the levels measured are low and represent exceedingly low population dose contributions, it would be prudent to take “As Low As Reasonably Achievable” (ALARA)-type steps to minimize such releases. The most important of these is implementing some of the recommendations related to site-wide hydrologic controls discussed at the beginning of the groundwater section and implementing protections against transient tritium spikes as discussed above. Other steps may be to perform some of the effort in terms of population dose rather than MCL at a maximum seep and, similarly, to account for the maximum reasonable contribution of seep water to a maximum individual exposure. A final consideration would be to combine the above approaches with information on the half-life of tritium to make sure that lifetime exposures account for the decay and do not assume that current or past levels are assumed 50+ years into the future. These suggestions are consistent with the brownfield plan for the Mound Plant site but need to be carefully implemented with full participation of stakeholders for the surrounding areas and offsite seeps.

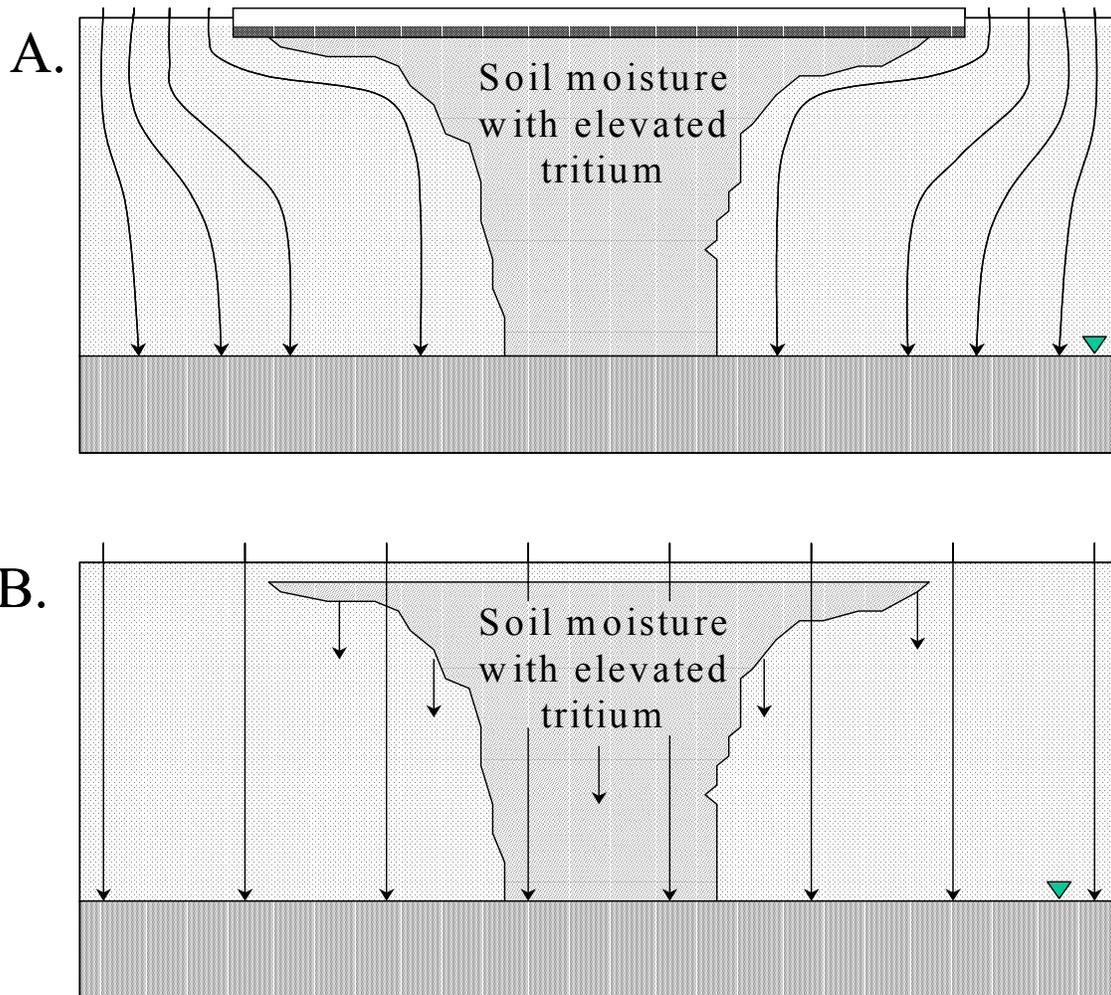


Figure 4. Conceptual depiction of flow lines around a building slab (A), and changes associated with removal of buildings and slabs (B)

4.2.7 Long-term stewardship issues for the landfill

Typically, clay-lined and clay-capped landfills develop cracks and leaks, so it is probable that the Mound landfill will eventually leak. Given the removal of all other contaminated soil and debris off-site to remove any future liability to DOE, DOE should also consider the removal of the refuse in the landfill offsite or have a contingency for downgradient containment and immobilization of contaminants of concern (COCs) that might eventually migrate from the landfill. A more detailed technical assistance request would be necessary to evaluate all the possibilities and the best ways to handle an excavation of the site if removal was deemed necessary.

