TECHNICAL AND MANAGERIAL APPROACHES TO GROUNDWATER RESTORATION AT UMTRA PROJECT SITES

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ABSTRACT

This paper describes a proposed approach to identification and implementation of groundwater protection compliance activities for the U.S. Department of Energy (DOE) Uranium Mill Tailings Remedial Action (UMTRA) Project Groundwater Restoration Program.

The approach incorporates the observational method, which essentially consists of a graduated approach to groundwater restoration. The end result is a cost-effective procedure that fully protects human health and the environment, and is in full compliance with proposed EPA groundwater protection standards.

BACKGROUND

The DOE UMTRA Project's primary objective in the 1990s will change from surface remediation to groundwater restoration. This change results from the issuance of the proposed U.S. Environmental Protection Agency (EPA) groundwater protection standards, which originated as follows:

- 1983 - The original standards were promulgated.
- 1985 - The standards were challenged and the U.S. Tenth Circuit Court of Appeals remanded them to the EPA for further consideration.
- 1987 - The EPA issued proposed standards.

Because of specific legal provisions in the Uranium Mill Tailings Radiation Control Act of 1978, the proposed groundwater protection standards are binding on the DOE and must be met, even though they have not been promulgated in final form.

GROUNDWATER PROTECTION STANDARDS

The proposed standards require that if the groundwater quality at an UMTRA Project processing site does not meet criteria established in the standards, groundwater restoration should be undertaken to clean up contaminated groundwater to the concentration limits specified in the standards.

The proposed EPA groundwater protection standards for the UMTRA Project sites and vicinity properties are:

- Concentration limits of contaminants shall not exceed the specified maximum concentration limits (MCLs) or background concentrations.
- An alternate concentration limit (ACL) may be applied to a listed constituent if it will not result in a substantial present or potential hazard to human health, and if the U.S. Nuclear Regulatory Commission (NRC) concurs that the limit is as low as reasonably achievable.
- Supplemental standards may be applied if:
  - The restoration clearly produces excessive environmental harm compared to the benefit.
  - Restoration is technically impracticable from an engineering perspective.
  - The groundwater meets the EPA's limited-use criteria. A limited-use groundwater system is one that is not a usable resource due to widespread ambient contamination, total dissolved solids concentration in excess of 10,000 milligrams per liter, or a yield of less than 150 gallons per day. Supplemental standards applications must demonstrate no threat to remedial action workers or to the public.

Neither gradient manipulation nor active restoration need to be undertaken if:

- Natural flushing at a site will restore groundwater quality to MCLs or background within 100 years, and
- Institutional controls can be implemented to prevent access to the decreasingly contaminated aquifer for the required period.

GROUNDWATER COMPLIANCE STRATEGY

The groundwater compliance strategy for a given UMTRA Project site must lead to compliance with the proposed EPA groundwater protection standards in 40 CFR 192, Subparts B and C. Selection of the optimum compliance strategy takes into account:

- Regulatory compliance.
- Site-specific characteristics.
- Technical factors.
- Economic considerations.
- Societal factors.
- Environmental benefit.

The Jacobs Team's proposed approach to compliance strategy optimization is a "bottom up" review of compliance options, starting with the simplest approach (usually the least expensive) and evaluating increasingly complex (usually more costly) options.

Figure 1 illustrates the compliance strategy decision process. This process begins with an evaluation of existing data to determine whether that data are sufficient to develop a compliance strategy and to determine if additional characterization is needed.

If the groundwater quality does not exceed MCLs or background, or supplemental standards are applicable, no further action is required. Where MCLs or background concentrations are exceeded, a risk assessment may be performed to support supplemental standards or an ACL application.

Groundwater restoration programs at many UMTRA Project sites may include the use of passive flushing and ACLs. In some cases, passive flushing will be augmented with gradient manipulation using injection and extraction wells to direct the contaminant plume. In a few cases, no action or no action with an ACL will be warranted.

