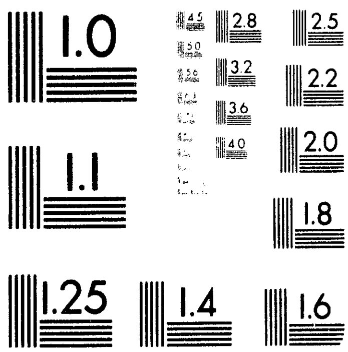
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TECHNICAL APPROACH TO GROUNDWATER RESTORATION

Final

November 1993

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Definition
ACL	alternate concentration limit
AOM	Albuquerque Operations Manual
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DQO	data quality objective
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FR	Federal Register
MCL	maximum concentration limit
NEPA	National Environmental Policy Act
NRC	U.S. Nuclear Regulatory Commission
PEIS	Programmatic Environmental Impact Statement
PL	Public Law
QA	quality assurance
QAIP	Quality Assurance Implementation Plan
RAP	remedial action plan
RCRA	Resource Conservation and Recovery Act
SIP	stabilized in place
SOP	standard operating procedure
SOS	stabilized on-site
SOWP	site observational work plan
SR	status report
SWDA	Solid Waste Disposal Act
TAC	Technical Assistance Contractor
TAD	Technical Approach Document
TAGR	Technical Approach to Groundwater Restoration
UMTRA	Uranium Mill Tailings Remedial Action
UMTRCA	Uranium Mill Tailings Radiation Control Act

1.0 INTRODUCTION

1.1 PURPOSE

The *Technical Approach to Groundwater Restoration* (TAGR) provides general technical guidance to implement the groundwater restoration phase of the Uranium Mill Tailings Remedial Action (UMTRA) Project. The TAGR provides a technical overview of how the groundwater program will be conducted. The TAGR covers the regulatory basis and requirements for compliance and provides a framework for the program activities needed to meet those requirements. The program activities follow the observational approach, which results in a dynamic process. The program may change with time, based on the final U.S. Environmental Protection Agency (EPA) regulations, regulatory guidance from the U.S. Nuclear Regulatory Commission (NRC), and application of the observational approach. These changes will be reflected in modifications to this document. The TAGR is directed toward the technical and management staffs of the U.S. Department of Energy (DOE) and the Technical Assistance Contractor (TAC), and to the staffs of regulatory agencies involved in the UMTRA Project (NRC, states, and tribes).

The TAGR includes a brief overview of the surface remediation and groundwater restoration phases of the UMTRA Project and describes the regulatory requirements, the National Environmental Policy Act (NEPA) process, and regulatory compliance. A section on program strategy discusses program optimization, the role of risk assessment, the observational approach, strategies for meeting groundwater cleanup standards, and remedial action decision-making. A section on data requirements for groundwater restoration evaluates the data quality objectives (DQO) and minimum data required to implement the options and comply with the standards. A section on site implementation explores the development of a conceptual site model, approaches to site characterization, development of remedial action alternatives, selection of the groundwater restoration method, and remedial design and implementation in the context of site-specific documentation in the site observational work plan (SOWP) and the remedial action plan (RAP). Finally, the TAGR elaborates on groundwater monitoring necessary to evaluate compliance with the groundwater cleanup standards and protection of human health and the environment, and outlines licensing procedures.

1.2 PROGRAMMATIC DOCUMENTATION

The groundwater restoration phase of the UMTRA Project will also be guided by several other programmatic documents. A draft Programmatic Environmental Impact Statement (PEIS) proposes an objective programmatic decision-making strategy and framework for guiding the selection of appropriate site-specific compliance methods. Procedures for field activities are specified in numerous standard operating procedures (SOP) contained in the Jacobs Engineering Group Inc. Albuquerque Operations Manual (AOM) (JEG, n.d.). Quality assurance (QA) issues will be addressed in the *Quality Assurance Implementation Plan* (QAIP), now being developed, which will provide QA specifications for collecting environmental samples and data and for analyzing environmental samples. The QAIP will specifically address DQOs for data collection and analysis. Quality issues associated with data and samples related to geology, hydrology, chemistry, biology, and engineering will be covered by the QAIP. Other programmatic documents include the *UMTRA Project Environmental, Safety and Health Plan* (DOE, 1992c) and a public communication and involvement plan currently in preparation.