5.0 BURIED OBJECTS

The technical assistance team recommends MCP use geophysical techniques to locate buried objects. Based on presentations, the team understands that the primary task is the 3-D mapping of the location of crushed drums in corner of landfill in PRS-11. There are other areas where exact 3-D location of buried drums is needed. It would be expedient to contract a competent geophysics contractor that could do all PRSs either in one mobilization or at least on a single contract. The geophysics contractor must have expertise in multiple electromagnetic (EM) techniques and at least two different EM techniques are recommended. There are as many inexperienced contractors as experienced in the geophysics field and so Caveat Emptor. The recent EM-31 and resistivity mapping of soils at PRS-66 (DOE 2002b) seems to have the resolution and results desired by the site for project planning purposes. There are higher resolution electromagnetic and resistivity mapping algorithms available but do not seem to be needed for this site.

6.0 SANITARY AND STORM SEWER LINES

The site requested the TAT to advise MCP on how it can provide the City of Miamisburg verification that sanitary sewer lines (16,000 lineal feet) can be hooked up to the city lines and that storm sewer lines (34,000) are clean for leaving in place. The team consensus was that a certification (or cleaning and certification) process for the sanitary sewers would be difficult and expensive and that alternative solution(s) might be viable. In particular, the radionuclide levels observed in the sewage system appear quite low. Thus, as an initial step, these levels should be organized and summarized, and trends plotted. This would support putting the Mound data in context with radionuclide activities in sewage treatment sludge from various locations across the United States. Several references are available to support this initial step. In particular, several references have been generated by a joint task force from EPA and NRC. This committee, known as the Interagency Steering Committee on Radiation Standards (ISCORS) Sewage Sludge Subcommittee, has performed national surveys of radionuclides in sewage sludge and estimated the risks from subsequent exposure pathways, including agricultural applications of biosolids. This topic has also been reviewed by the Radionuclides in Sewage Sludge Subcommittee of the Radiation Advisory Committee (RAC) of the EPA Science Advisory Board (SAB). A few references gathered by the team during their visit include:

- Joint NRC/EPA Sewage Sludge and Ash Radiological Survey: Dose Assessment
- Radionuclides in Sewage Sludge and SAB Advisory
- Radiological Monitoring of the Raw Sewage, Final Effluent, Sludge and Biosolids of the Metropolitan Water Reclamation District of Greater Chicago
- Guidance on Radioactive Materials in Sewage Sludge and Ash at Publicly Owned Treatment Works

More such references and guidance are available that would assist with the technical aspects of this issue. The team believed that turnover of the sewers may be technically

feasible but that such an effort would require close cooperation between the various entities and a clear understanding of the fact that radionuclides including Pu can occur in sewage sludge and that Mound may contribute incrementally to these levels.

Specifically in relation to the Pu hits, it is recommended that detection in treatment plant sludge be analyzed in greater depth. Many waste treatment facilities have detectable levels of Pu in their sludge (due to historical atmospheric testing) and therefore an analysis of sludge in the facility compared to other facilities is needed. There also should be an analysis of any historical analyses of Pu in the sludge for trend analyses. The team recommends that the sludge analyses be examined from a risk perspective and if the risk is not different than at any other treatment facilities, analysis may be able to be used in conjunction with a sampling effort in the lines to justify hooking up to the city's lines. Alternative plans would require partial or complete replacement of lines (to allow hook up to the offsite sewage treatment plant), or installation of a small modular package style treatment plant specifically to service the Mound Advanced Technology Center. The TAT felt that installation and use of a package treatment plant for the Mound Advanced Technology Center may be desirable since future (i.e., not associated with historical Mound Plant operation) contamination associated with the proposed light industry in an advanced technology park might be a significant risk to MMCIC's long-term operation plans.

The TAT also recommends that MCP review the storm sewer line recommendations given in the March 2002 technical assistance on buried piping to Mound and Ashtabula (DOE 2002a). The recommendation called for a graded approach in relation to characterization. This has been done at a number of nuclear facilities and should give regulators and others more confidence in allowing lines to remain in place. The previous technical assistance report describes characterization options for storm and sanitary lines. The characterization of the lines to assure the lines are clean could be a graded approach and could be used to characterize the sanitary sewer lines to allow temporary hook up to the city lines. With installation of new lines, locations and amendments could be applied as an inexpensive way to limit future DOE liability that any residual site contamination would leak into the lines from soils.

7.0 RECOMMENDATIONS

The TAT made a number of recommendations to DOE-MCP. These suggestions are described in detail in the body of this report and summarized in the list below:

- Develop a site-wide strategy for designing and implementing building D&D along with associated soil remediation.
- Refine the articulation of soil guideline levels to include averaging area and hot spot definitions.
- Develop total contaminated soil volume estimates that explicitly address uncertainty in the estimate. Any additional pre-design data collection across the site should focus on overall uncertainty reduction.
- Revisit the soil excavation design and implementation process to encourage waste stream minimization.
- Develop a strategy for addressing bedrock with embedded contamination.
- Require locational control and logging for all soil surface radiological surveys.

- Investigate the use of soil amendments as a means for minimizing post-closure contaminant movement, and addressing embedded contamination issues for bedrock.
- Develop a more site-wide hydrologic conceptual model paradigm.
- Evaluate low levels of contaminants in the fractured rock to determine if the original exposure scenarios are valid.
- Evaluate the use of less conservative and more technically robust leaching models to back calculate soil standards for non-radioactive contaminants.
- Use rigorous data interpretation to explain unusual chemistry in a few bedrock wells and potential for above-MCL concentrations for barium, radium, nickel, and chromium in monitoring wells.
- Consider monitored natural attenuation strategies for post VOC pump and treat and SVE system operations in Operable Unit-1 (OU-1).
- Consider a number of tritium management strategies to minimize risk and potential remediation costs.
- Consider evaluating the long-term stewardship issues associated with maintaining the onsite landfill, when all other contaminated sources are being removed from the site for off-site disposal.
- To determine where buried objects are located, consider contracting a competent geophysics contractor that could do all PRSs either in one mobilization or at least on a single contract.
- Characterize storm sewer lines by the graded approach similar to that recommended by the previous technical assistance request for Mound and Ashtabula.
- For consideration of hookup to the Miamisburg sewage treatment system, carefully analyze historical sludge data from the onsite sewage treatment system for potential contaminants of concern and similar data from nearby city sewage treatment plants. Alternatively, DOE-MCP should also consider installation of a new package plant for onsite sewage treatment, in lieu of hooking-up to the city sewer system and the associated potential for long-term liability.

