MMR TECHNICAL PEER REVIEW

EXECUTIVE SUMMARY

Background

Pursuant to a Department of Defense (DoD) Inspector General (IG) recommendation, during July and August 1999 a peer review team, consisting of six experts, performed an independent assessment of the Massachusetts Military Reservation's (MMR) Installation Restoration Program (IRP). The team evaluated the credibility of decision-making processes, the rationale used in reviewing and selecting remedial actions, whether risk assessment concepts were appropriately applied to remedial decisions, and the technical validity and feasibility of selected remedies to achieve the stated remedial goals.

Peer Review Process

The primary focus of the Technical Peer Review (TPR) was on activities since the Air Force Center for Environmental Excellence (AFCEE) took over management of the MMR's IRP from the Air National Guard Bureau in May of 1996. The Technical Peer Review Team (TPRT) organized its assessment around examination of three key topics: community involvement, risk assessment, and remedial technologies. The team prepared three reports on these topics, evaluating the adequacy of the processes used to investigate, evaluate, and remediate thirteen significant groundwater plumes.

The TPRT interviewed a sample of government employees, contractor personnel, and community participants, reviewed hundreds of documents, and toured the sites. Most agreed that AFCEE inherited a highly contentious program. Utilizing professional competence, personal integrity, and determination, the AFCEE team developed a productive climate that allowed cleanup to proceed and improved the community's faith in the military's ability to do the right thing. They are to be congratulated.

Inasmuch as all sites and documents could not be evaluated in the time provided, the TPRT chose six of the 13 identified significant plumes at MMR as case studies. The six plumes (Ashumet Valley, FS-12, SD-5, FS-28, CS-10 and LF-1) are thought to be representative of MMR plumes. Additionally, the case study plumes included four that have undergone the MMR-specific Decision Criteria Matrix process.

Summary of Individual Reports

The TPRT developed technical findings and recommendations for each of the three areas evaluated. A short synopsis of each report, and the findings and recommendations are summarized below. The reader is encouraged to review the individual reports that contain comprehensive analyses in support of the findings and recommendations. Each finding and recommendation is referenced to an individual report and page number (e.g. **Technical Review** (TR), **Community Involvement** (CI), **Risk Assessment** (RA)).

Community Involvement Synopsis

A major impetus for this peer review was the Inspector General's belief that cleanup decisions at MMR had been driven by community-based preferences that were not substantiated by technical analyses of risks to human health or the environment. The TPRT found that community views had indeed played a large role in remediation strategy at MMR. The reasons behind this influence stem largely from the military's missteps in responding to the pollution and community concerns prior to AFCEE's arrival. These missteps damaged the military's credibility as responsible environmental managers and greatly strengthened the influence of the community and their elected representatives in shaping the direction of the cleanup. It should be noted that federal and Commonwealth regulators also play important roles in determining cleanup goals at MMR.

AFCEE is acknowledged by the TPRT as having re-established the credibility of the military and having moved the cleanup forward. The TPRT found, however, that the military has not yet acknowledged, in visible and meaningful ways, the outrage experienced by local communities as a result of the contamination caused by MMR. Acknowledging such outrage is likely to result in less community insistence on remediation deemed excessive in strictly risk-based terms.

AFCEE responded to the contentious situation it inherited in 1996 by establishing a community involvement program that was noted to go far beyond the community involvement requirements mandated by CERCLA. The decision processes used to formulate environmental remediation decisions are notable for the large degree of influence accorded to community representatives. Many in the military, notably the IG, regard this influence as a cause of excessively stringent, wasteful, and technically unsupported remediation decisions and strategies. What has not been perceived or pursued is the opportunity to use excellent community involvement processes as the basis for technically sound, consensual decision making. Pursuit of such a community-based decision strategy is the course most likely to maximize benefits and minimize costs.

MMR is entering a period of transition which presents opportunities for a renewed community involvement strategy that combines community-based decision making with sound analytical judgements of risk and remedy selection. Improved risk communication efforts and more sophisticated approaches to group decision making would be useful. Attempts to renege on past promises to allow the community a significant role in decisions at MMR will likely meet with strong resistance. The military's recently regained credibility is also threatened by the absence of a forum wherein citizens and regulators can explore the full spectrum of health and environmental impacts that many on the Upper Cape suspect stem from MMR activities.