1.3 PROJECT OVERVIEW

The UMTRA Project was authorized by the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) [Public Law (PL) 95-604]. This act established a program of assessment and remedial action at inactive uranium mill sites (Title I) to dispose of, stabilize, and control residual radioactive material. Residual radioactive material is defined as radioactive waste in the form of tailings resulting from the processing of ores for the extraction of uranium and other valuable constituents of the ores, and other radioactive waste at a processing site which relates to such processing. The UMTRA Project's purpose is to ensure that radiological and nonradiological hazards at the sites do not exceed the standards established by the EPA for the protection of public health, safety, and the environment.

The UMTRCA directs the DOE to perform assessment and remedial action at 24 inactive uranium mill sites in 10 states (Figure 1.1). It also requires that the EPA promulgate standards of general application to protect public health, safety, and the environment from hazards related to the Title I sites [40 Code of Federal Regulations (CFR) 192]. The standards provide protection that is consistent with the requirements of the Resource Conservation and Recovery Act (RCRA) of 1976, as amended. The UMTRCA gives the NRC concurrence and licensing authority for the DOE UMTRA Project remedial actions.

Groundwater restoration activities will also be consistent with DOE Order 5400.1. DOE Order 5400.1 requires that environmental protection programs be established to ensure compliance with all applicable Federal, state, and local environmental protection laws and regulations, executive orders, and DOE policies. Chapter III of DOE Order 5400.1 requires all operations to design and implement specific environmental protection program plans. To comply with Chapter III, the UMTRA Project Office issued the *Environmental Protection Implementation Plan* (DOE, 1992a) and the *Groundwater Protection Management Program Plan* (DOE, 1992b).

FIGURE 1.1
UMTRA PROJECT SITE LOCATIONS

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The UMTRA Project, under 40 CFR 192, consists of two phases: surface remediation (Subpart A) and groundwater restoration (Subpart B). The surface remediation phase has a specific termination date and is nearing completion; its activities are described in the *Technical Approach Document* (TAD) (DOE, 1989) and related documents. The groundwater restoration phase began in 1991 and currently has no specific time limitations; its activities are described in this and related documents.

1.3.1 Surface remediation

The UMTRA Project processing sites are located in 10 states and on tribal lands. The existing conditions at the processing sites vary, depending on location, hydrogeologic and geochemical characteristics, proximity to naturally mineralized areas, size of the milling operation, type of milling process, and the alternative selected for surface remediation. Tailings-related contamination of groundwater is present beneath and downgradient from many of the processing sites. Regulated constituents in groundwater whose concentrations or activities exceed maximum concentration limits (MCL) or background levels at one or more sites include (but are not restricted to) uranium, selenium, arsenic, molybdenum, nitrate, gross alpha, and radium-226 and -228. The scale and magnitude of contamination resulting from the uranium processing activities and the related effects on human health and the environment vary among the sites.

As part of the surface remediation requirements, groundwater protection strategies were developed for each disposal site to minimize or eliminate continued site-related contamination of groundwater resources. Conditions at some of the sites may pose future potential health risks, but currently no groundwater contaminated by surface-related activities is used as a drinking water resource. The surface remediation activities have essentially been limited to removing or controlling the tailings and other materials that are the source of groundwater contamination. These activities have not addressed groundwater restoration at processing sites.

Details of the surface remediation phase of the UMTRA Project are available in site-specific RAPs, environmental impact statements (EIS), and environmental assessments (EA). These documents are available in the UMTRA Project Office in Albuquerque, New Mexico.

1.3.2 Groundwater restoration

The DOE is required to demonstrate that proposed groundwater cleanup actions at the UMTRA Project processing sites will comply with the proposed EPA groundwater cleanup standards in 40 CFR 192, Subparts B and C. The need for groundwater restoration at selected UMTRA Project processing sites is determined based on the EPA regulatory requirements for protection of human health and the environment. The PEIS, now being developed, would be used as a planning and decision-making document to determine the program-wide groundwater compliance strategy.

