Environmental Management Science Program

Project ID Number 60069

Least-Cost Groundwater Remediation Design Using Uncertain Hydrogeological Information

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June 1, 1998

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Research Objective

The objective of the project is to formulate, test, and evaluate a new approach to the least-cost design of groundwater contamination containment and decontamination systems. The proposed methodology employs 'robust optimization', the outer-approximation method of non-linear programming, and groundwater flow and transport modeling to find the most cost-effective pump-and-treat design possible given the physical parameters describing the groundwater reservoir are known with uncertainty. The result is a methodology that will provide the least-cost groundwater remediation design possible given a specified set of design objectives and physical and sociological constraints.

Research Progress and Implications

As of the end of the first year of this 3-year project we have developed and tested the concept of 'robust optimization' within the framework of least-cost groundwater-contamination-containment design. The outer-approximation method has been employed in this context for the relatively simple linear-constraint case associated with the containment problem.

In an effort to enhance the efficiency and applicability of this methodology, a new strategy for selecting the various realizations arising out of the Monte-Carlo underpinnings of the 'robust-optimization' technique has been developed and tested. Based upon observations arising out of this work a yet more promising approach has been discovered. The theoretical foundation for this most recent approach has been, and continues to be, the primary focus of our research.

Planned Activities

Because of the importance of the realization-selection process to the overall success of our project, we intend to focus primarily on this issue until it is suitably resolved. Further theoretical development, analysis and testing of our new methodolgy is required. We anticipate this will take approximately six months.

Upon completion of this task we will turn our attention to incorporating and evaluating our new realization selection technique within the framework of least-cost design of groundwater contamination containment. We anticipate test results will be forthcoming within twelve months.

Upon successful completion of this work we will turn our attention to the more challenging task of robust least-cost groundwater decontamination design under uncertainty. The development, analysis and testing of our methodology within this context will constitute the bulk of the remainder of our research effort.