Priority Recommendations

One of the key requests made by the site of the TAT was to recommend a prioritization of activities pertaining to the characterization and delineation of underground contaminants. Of the recommendations listed above, the TAT offers the following prioritized list of issues it believes are most crucial to MCP at this time:

1. Site-wide strategic plan - The TAT advises the site to develop a consistent, coherent, technically defensible strategy for the site. Such a plan would assist in program continuity, ensure consistency in approaches, improve overall closure quality, and reduce project management costs for individual projects.
2. Exposed bedrock contamination issues – Reevaluating the site’s cleanup standards, developing pathway-specific risk mitigation strategies, and developing characterization approaches to identify problems early in the D&D process may all help reduce potential cost and schedule problems for waste transfer lines and the SW/R building complex.
3. Refinement of site cleanup goals – Revisiting soil guideline levels will contribute to a better-defined closure process.

4. Waste minimization strategies for excavation – Minimizing the waste stream is the principal opportunity for cost savings at MCP. It could be achieved by developing a contractual mechanisms for contingencies, performance rewards for contractor achievement of waste minimization, and developing a methodology for balancing characterization with expected reductions in disposal volumes.
5. Reevaluation of the contaminated soil volume estimates for excavation – Several options exist for reducing the uncertainty of the volume of subsurface contamination that will need to be addressed, which contributes to waste minimization and thus, cost and schedule improvements.
6. Soil amendment possibilities – Since the site will be leaving soils with residual activities above the background for Pu-238 and may encounter bedrock with embedded contamination, the use of soil amendments could help control potential migration of residual contaminants from backfilled areas and mitigate risk for embedded contamination in bedrock.
7. Strengthen the site-wide hydrologic conceptual model to reduce recharge – Minimizing infiltration into the subsurface is a low-cost approach to decreasing plume migration. Several suggestions are provided to modify the large-scale hydrologic driving forces in the Mound groundwater system.
8. Consider tritium issues – During decommissioning activities, tritium may be encountered in the soil and vadose zone beneath buildings and in the groundwater system. Creative characterization approaches, such as gas phase sampling beneath buildings and slabs, are encouraged. The site may also want to consider leaving building slabs in place due to the potential to increase transport to the groundwater.

8.0 FUTURE TECHNICAL ASSISTANCE EFFORTS

Given the broad scope of the TAT's statement of work and limited timeframe, it was not possible to address all potential technical issues in the detail necessary. Therefore, as part of the recommendations and prioritization provided to MCP, the TAT identified specific future technical assistance efforts that it felt would benefit the site:

- Development of site-wide closure strategy for concrete and soils
- Development of cleanup values for fractured rock contamination
- Review and recommendations of soil amendments to be added during excavation to reduce mobility of residual contaminants
- Development of a sampling and excavation strategy for the area containing Buildings WD and HH
- Develop dose calculation information requirements for dose modeling for T Building to support free release
- Support evaluation of alternatives for the storm water and sanitary sewer lines including fate and transport evaluations associated with the potential for residual contaminants in sludge that is directed to land application.
- Support the evaluation of the rebound test and monitored natural attenuation implementation post pump and treat/SVE treatment for VOCs.

9.0 REFERENCES

DOE 2002a. *Characterization of Underground Piping Contaminated with Radionuclides at the Miamisburg, Columbus, and Ashtabula Environmental Management Projects*. U.S. DOE Office of Science and Technology Technical Assistance to Ohio Field Office, September 2002, Draft Report.

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DOE 2002c. *WD Building Soils Characterization*. Mound Plant, Miamisburg, Ohio. U.S. Department of Energy, May 2002. Final, Revision 0.

DOE 2002d. *Technologies to Address Excavated VOC Contaminated Soil from Areas 3A/4A and Plant 6 at Fernald Environmental Management Project*. Fernald Technical Assistance #138. May 2002. WSRC-TR-2002-00313.

DOE 2002e. *Nevada Test Site Waste Acceptance Criteria*. February 2002. Revision 4. DOE/NV-325-Rev.4.

DOE 2001. *Mound Exit Project Performance Baseline 2002 (PB2), Volume III Performance Baseline Overview Summary*. Prepared by BWXT of Ohio for U.S. DOE Ohio Field Office, November 20, 2001, Revision A.

DOE 2001. *Action Memorandum Engineering Evaluation/Cost Analysis: Buildings R, SW, 58, and 68 Slab Removal Action*. Mound Plant, Miamisburg, Ohio. U.S. Department of Energy, March 2001. Final, Revision 0.

DOE 1999. *Work Plan for Environmental Restoration of the DOE Mound Site, The Mound 2000 Approach*. U.S. Department of Energy, February 1999. Final, Revision 0.