To ensure that technically and financially sound groundwater restoration activities are selected, the observational approach is proposed. The observational approach (described more fully in Section 3.3) uses existing site data to develop a conceptual model of site conditions and applicable compliance strategies. This information is used to develop a groundwater restoration program based on "most probable" site conditions. The most likely alternative scenarios are also postulated during the development of the initial groundwater restoration action plan. Contingency plans are developed to deal with deviations from reasonably anticipated conditions. The observational approach links a cost-effective remediation option with an effective contingency plan that will result in full regulatory compliance and protection of human health and the environment without the burden of excessive site characterization and conservatism.

2.0 REGULATORY REQUIREMENTS

2.1 URANIUM MILL TAILINGS REMEDIAL ACTION PROJECT

2.1.1 Legal mandate

The U.S. Congress enacted the UMTRCA on November 8, 1978 (PL 95-604). The purpose of the Act and its amendments was to conduct assessments and remedial actions at designated sites to "stabilize and control such tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards to the public . . . ." The Act directs the EPA to set ". . . standards of general application for the protection of the public health, safety, and the environment . . . " to govern this process of stabilization, disposal, and control. The Act directs the DOE to conduct such remedial actions at the inactive uranium processing sites as will insure compliance with the standards established by the EPA. This remedial action is to be selected and performed with the concurrence of the NRC.

The EPA issued a final EIS for 40 CFR 192 in October 1982 and promulgated final standards for control of both active and inactive uranium mill tailings sites under the UMTRCA on January 5, 1983. These standards were challenged in the U.S. Court of Appeals for the Tenth Circuit. The groundwater portion of the standards applying to the inactive (Title I) sites were remanded to the EPA on September 3, 1985, because they were not consistent with the provisions of the SWDA as amended by RCRA. On September 24, 1987, the EPA issued new proposed standards for groundwater protection at Title I sites based on RCRA regulations for disposal facilities [52 Federal Register (FR) 36000]. These proposed standards are similar to the basic provisions of the RCRA standards of 40 CFR 264.92, 264.93, and 264.94 regarding groundwater protection, with the addition of MCLs for gross alpha, molybdenum, radium, uranium, and nitrate. In addition, provisions were added to the Title I standards allowing for the application of supplemental standards, institutional controls, or groundwater restoration through natural flushing where no community drinking water source is involved. The proposed groundwater protection standards of September 1987 have been revised and were submitted to the Office of Management and Budget for review in May 1991. The DOE is required to use the proposed standards of September 1987 (52 FR 36000) on an interim basis until the final EPA standards are promulgated.

2.1.2 Groundwater cleanup standards

The DOE is required to demonstrate that proposed groundwater cleanup actions (groundwater restoration phase) at the UMTRA Project processing sites will comply with the proposed EPA groundwater cleanup standards in 40 CFR 192 Subparts B and C. The elements for demonstrating compliance will consist of the cleanup standard, demonstration of effectiveness, and a monitoring program.

Cleanup standards

The groundwater cleanup standards specify target concentrations for cleaning up hazardous constituents in contaminated groundwater [40 CFR 192.12(c)]. Hazardous constituents will be identified that are reasonably expected to be in, or derived from, residual radioactive material at the processing site. The list of hazardous constituents will be based on characterization of the residual radioactive material, groundwater quality data, soil contamination data, and analysis of processes and reagents used in the processing of uranium. The DOE will propose a concentration limit for each identified hazardous constituent. The concentration limit will be the background concentration for the constituent, the MCL [40 CFR 192.02(a)(3)], an alternate concentration limit (ACL), or supplemental standards under 40 CFR 192.22.

Cleanup demonstration

The cleanup demonstration will show how the planned remedial action will attain the proposed concentrations [40 CFR 192.12(c)]. The DOE will describe in detail the proposed program to clean up groundwater at each processing site to comply with concentration limits identified for each hazardous constituent. The description will address the extent of tailings-related groundwater contamination, the rate and direction of movement of contaminated groundwater, and the assessment of future plume movement [40 CFR 192.20(b)(4)]. The description will also include details of the proposed methods for groundwater restoration and a schedule for the cleanup. The DOE will assess the effectiveness and efficiency of the cleanup activities and will demonstrate that the proposed groundwater cleanup program will comply with the site-specific cleanup standards.