At some UMTRA Project sites it will be necessary to undertake active groundwater restoration involving groundwater extraction with subsequent evaporation or treatment of contaminated groundwater.

Total extraction and treatment of all contaminated groundwater will not always be necessary. Limited pump and treat may be appropriate. For instance, it may be feasible in a short time to reduce contaminant levels enough so that within 100 years passive restoration or gradient manipulation will result in compliance with applicable standards.

REMEDIAL ACTION OPTIONS

The following are the main remedial action options that may be adopted to meet selected compliance strategies:

- Natural flushing.
- Gradient manipulation, including, if appropriate:
  - In situ geochemical process enhancement.
  - Slurry walls.
  - Trenches and/or extraction and injection wells.
- Extraction of contaminated groundwater, with
  - Evaporation.
  - Treat and discharge.
  - Treat and reinfect.

GROUNDWATER COMPLIANCE OPTIMIZATION

The approach to compliance with the standards for the surface remedial actions on the UMTRA Project has been conservative to assure that statutory deadlines were met.

The groundwater restoration program, with no statutory completion date, may present greater opportunities for agency coordination to deal with technical issues. The Jacobs Team proposes to develop and advocate a cost-effective approach to compliance with the groundwater standards. Essential components of this approach include:

- Adoption, as feasible and as approved by the DOE, of cost reduction initiatives.
- Schedule optimization.
- Use of the observational method.
- Agreement with affected groups and agencies.

Since the states share remediation costs, they should support cost-effective compliance strategies. The states have a clear interest in protecting their groundwater resources and are not likely to agree to inadequate remedies. The support of the states in UMTRA Project remedial action plans will undoubtedly reinforce the DOE plan with the NRC.

THE OBSERVATIONAL METHOD

In order to ensure that cost-optimized remedial action protects human health and the environment, and is concurred with by the NRC, states, tribes, and the public, the Jacobs Team proposes an "observational method" (1,2) approach to compliance. Figure 2 is a brief description of the essential features of the observational method. Figure 3 shows the logic of the observational method diagrammatically.

The observational method incorporates a performance monitoring program to track the effectiveness of remedial action over time. In the event that the monitoring shows a deviation from the expected remedial action design performance levels, a predetermined contingency action would be initiated to return the remediation effort to acceptable parameters.

During the development of the initial remedial action plan, the most likely deviation scenarios would be postulated. Contingency plans would be developed to deal with deviations from reasonably anticipated conditions. Therefore, if performance monitoring detects a deviation, it will