Envirocare of Utah, Inc. 2001. *Waste Acceptance Guidelines*. Revision 3, May 16, 2001.

Los Alamos National Laboratory 1990. *Letter Report: Preliminary Results of Reconnaissance Magnetic Survey Mound Plant Areas 2, 6, 7 and C*. November 1990. Environmental Restoration Program, Technical Support Office, Los Alamos National Laboratory. Working Draft.

Technical Assistance Baseline

(E-mail to susan.meyer@srs.gov, fax to Susan Meyer at 803-725-4129, for the Lead Laboratory)

Tracking Number:		
Request Title:	Integrated SubSurface Characterization	
Contact Individual:	Doug Maynor-OH, Jim Gambrell-MEMP	
Requesting Organization:	Ohio Field Office – Miamisburg Environmental Management Project	
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Scope of Work:

Miamisburg requests technical assistance to define the optimum methods for characterizing the extent of subsurface contamination and then recommend the most effective means to remediate the various site problems. The specific focus of this technical assist will be several Potential Release Sites (PRS's) being addressed this year and in early 2003. The primary COC's are Tritium, Actinium, Plutonium 238, Thorium, and Radium. Following are some of the overall technical issues requiring assistance:

- **Examination / Validation of the technical approach for PRS-66 remediation**
- **Review of data collected in the Phase I work to determine the extent of contamination under SW and R buildings**
- **Based on Phase I review, make recommendations for Phase II work**
- **Assist in locating buried Thorium Drums in Operable Unit 1 and delineate the extent of the problem**
- **Examine overall approach now being used to characterize, remediate, and then validate the individual PRS's prior to turning them over to the City of Miamisburg**
- **Assist in completing the current program to deploy a near-real time Pu238 field instrument.**

Specifically, OH is requesting technical assistance in the above problem areas to help guide the proper use of existing ASTD and site funding in an integrated effort to reduce risk to the Closure schedule. Following a formal week-long TA study, conducted on-site in Miamisburg, further Technical Assistance is expected be of a consulting nature and would be needed on a sporadic basis as questions come up during implementation.

Support:

What resource(s) have been selected?

It is believed the previously used expertise from ANL, SNL, and INEEL would be of greatest value.

What resources were offered, but not selected?

N/A

Requested Start Date:

9/15/02

Requested Completion Date:

TBD

Estimated Cost:

\$50 to \$70K

Submitted By:

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APPENDIX B

PARTICIPANTS AND CONTACT INFORMATION

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 Miamisburg Closure Project, Ohio
 October 28-31, 2002**

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Ms. Eddy-Dilek is a research scientist in the Environmental Restoration Technology Section at the Savannah River Technology Center, the research and development laboratory supporting SRS. Her responsibilities have included many aspects of applied research related to characterization of hazardous waste sites and monitoring and performance assessment of remedial technologies. This work has a strong geotechnical, geological, and geohydrologic basis. For the last four years, she has been the lead investigator for the DOE's cone penetrometer sensor testing and evaluation program and has been actively involved in the development, evaluation, and application of new sensors and approaches for site characterization and monitoring. During 1998-1999, she led the site characterization efforts for the Interagency DNAPL Consortium Program at the Cape Canaveral Air Station, Florida, a joint EPA-NASA-DoD-DOE program for evaluation of innovative technologies for DNAPL remediation.

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Areas of Expertise:

Dr. Gogolack has spent his entire career at the Environmental Measurements Laboratory. His earlier work included research on the impact of non-nuclear energy technologies on the environment and the effect of diurnal radon progeny concentrations on terrestrial gamma-ray exposure rates; testing real-time monitoring instrumentation for ⁸⁵Kr releases from nuclear reprocessing plants; developing the first mobile computer system on on-site data analysis of in-situ gamma ray measurements and designing a monitoring program for potential releases from light water reactors employing high pressure ionization chambers and thermoluminescent dosimeters. Dr. Gogolack was a member of a team which developed statistical procedures for the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). The team was awarded Vice President Al Gore's Hammer Award for Reinventing Government. In addition, he developed statistical methods for linking data quality objectives and measurement quality objectives for the Multi-Agency Radiological Analytical Laboratory Protocols (MARLAP) Manual.

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Dr. Hazen's area of specialty is environmental microbiology, especially as it relates to bioremediation. His current research is focused on aerobic bioremediation of landfills, PAH contaminated soil, solvent contaminated soil and groundwater, and actinide biogeochemistry. Since early 1998, Dr. Hazen has been Head of the Microbial Ecology and Environmental Engineering Department and Lead Scientist for the Environmental Remediation Technology Program in the LBNL Earth Sciences Division. Since September 1999 he has also been head of the Center for Environmental Biotechnology. He is a fellow of the American Academy of Microbiology and has authored more than 151 scientific publications, not including more than 390 abstracts and chapters in several books. He has also given more than 670 scientific presentations, 75% of them invited. Dr. Hazen received the 1995 R&D 100 Award, 1996 R&D 100 Award, and the 1996 Federal Laboratory Consortium Excellence in Technology Transfer for bioremediation technologies. He has patents on 5 bioremediation processes that are being used in 15 states; these technologies have been licensed to more than 30 companies. Dr. Hazen has acted as an expert reviewer for 25 different scientific journals and 14 federal research granting agencies. He has supervised and consulted on the implementation of bioremediation at more than 50 sites in several countries. He is currently the LBNL representative to the DOE EM50 Strategic Lab Council, the DOE Natural and Accelerated Bioremediation Research Program Field Research Center, the EM50 Subsurface Contaminant Focus Area Lead Lab POC, and the EM50 lead for LBNL. He was recently appointed to the United Nations Global Water Quality Task Force, one of only two US scientists.

