6.1 How Technology is Improving Decision Making for Environmental Restoration

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Abstract

Environmental restoration, or the cleanup of contaminants from past activities, at its core depends on a series of decisions about the nature and extent of contamination, the risk to human health and the environment, and the potential effectiveness of remediation techniques and technologies to reduce the risk to acceptable levels. The effectiveness with which these decisions are made has significant impacts on the cost and duration of the cleanup efforts. The decisions must often be made on the basis of incomplete and uncertain data. Emerging environmental information and data acquisition technologies together with appropriate strategies to support decision making are beginning to change the way environmental restoration occurs in the United States.

Past environmental restoration activities too often relied on prescriptive data collection activities to generate the information upon which decisions were to be made. Retrospective studies of such activities have shown that, while often data were gathered for the purpose of reducing the risk in consumed. Recent examination of the failures in the United States to achieve many complete cleanups, despite the investment of large sums and time, points to the inability to have decisions made efficiently. The solution to the problem involves both regulatory change to allow more flexibility in decision-making and the introduction of technology to improve decision making.

This paper reviews the recent assessments made of the cleanup process and application of strategies and technologies to enhance decision-making for cleanup. It provides examples of the new decision approaches and the technologies that have been employed to speed up characterization and to optimize the implementation of remediation.

6.1.1 Introduction

The cleanup of contaminants from past activities, environmental restoration, has been a major environmental activity in the United States for the past fifteen years. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund) and the Superfund Amendments and Reorganization Act of 1986 (SARA) provided the U.S. Environmental Protection Agency (EPA) with authority and funding to establish cleanup requirements and to cleanup the nation's worst
hazardous waste sites. The Corrective Action portions of the Resource Conservation and Recovery Act (RCRA) likewise require the closure and cleanup of waste facilities.

The EPA's National Priorities List (NPL) now contains over 1200 seriously contaminated sites and is projected to grow to about 2100 sites by the year 2000 (GAO, 1992). In addition there are over 300 sites at federally-owned facilities that have been added to this total. There have been few completed cleanups and less than 50 sites have been removed from form the NPL. Estimates of the costs of cleaning up the remaining sites vary widely, but they are all in the hundreds of billions of dollars. Large federal facilities, particularly those related to the defense establishment, have received increasing attention in recent years and now represent a significant portion of the cleanup effort.

At its core environmental restoration of contaminated sites depends on a series of decisions about the nature and extent of contamination, the risk to human health and the environment, and the potential effectiveness of remediation techniques and technologies to reduce the risk to acceptable levels. The Superfund program in the United States established a series of regulatory steps leading from the discovery of a potential contamination problem to its cleanup. They are designed to provide information for progressive decision making. In simple terms, the steps and their purpose are as follows:

- preliminary assessment: review of available information and reconnaissance visit to the site to determine if a release of hazardous substances requires further investigation or action.
- site inspection: collection of samples to describe known contaminants, the surrounding area, and potential human and environmental receptors of contamination.
- remedial investigation: characterization, through sampling and analyses, of the nature and extent of contamination. It affords sufficient information to support the evaluation of remedial alternatives and remedy selection.
- baseline risk assessment: qualitative and quantitative evaluation to define the risk posed to human health and/or the environment by the presence of specific contaminants.
- feasibility study: evaluation of alternative remedial actions screened against several technical, cost, and regulatory criteria, leading to selection of a preferred remedy.
- public comment: community commentary on the selected remedy.
- record of decision: documentation of the final remedy selection.
- remedial design: development of engineering plans and specifications for implementation of remedy.
- remedial action: action construction and implementation of the cleanup.

As logical as the above sequence of activities appears, practice has shown that the "feed forward" requirements for information to support decisions do not work effectively. It is common in practice to find that the data brought forward for decisions at a particular step are inadequate or inappropriate or both. The subsequent return to earlier steps to acquire the necessary data becomes a significant consumer of time and resources.