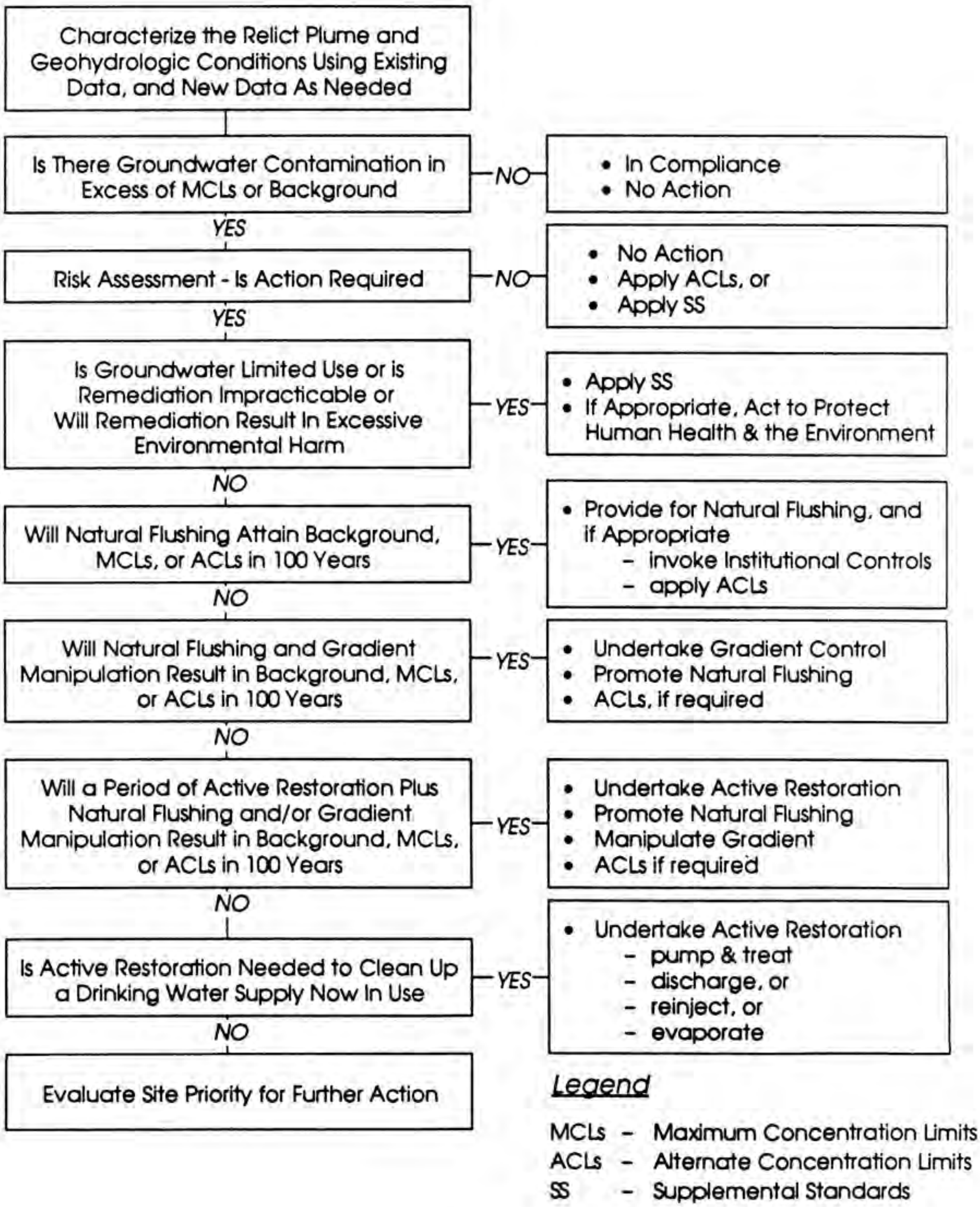

Fig. 1. Compliance decision logic.

a. Characterization Sufficient to Establish at least the General Nature, Pattern and Properties of the Groundwater System

b. Assessment of the Most Probable Conditions and the Most Unfavorable Conceivable Deviations from these Conditions

c. Establishment of a Remedial Action/Design Based on a Working Hypothesis of Behavior Anticipated under the Most Probable Conditions

d. Selection of Characteristics to be Observed as Remedial Action Proceeds and Calculations of their Anticipated Values on the Basis of Working Hypothesis

e. Calculation of Values of the Same Characteristics Under the Most Unfavorable Conditions Compatible with the Available Data

f. Selection in Advance of a Course of Action or Modification of Design for Every Forseeable Significant Deviation of the Observational Findings from Those Predicted on the Basis of the Working Hypothesis

g. Measurement and Evaluation of Actual Conditions

h. Modification of Action to Suit Actual Conditions

Fig. 2. The observational method.

most likely be one that has been postulated and for which an effective action plan can readily be implemented.

The compliance strategy optimization method links a cost-effective remediation option with an effective contingency plan that will result in full regulatory compliance and protection of the environment without the burden of excess conservatism.