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Areas of Expertise:

Dr. Johnson's technical area of expertise includes design of precision excavation programs for soil remediation, application of geostatistical methods to the design of environmental sampling programs, MARSSIM-based closure methodologies rad contaminated sites, web-based approaches to environmental data management and communication, advanced object-oriented database designs for environmental site assessments, numerical modeling of groundwater flow and contaminant transport, and optimization techniques applied to subsurface remedial action design. Past work at Argonne includes the following: developing real-time data collection programs to support soil remediation actions; designing "smart", interactive software for sample

network design that fully exploits the spatial characteristics of environmental contamination and integrates hard and soft information on the probable location of contamination events; and designing and implementing Adaptive Sampling and Analysis Programs for hazardous waste characterization. He has also taught MARSSIM implementation workshops; developed specialized web sites for environmental data management and communication; developed specialized Java-based software for disseminating GIS information over web browsers; developed and implemented object-oriented databases to be used for integrating and visualizing diverse environmental data collected at Department of Defense installations undergoing site restoration; and provided lab support for multi-phase contaminant transport modeling.

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Dr. Krstich is an environmental specialist with more than twenty-two years of experience in the environmental field, including academia, government and industry. He has focused on the characterization and remediation of contaminants in terrestrial systems. For the past decade, he has focused on science and technology in supporting the Department of Energy's (DOE) evaluation and deployment of remediation technologies for their environmental restoration programs.

Dr. Krstich holds a BS and MS in Natural Resource Management from Arizona State University. He received his Ph.D. from the University of Tennessee in 1987 with an emphasis in soil chemistry. His post-doctoral work at UT focused on the fate and transport of synthetic organic contaminants in terrestrial systems. He subsequently has worked for IT Corporation's Technology Development Laboratory in Knoxville, TN and for Fluor Daniel's Technology Programs at the DOE Fernald site in Ohio. For the past six years, Dr. Krstich has been president of Environmental Management Solutions, a technical support services company to the DOE and located near Cincinnati, Ohio. During this time, he has worked directly with many of the National Laboratories, including ANL, INEEL, SNL and ORNL, in evaluating and deploying characterization and remediation technologies for many of the sites within the DOE Complex.

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Areas of Expertise:

Dr. Looney is a fellow research engineer at the Savannah River Technology Center. In this position for the past 15 years, he has coordinated development and deployment of

environmental characterization and clean-up technologies. Dr. Looney has successfully performed environmental projects on a wide range of topics. For example, he was principal investigator responsible for the first large scale application of horizontal drilling to environmental remediation. Other successful research efforts include: soil gas survey techniques for hazardous waste sites, barometric pumping for vadose zone clean up, gas phase nutrient addition to stimulate bioremediation, and various topics associated with modeling and risk assessment. Dr. Looney currently holds five U.S. and one foreign patent for environmental technologies. Most of these are licensed to environmental engineering companies and are in use throughout the U.S. Dr. Looney, in collaboration with others, contributed to recent field studies at the Mayak Site (a former nuclear production facility) in Russia. Recently, Dr. Looney co-edited the book "Vadose Zone Science and Technology Solutions". He also led the successful efforts to redefine the Subsurface Contaminants Focus Area technical program in terms of technical targets within which R&D programs could be developed.

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Areas of Expertise:

Dr. Roelant is the Sensors, Automation and Robotics Program Manager at Florida International University's Hemispheric Center for Environmental Technology. Dr. Roelant has been involved with performing or managing research and development for the past 25 years. Over the past 11 years, he has either lead or provided technical management to more than 400 R&D projects valued over \$120M. These projects have ranged from new research to rapid engineering improvements to existing technologies. R&D has included: sensors and long-term monitoring systems for soil, groundwater, landfill, and facility applications; DNAPL characterization technologies; improved radiation-detection systems; nondestructive assay and evaluation systems; geophysical techniques; and remote-sensing technologies. During this time, he has worked with experts from academia, industry and national laboratories in developing new sensors, long-term monitoring modeling, remote-sensing technology and improved characterization and sampling strategies. He has developed numerous field-deployable sensors and turn-key sensor data-acquisition, analysis, and decision-support systems. He has also helped manage the development, testing, and evaluation of numerous sensor systems from national laboratories and private industry for the U.S. Department of Defense and the DOE for the past 11 years.

Ohio Technical Solutions Study Scope of Work

Recommendations to Address Uncertainties in Characterization and Delineation of Certain Surface and Subsurface Contaminants for the Miamisburg Closure Project (MCP)

PROBLEM DESCRIPTION:

The Miamisburg Closure Project (MCP) [formerly the Miamisburg Environmental Management Project (MEMP)] has identified specific uncertainties related to characterization and delineation of surface and subsurface contaminants for the following areas:

1. Contamination including soils, piping and concrete pads under WD, 38, HH, SW and R Buildings
2. Soil and groundwater contamination
3. Buried objects
4. Underground piping between buildings including storm and sanitary lines

This Technical Assistance (TA) Team will review the current MCP technical approaches to resolving these issues as provided in the PB2 Baseline¹. The technical approaches include additional characterization in the above areas to reduce uncertainties and risks. The TA Team will examine the available data and recommend improved methods to quantify the extent of radionuclide contamination beyond arbitrary boundaries. MCP is seeking improved characterization methods to remove uncertainties associated with surface and subsurface contaminants that could interfere with reaching site closure by 2006.