Community Involvement Findings

a. The credibility of the military's professional competence and commitment to cleanup at MMR has markedly improved due to AFCEE's openness and improved opportunities for community involvement **(CI, 1).**

b. A commonly held belief (by government personnel) is that community-based decisions are necessarily excessive, wasteful and unresponsive to technical assessments. This paradigm may have prevented AFCEE from pursuing a superb community involvement program that would have resulted in more closely aligned stakeholder preferences and less costly cleanup options **(CI, 1).**

c. Understanding community concerns requires distinction between "hazard" and "outrage." DoD has failed to recognize and respond appropriately to the "outrage" caused by MMR pollution and has likely triggered "hazard" management that it now considers "excessive." Conversely, outrage management could have resulted in less excessive hazard management (i.e. less costly remediation) **(CI, 1).**

d. AFCEE has established an expectation that community involvement will play a major role in remedial decisions. Community involvement programs must be institutionalized, deepened, broadened, and measured to be effective tools for aligning community values with technical remedial analyses. The Community Involvement Plan revision, currently in progress, provides an opportunity to incorporate community involvement practices into an overall strategy for the next phase of cleanup **(CI, 1).**

e. Community concerns about the consequences of past and present military activity, whether under the CERCLA umbrella or not, are threatening AFCEE's credibility. Overarching health concerns, particularly cancer rates on the Cape, are believed to be environmentally related. DoD can enhance its somewhat fragile credibility by taking the lead in establishing a forum to address these concerns **(CI, 2).**

Community Involvement Recommendations

a. Reaffirm DoD organizational commitment to community involvement as the basis for decision making **(CI, 21).** Affirm that cleanup criteria appropriately rely on technical and non-technical factors assessed jointly by MMR and its stakeholders **(CI, 6).**

b. Acknowledge the various sources of stakeholder outrage at MMR: DoD polluted MMR; DoD was slow to respond; early cleanup efforts were unsatisfactory; health and environmental risks posed by some sites at MMR are uncertain; mistrust remains somewhat high; cleanup has been largely a result of stakeholder pressure **(CI, 15-16).**

c. Develop more systematic, innovative methodologies for explaining and discussing technical and non-technical information, values, and outrage concerns with stakeholders **(CI, 24).** Integrate "outrage management" approaches into MMR community involvement efforts **(CI, 8).**

d. With stakeholder input, codify and follow more explicit protocols for community involvement **(CI, 21).** Incorporate community involvement into the "business" side of the cleanup ensuring clear goals, formal evaluation standards, and periodic external reviews **(CI, 9,24).**

e. Ensure that statements made in "public fact sheets" and similar summaries are keyed to accessible and comprehensible technical documents to which stakeholders can refer **(CI, 9,23).**

f. Expand community involvement efforts to provide a forum for discussing other Cape environmental health concerns, whether or not these concerns are part of IRP's mandate or even part of MMR's footprint **(CI, 25).**

g. Explore methods to develop a "win-win" culture that embraces technically defensible remedies and community-based decision making (CI, 5). For example, negotiated compensation may reduce stakeholder demand for remediation approaches that might otherwise be considered technically inappropriate **(CI, 16).**

h. Ensure community involvement in the revision of the Community Involvement Plan and utilize it as an opportunity to begin implementing the above recommendations **(CI, 19).**

Technical Review Synopsis

The MMR plume response management goal as agreed to by AFCEE, regulators, local citizens and elected officials is "100 percent capture of all plumes above maximum contaminant levels (MCLs) or other risk-based levels and treatment of contaminants and cleanup of plume(s) to background levels if technically and economically feasible." Three technologies have been or are planned to be utilized to achieve groundwater cleanup goals: (1) extraction, treatment and reinjection (ETR) systems (aka "pump and treat"), (2) recirculating well technology (RWT), or (3) a combination of ETR, RWT, long term monitoring (LTM), and monitored natural attenuation (MNA).

Projected remediation costs at MMR are about $800 million. Of that total, groundwater remediation costs are expected to exceed $300 million. The MMR Groundwater Plume Technology Evaluation Table (see Table 1 in the **technical review** report) developed by team experts summarizes the current status of remedial actions, relevant site data, and costs for MMR's thirteen significant groundwater plumes.

Extraction, treatment, and reinjection (ETR) was correctly chosen as the appropriate primary remedial technology for the thirteen identified plumes containing up to an estimated 40 billion gallons of impacted groundwater. Remedial actions were determined using one of three decision-making processes: 1) interim action Record of Decision (IROD), 2) remedial investigation and Record of Decision (RI-ROD), or 3) a combination IROD and MMR-specific Decision Criteria Matrix (DCM) process.