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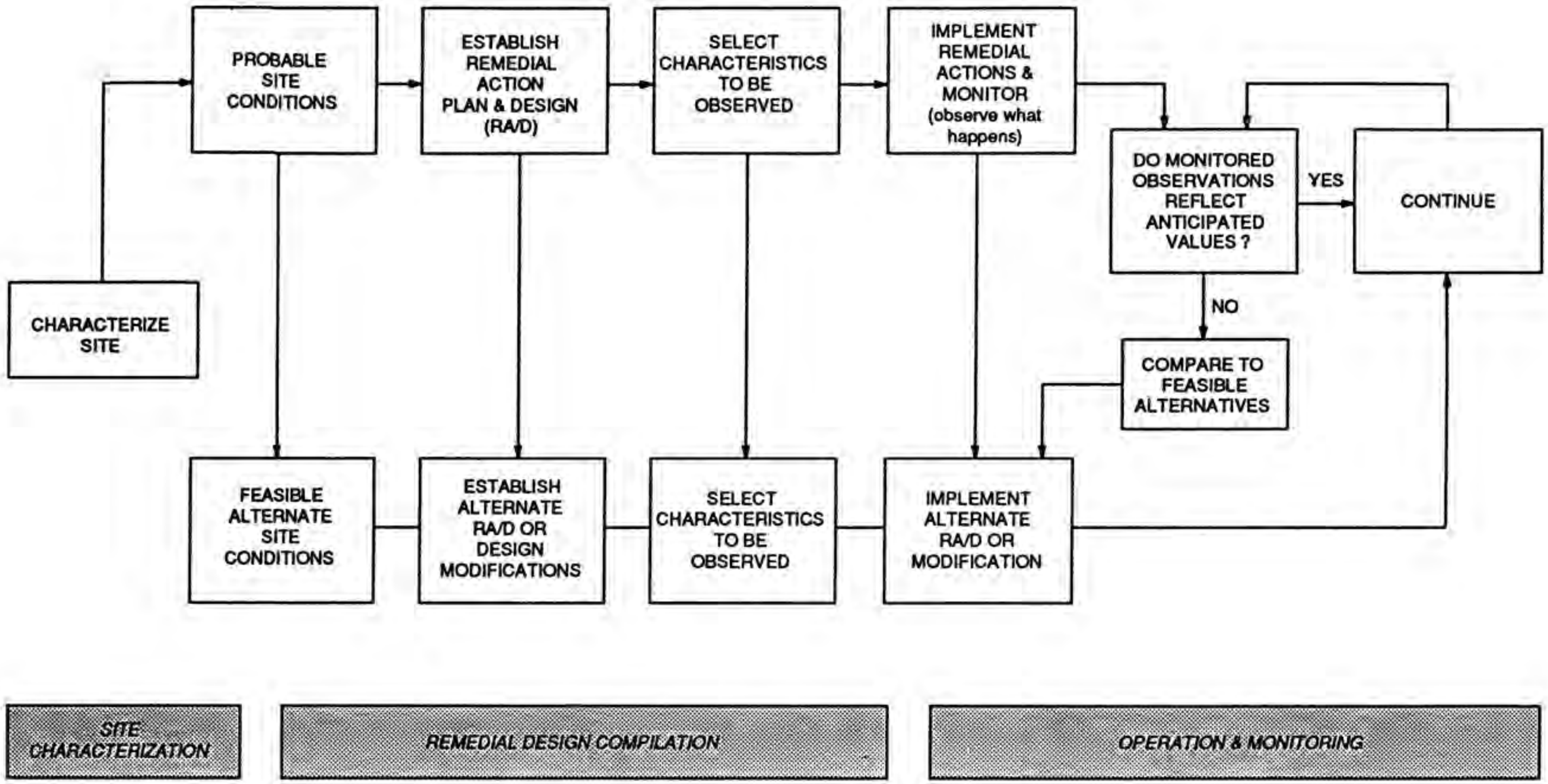

SOURCE: EPA 1989 LEGEND: RA/D - REMEDIAL ACTION PLAN & DESIGN

Fig. 3. Observational method general approach.