¹ PB2 Baseline refers to the redacted version of the, "Mound Exit Project, Performance Baseline 2002 (PB2)," Revision A, submitted November 20, 2001.

BACKGROUND:

In March 2002, the Department of Energy (DOE) Ohio Field Office (OH) and the Ohio Closure Support Group (OCSG) identified eleven technical needs for MCP in the report, “*Ohio Field Office Request for Closure Site Technical Support.*” Items 1-4 in the Problem Description are subsets of the technical needs related to characterization, delineation and remediation of surface and subsurface contaminants.

SCOPE:

The TA Team will be provided with background information concerning the problems being addressed, and will be made aware of the proposed PB2 Baseline technical solutions for those problems. Upon arrival, the Team will be briefed on the scope of the study and the expectations of MCP. Next, the contractor will provide a general overview of uncertainties identified for contaminated environmental media and the current proposed characterization and remediation approach. The Team will then tour the site with the contractor and have any questions fully answered before addressing the study objectives.

The TA Team will review the PB2 Baseline technical approach to the characterization and delineation of surface and subsurface contaminants at the Mound site. This review will include the uncertainties identified with characterization, delineation and remediation of contamination of areas under buildings, surface soils, subsurface soils, groundwater, buried objects, underground piping and concrete pads. This TA Team will review the existing characterization data to identify data gaps. If required, they will recommend the optimum methods for gathering any additional data needed and then determine how the data can best be used to accelerate closure.

The team will propose technically-sound alternatives that will provide technical improvement over baseline.

OBJECTIVES:

The primary objective of the TA Team is to identify and recommend improved characterization methods to remove uncertainties associated with surface and subsurface contaminants that could interfere with reaching site closure by 2006. These recommendations should provide technical improvement over baseline to accelerate the schedule, reduce the cost or reduce health and/or environmental risks.

To reach this objective, the TA Team will review existing environmental media characterization data and selected remedies relative to the MCP Exit Plan (PB2 Baseline).

The TA Team will integrate experiences at other DOE sites and federal agencies to address the surface and subsurface issues at MCP.

Specific tasks of the TA Team are to review the following areas, and if possible, identify and propose technically-sound improvements that will reduce uncertainties, accelerate the schedule, reduce the cost or reduce health and/or environmental risks:

1. Review the PB2 Baseline technical approach for characterization and remediation of the contamination (including soils, piping and concrete pads) under WD, 38, HH, SW and R Buildings. Review recent sampling and analysis activities (e.g., Weston sampling and characterization effort) and proposed characterization strategies (ITRD report “Characterization Strategies for Subsurface Soils, Beneath the SW and R Buildings, MEMP, Miamisburg, Ohio”). The current base-line remediation plan considers the top two feet of soil immediately beneath and 15 feet beyond the building footprint as potentially contaminated. There is considerable evidence of subsurface contamination outside of these 15-foot perimeters.
2. Review the PB2 Baseline technical approach for the characterization and remediation of soils and groundwater in selected areas of the site. The selected areas will include the significant areas of contamination that still require characterization and/or remediation.
3. Review the PB2 Baseline for the characterization and remediation of buried objects in select areas of the site.
4. Review the PB2 Baseline for the characterization and remediation of piping between buildings including storm and sanitary lines. These lines are assumed to be clean. However, a path forward to remove the uncertainty and certify them as clean has not been developed.

DELIVERABLES:

The TA Team will address the Objectives 1-4 above, propose and develop technically-sound improvements to the PB2 Baseline technical approach with a focus on reducing uncertainty, and present the results to DOE as a draft final report prior to leaving the site. MCP will review the draft report for factual accuracy and provide comments to the Team. The Team will issue a final report by November 27, 2002. It is anticipated that after completion of the final report, some portion of the team will be available for continued consultation. The consultation may range from phone calls to site visits, either individually or as part of a team.

SCHEDULE:

The schedule is as follows:

- *Received Technical Solutions Request – 10/15/02*
 - *Site Call to Clarify Request – 10/18/02*
 - *Site Visit – 10/28/02 through 10/31/02*
 - *Closeout and Distribute Draft Report – 10/31/02*
 - *MCP Provide Comments of Draft Report - 11/15/02*
 - *Complete Final Report – 11/27/02*

APPENDIX E

TECHNOLOGY REMEDIATION MATRIX

Technologies to Address Excavated VOC Contaminated Soil

Remediation Technology	Remediation Strategy	Effectiveness*	Permitting Risk	Implementability	Health and Safety Issues	Cost**	Public Acceptability (Stakeholder)	Long-term Liability	Technical Maturity	Overall
Off Site Disposal	No treatment – waste removal	Rapid and removes soil to facilitate remaining cleanup.	Minimal	Moderate - Handling and packaging, utilizing transport and disposal vendor.	Moderate, requires handling and transportation.	High	High	Low but organics remain in soil.	Commercially available, infrastructure already in place.	Viable, but high cost.
Passive Soil Venting	VOC removal from soil	Effective given sufficient time. High uncertainty for treatment duration.	Low	Straightforward – will require significant sampling and/or soil turning.	Minimal – but may require some physical manipulation of pile.	Low	High but generates some fugitive emissions of VOCs.	Low	N/A	Viable, but may not meet schedule requirements.
Enhanced Soil Venting	VOC removal from soil	Effective – should meet schedule requirements, PCE removal requirements. Presumptive EPA remedy in soil.	Low	Straightforward, off gas treatment, if necessary, would eliminate fugitive emissions. Many configurations are possible. Solar heat would accelerate process. Minimal infrastructure required and potential for additional application.	Minimal – requires insertion of venting infrastructure into soil.	Low to moderate	High	Low	Commercially available and easily implemented by local craft.	Viable, meets all requirements. Best alternative.
Zero Valent Iron	Destruction – ex situ	Reasonable technology for chlorinated solvents, VOCs. Generates intermediate with lower WAC. Requires complete destruction. Likely to be effective	Low, need to demonstrate control, conditions and completeness.	Straightforward. Requires soil handling and mixing facility, iron storage and delivery facilities (extending footprint). Probably requiring treatability study.	Moderate, heavy equipment	Medium to high	High	Low	Commercially available – unique application	Potentially viable – but not best alternative.