Challenges identified by the TPRT in the technical review area included continuous pumping and treating of relatively clean groundwater, overly optimistic times to achieve cleanup, monitoring data that did not properly represent plumes, and site-specific groundwater modeling approaches that were not consistent with available field data nor the complexity of the site.

Technical Review Findings

a. Extraction, treatment, and reinjection (ETR) of groundwater, the primary technology selected at MMR, is appropriate **(TR, 7).** However, continuous pumping of some extraction wells has resulted in pumping and treating of relatively clean groundwater **(TR, 9).** Estimates of times to achieve cleanup goals (e.g. restoration) are overly optimistic **(TR, 12).**

b. Groundwater remediation system implementation has proceeded quickly since AFCEE assumed IRP responsibility **(TR, 8).** With two exceptions (FS-1, FS-28), remedial decisions have been driven by aquifer restoration to achieve background levels consistent with Massachusetts' state standards for Cape Cod's sole source aquifer (ARAR) **(TR, 7).**

c. Formal, independent technical peer review of key documents, such as groundwater models, project implementation plans, and remedial designs, is generally lacking **(TR, 10).**

d. Plume depictions in MMR Fact Sheets and reports do not consistently represent monitoring data **(TR, 9).** Given the size and complexity of some plumes, additional time devoted to field studies (months) may be justified to ensure thorough technology evaluation and optimized final designs **(TR, 11).** Although scheduled milestones are important, schedule slippage should be considered when technically justified **(TR, 14).**

e. Site-specific groundwater modeling approaches, where examined, are not consistent with the available field data, complexity of the site, intended use of the model, and the question the model is supposed to address **(TR, 10).** Further, there appears to be inappropriate use of and/or over-reliance on modeling predictions in lieu of field data analyses **(TR, 11).**

f. Transition from active remediation (pumping) to long-term aquifer management is conceptually defined. Stakeholder consensus in developing the practical details and procedures for implementing this transition should be immediately pursued **(TR, 12).**

Technical Review Recommendations

a. Develop a more comprehensive, routine performance assessment program of the plume remediation programs based on actual field data as reported in the quarterly monitoring reports. The scope of reports should be expanded to include such criteria as projected time to achieve cleanup, ETR system optimization, extent of natural degradation taking place, and estimates of mass removal **(TR, 17).**

b. Continue to utilize the "observational approach" and improve data monitoring to update and refine groundwater remedial systems performance. This approach for groundwater remedial systems optimization requires careful data review and evaluation of potential system modifications **(TR, 16).**

c. Define the appropriate qualifications and skill mix needed for the next phase of groundwater cleanup. Future program success will depend on the contractor(s) capabilities to monitor and optimize system performance **(TR, 15).**

d. Although transition from active remediation (pumping) to long term management of plume restoration is conceptually defined, develop the practical details and procedures for implementing this transition. The consensus process among regulators, stakeholders, and the DoD regarding the details of implementation should begin as soon as the ETR systems are installed **(TR, 18).**

e. Establish a formalized peer review process for various aspects of the projects on a periodic basis. The MMR program is evolving into a phase wherein independent external peer review can lead to significant life cycle cost savings **(TR, 16).**

f. Report capital and annual costs of remediation systems and future or life cycle costs in an accessible format. The current program appears to lack a consistent approach for documenting capital, O&M, and life cycle costs for MMR remedial systems **(TR, 19).**

g. Consider establishing a center for research at MMR on community outreach, risk and technology communication, and evaluation of innovative technologies to develop effective strategies for federal facilities to achieve site closure in a manner acceptable to the impacted community in the most cost effective manner achievable **(TR, RA, CI)**

Risk Assessment Synopsis

Risk assessment principles were used to varying degrees in development of risk management decisions. Remedial decisions were not solely dependent on risk calculations but also appropriately incorporated such factors as community values, feasibility, and cost. The MMR remedial decisions reviewed by the TPRT indicated that risk assessment, elements of risk assessment, or risk-based regulatory values were considered in many, if not all, remedial decisions. Risk estimates, however, were typically not the driving factor in those decisions.

Three distinct risk assessment guidance protocols were used to evaluate risks at MMR: (1) the Risk Assessment Handbook (RAH); (2) the Decision Criteria Matrix (DCM), and (3) EPA's Risk Assessment Guidance for Superfund (RAGS) and associated documents. The RAH and DCM were developed specifically for MMR purposes. The established policy of continuing to use the same protocol that was in use at the time the analysis of the plumes began has resulted in contemporaneous risk estimates developed from different risk assessment protocols. The decision to continue to concurrently follow several risk protocols has created confusion and may lead to misinterpretation and overestimation of risks.

Risk Assessment Findings

a. Most of the plume remediation risk management decisions relied on either classic, regulatory risk assessment processes, elements of risk assessment, or risk-based regulatory values **(RA, 1).**

b. Many risk assessments were not classic, regulatory risk assessments but rather were screening assessments. The risks estimated from these screening assessments were presented in MMR documents as if they resulted from state-of-the-art risk assessments **(RA, 7).**

c. The screening assessments examined by the TPRT appear to use very conservative assumptions and models, presumably to ensure that risks would not be underestimated in the screening process. However, most risk managers appeared to be unaware of the extent to which screening assessments tended to overestimate actual risks, in some cases significantly **(RA, 8).**

d. Major elements of risk assessment required to repeat, evaluate, or modify the assessment were missing or difficult to locate in the assessments reviewed (e.g., a clear statement of the purpose and goals of the assessment and/or data, criteria, and assumptions) **(RA, 14).**

e. There appeared to be an absence of an appropriate, independent, and overarching review of the risk assessments conducted at MMR. This resulted in risk assessments of varying quality and design, which in turn, sometimes produced risk estimates that either were incapable of being interpreted or were not particularly useful for the evaluation of potential remedies. Interpretation of the risk estimates is further complicated by the fact that various risk assessment protocols have been and are continuing to be used in developing risk assessments **(RA, 15).**

Risk Assessment Recommendations

a. Identify those MMR risk estimates that result from screening assessments and highlight major assumptions that produce large overestimates of risk. Risk estimates are frequently considered more certain than is warranted by the process used to generate such values. Special care, therefore, should be taken to identify values that are even more uncertain and likely to overestimate risks. If screening assessments are not properly characterized, more sophisticated and accurate risk assessments prepared in the future may not be believed **(RA, 9).**

b. Conduct an audit to document the major decisions regarding MMR risk assessments to include procedures, models, and exposure assumptions selected. Many stakeholders and decision makers may be unaware of the choices made regarding risk assessment assumptions that could have substantially overestimated the risk **(RA, 13).** Key choices among models and assumptions for major risk assessments should be documented and explained. This process would allow individuals not personally involved with those risk assessments to understand and interpret the risk estimates more accurately **(RA, 20).**

c. Ensure that the rationale and supporting documentation are included with the risk assessment, especially when negotiated assumptions, models, or values are used. While the consensus process for determining risk assessment parameters and models appears to have worked reasonably well in the examples evaluated, the decisions were not well documented. Any future reevaluation of the assumptions and uncertainties associated with these risk estimates may otherwise be left to conjecture **(RA, 12).**

d. Ensure that risk assessments are routinely peer reviewed by an experienced risk assessor independent of the entity conducting the risk assessment. This person should be familiar with MMR and be responsible for ensuring that the risk assessments are addressing the appropriate questions to achieve remedial goals **(RA, 16).**

e. Improve document control and ensure copies of all data that are used for decision making are properly catalogued **(RA, 17).** For risk assessments to be credible, documentation of the methods and assumptions underlying the risk estimates must be both readily accessible and reliable **(RA, 12).** Future risk documents should contain pointers to the documents where risk assessment supporting data, models, or calculations can be found **(RA, 17).**

f. As part of the Community Involvement Plan and using data and situations from MMR data, develop case studies to assist groups or individuals in understanding the risk assessment paradigm and process. Hands-on experience with the risk assessment process should be useful to inform stakeholders about the strengths and limitations of risk estimates, thus allowing more knowledgeable participation in the decision-making process **(RA, 6).**

Future Decision Process

In the next phase of the MMR cleanup, as installed and planned engineering systems remove contaminants from the groundwater, decisions about whether to continue, alter or halt remediation efforts must be confronted. AFCEE, in conjunction with regulators, proposes to use a three-step decision-making process to determine future actions:

1. Continue active remediation until federal MCLs and state drinking water standards are achieved
2. Once MCLs are achieved, determine if unacceptable risks are present. If so, continue system operations and /or pursue additional measures to achieve acceptable risks;
3. Once risk levels are deemed acceptable, evaluate the technical and economic feasibility of additional remediation to approach or achieve background concentrations.

The processes by which stakeholders, regulators, and the DoD reach agreement about how the above criteria will be applied to upcoming decisions is critical to AFCEE's future success with the Massachusetts Military Reservation's Installation Restoration Program.