Remediation Technology	Remediation Strategy	Effectiveness*	Permitting Risk	Implementability	Health and Safety Issues	Cost**	Public Acceptability (Stakeholder)	Long-term Liability	Technical Maturity	Overall
		within desired schedule.								
Thermal Desorption	VOC removal from soil	Rapid and controlled, can meet schedule requirements.	Low but may require additional permits.	Straightforward, off gas treatment, if necessary, would eliminate fugitive emissions. Would require significant equipment infrastructure. May be able to use or modify existing on site equipment.	Moderate – requires significant handling of soil and worker proximity to heat source.	Low with existing equipment - high if new equipment is needed.	High	Low	Commercially available and may be implemented by local personnel.	Viable, may be difficult to implement.
Anaerobic Bioremediation	Destruction that can be in situ or ex situ	Reasonable technology for VOCs. Generates intermediates with lower WAC. Requires complete destruction.	Low, need to demonstrate control, conditions and completeness. Bio-augmentation would increase permitting risk and extend schedule.	More difficult because soil has been excavated. Unlikely to achieve schedule goals. Requires subcontractor or product supplier. May require bio-augmentation. Requires treatability tests.	Minimal	Medium	High, but bio augmentation could reduce it.	Low	Commercially available	Potentially viable but not best alternative.
Aerobic Bioremediation	Destruction that can be in situ or ex situ	Reasonable for VOCs (slow for PCE).	Need to document timely PCE destruction.	Requires addition of carbon sources for co-metabolite. May not achieve schedule goals. Requires treatability tests.	Fugitive air emissions, but minimal. Could increase if flammable co-metabolites are used.	Medium may be lower than anaerobic.	High	Low	Commercially available	Potentially viable but not best alternative.
Vacuum Desorption	VOC removal from soil	Rapid and controlled, can meet schedule requirements.	Low	Potential to integrate with drum soil treatment. Shipping to offsite vendor for remote treatment and disposal.	Moderate, requires handling and transportation.	High, given offsite treatment and disposal.	High (treated offsite)	Low	Commercially available, may be difficult to implement in time due to need to set up large	Viable, not best alternative.

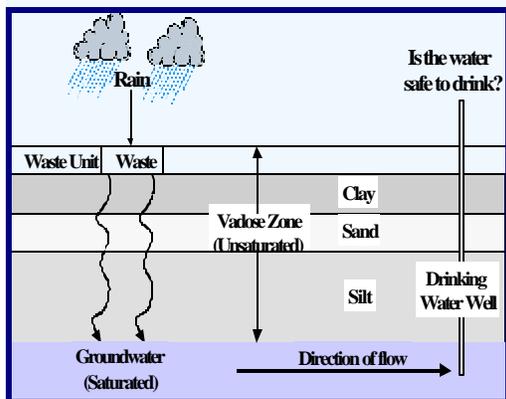
Remediation Technology	Remediation Strategy	Effectiveness*	Permitting Risk	Implementability	Health and Safety Issues	Cost**	Public Acceptability (Stakeholder)	Long-term Liability	Technical Maturity	Overall
									equipment, coordination with drum waste remains an issue.	
Incineration	VOC destruction	Rapid and controlled, can meet schedule requirements.	Minimal	Moderate - Handling and packaging required. Requires separate vendors for incineration and disposal.	Moderate, requires handling and transport.	Very High	High	Low	Commercially available	Viable, not best alternative.
Chemical Oxidation	VOC destruction	Rapid and controllable, can meet schedule requirements and treated soil meets WAC.	Low	Requires significant new infrastructure to control reagents (storage and delivery). Requires post treatment drying.	Moderate to high.	Moderate to high	High	Low, but U may be converted to a more mobile state U (VI)	Commercially available	Viable, not best alternative.
DNAPL Removal Technologies	Free product removal	Not appropriate because no significant free product in soil	NA	NA	NA	NA	NA	NA	NA	Not applicable to excavated soil.

*Effectiveness in terms of meeting goals such as schedule, onsite disposal, and cost.

**Cost: low < \$500,000, moderate > \$500,000, high > \$1M, very high > \$5M

Performs Fate and Transport Analysis

VZCOMML[©] (A Multi-Layer Vadose Zone Contaminant Migration Modeling Program)



Technology Brief

- Contains preloaded geochemical and chemical parameters
- Screens 187 contaminants simultaneously
- Compares ground water concentrations to MCL/RBC
- Defines time of peak concentration in aquifer
- Calculates three types of SSLs
- Uses up to four soil layers
- Calculates less restrictive, but still protective, cleanup levels
- Reduces time and cost of analyses and cleanup
- Approved by regulators
- Based in Microsoft[®] Excel

Additional information is available from:

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Westinghouse Savannah River Company (WSRC) has developed a software application that simulates contaminant fate and transport through the vadose zone to ground water. VZCOMML is a one-dimensional, infinite source, analytical contaminant transport model with a mass-balance limit that calculates key fate and transport parameters. The program identifies the type of contaminant(s), the peak groundwater concentration, and the time to reach peak groundwater concentration.

VZCOMML compares the calculated ground water concentrations to maximum contaminant levels and flags contaminants that fail the screening criteria. The program also compares soil concentrations to mass-balanced soil screening levels (SSLs) and flags contaminants that fail the screening criteria.

The program is designed to be consistent with the U.S. Environmental Protection Agency's (EPA's) Superfund Soil Screening Guidance: Technical Background Document (EPA 540/R-95/128).

Recognizes Soil Diversity

The vadose zone comprises multiple layers of different types and percentages of soils, such as sands, silts, and clays. Each soil type has different hydrogeologic properties, such as permeability, porosity, density, and hydraulic conductivity. Because of the diverse hydrogeologic properties, soil pore water will not move at the same velocity through the different layers. To account for the heterogeneous nature of soil, VZCOMML can use up to four separate layers to simulate the flow of water through the vadose zone. A weighted average is used to calculate porosities from each of the four soil layers.

Ensures Conservative Results

The simplified VZCOMML model uses fundamental fate and transport processes. The program assumptions ensure conservative results. These assumptions are: (1) the source is considered to be infinite, (2) the system is at equilibrium with respect to adsorption, (3) adsorption is linear with concentration, (4) contaminant adsorption to soil is linear, and (5) retardation is a function of total porosity. Factors such as dispersion, hydrolysis, dehydrohalogenation, and volatilization are not incorporated. This design minimizes the need to input data, which reduces the cost of gathering input data.

Screens All Compounds Simultaneously

VZCOMML is preloaded with geochemical and chemical parameters for 148 compounds on the target compound list/target analyte list (including

volatile organic compounds, semi-volatile organic compounds, pesticides, and metals) and for 39 radionuclides. All 187 compounds, or contaminants, can be screened simultaneously. Default parameters are easily modifiable to match site-specific conditions.

Uses Simple Logic

Simple logic functions are used to compare the calculated ground water concentration to a maximum contaminant level (MCL), or a 1×10^{-6} risk-based concentration (RBC) published by the EPA, Region 3. RBCs are used for chemicals that do not have MCLs. Ground water results are also compared to a 1,000 year hypothetical travel time to the aquifer. If an MCL/RBC is exceeded and the time of maximum concentration is less than 1,000 years, the program automatically lists any analyte that fails the logic criteria.

Three types of SSLs are calculated simultaneously based on site-specific data. The first type is an SSL using a first-order decay constant for radiological or biological half-life. The second type is mass-balanced SSL, and the third is a default SSL. The SSL values can be used as the cleanup goal or as a remedial decision-making tool.

Easy To Use

The VZCOMML program comprises a Microsoft Excel Workbook containing individual worksheets for the various analyses. Analyses are simplified by use of linked databases containing physical and chemical constants, macros, and input information. Databases are easy to customize for site-specific analyses. The output worksheets are high quality and can be easily cut and pasted into other documents. The program runs on a standard PC and requires only 500 kilobytes of memory. No additional hardware or software is needed.

The fundamental and established equations built into the program have been verified by many sources. The calculations and equations can be printed out on a spreadsheet for easy verification of specific analyses.

Cost Effective

Most commercially available modeling packages are complicated and require input of numerous parameters. The detailed output from these packages may provide the user with more information than is needed for the initial evaluation of remedial action alternatives. VZCOMML is faster, simpler, and less expensive to use than other models. It requires fewer data inputs and can model up to 187 contaminants and up to four soil layers simultaneously in one program execution. Other available models

Continued on next page ..

require separate program executions for each contaminant and may not include multi-layered capability. VZCOMML can be used as a first step in contaminant fate and transport modeling, enabling users to reserve the use of more expensive and time-consuming models for those contaminants that VZCOMML flags.

With more pre-loaded data inputs and greater sophistication than the EPA's Soil Screening Guidance, VZCOMML can calculate less restrictive, but still protective, cleanup values. This eliminates chemicals from concern earlier in the fate and transport evaluation, thereby reducing cleanup costs.

Successfully Demonstrated

VZCOMML has been approved by regulators and used at more than 20 cleanup sites at the U.S. Department of Energy's Savannah River Site. Output from the program has comprised the fate and transport analysis portion of the EPA-approved "plug-in" Records of Decision for these sites.

Partnering Opportunity

WSRC operates the Savannah River Site for the U.S. Department of Energy. WSRC scientists and engineers develop technologies designed to improve environmental quality, support international nonproliferation, dispose of legacy wastes, and provide clean energy sources. WSRC is responsible for transferring technologies to the private sector so that these technologies may have the collateral benefit of enhancing U.S. economic competitiveness.

WSRC is seeking environmental software distributors who would be interested in selling the copyrighted VZCOMML program to environmental consultants as a commercial product under a license with WSRC. Because the Excel program is included with the VZCOMML data file, it is anticipated that a distributor of VZCOMML may require a distribution agreement through the Microsoft Corporation's Product Integration Program. Further information may be obtained from <http://www.microsoft.com/permission/copyrgt/cop-soft.htm#data>.