Cleanup monitoring program

The DOE will describe the proposed cleanup monitoring program and demonstrate that the program will adequately 1) define the extent of groundwater contamination, 2) assess the effectiveness of groundwater cleanup and control activities, and 3) monitor compliance with the groundwater cleanup standards [40 CFR 192.12(c)(1)]. The description will include or reference the following:

- The need to monitor groundwater.
- Characteristics of the monitoring system (number, location, and types of monitoring installations).

- Frequency of monitoring activities.
- Selection of analytes.
- Procedures for collecting, handling, and analyzing groundwater samples.
- Procedures for evaluating monitoring results.
- Action levels that may trigger additional monitoring or otherwise change existing monitoring activities.

2.1.3 Regulatory compliance

The UMTRCA directs the DOE to conduct remedial actions at the inactive uranium processing sites in a manner that will insure compliance with the standards established by the EPA. This remedial action is to be selected and performed with the concurrence of the NRC. Upon completion of the remedial action program, the disposal sites will remain in the custody of the Federal government under an NRC license.

Preliminary efforts at prioritizing and categorizing the processing sites have been based on information generated during the surface remediation phase. This information provided the basis for preliminary conceptual models of the processing sites. The DOE will evaluate the conceptual site models to determine additional site characterization requirements to 1) provide sufficient data to define the need for and extent of groundwater restoration, 2) evaluate alternative remedial methods and technologies for groundwater restoration, 3) support treatability investigations, 4) enhance the remedial design phase, and 5) implement the remedial action.

The RAP is the evaluation and design document submitted to the NRC and states/tribes for concurrence. This document will contain the details of 1) site characterization performed to support the conceptual model of the site, 2) the development of remedial action alternatives, 3) remedial action selection, 4) the implementation plan for the remedial design and remedial action, and 5) the groundwater monitoring plan. The remedial action will be designed to comply with the EPA groundwater protection standards.

Site-specific NEPA documents will evaluate environmental impacts associated with implementing a specific groundwater restoration method at a site.

2.2 NATIONAL ENVIRONMENTAL POLICY ACT PROCESS

2.2.1 Programmatic NEPA compliance

The approach to NEPA compliance is a two-phased plan that will provide an appropriate and responsive vehicle for meeting NEPA requirements related to the UMTRA Project groundwater restoration phase. In the first phase, the PEIS (currently in preparation) will propose a program-wide groundwater compliance strategy (proposed action), consider alternatives to the proposed action, and assess the impacts of the alternatives (including the proposed action). The second phase will involve preparation of site-specific NEPA documents, generally EAs. The PEIS will be issued for public review in 1994 and a Record of Decision on the proposed action and alternatives is planned for late 1994.

The use and acceptance of a PEIS as part of the NEPA decision-making process is recommended by the NEPA, DOE, and other Federal agencies as a means to facilitate program planning, provide an early assessment of potential problems, assess programmatic impacts, and reduce the overall scope of subsequent NEPA documents. The PEIS is also valuable for informing regulators, states, and tribes of the DOE approach to groundwater compliance early in the process. In addition, it is an important mechanism for positively and proactively involving the public in the DOE decision-making process at an early stage.

The proposed action in the PEIS will provide program-level guidance for implementing groundwater compliance on the UMTRA Project. The DOE proposed action is to conduct a groundwater compliance program that will meet the proposed EPA standards using a consistent decision-making approach for all 24 UMTRA Project sites. Under this proposed action, a decision tree would be used to determine site-specific groundwater compliance strategies to be further analyzed in the site-specific documents. The PEIS will 1) summarize existing conditions at the 24 UMTRA Project sites, 2) analyze programmatic impacts of the proposed action and other alternatives, 3) identify and evaluate impacts associated with methods of groundwater restoration, and 4) describe site characterization activities and risk assessment methods.

2.2.2 Site-specific NEPA compliance

Site-specific NEPA documents will tier off the PEIS, incorporating background environmental information from other existing NEPA documents and technical reports. The PEIS will analyze programmatic issues that will be summarized or incorporated by reference in the site-specific NEPA documents. These issues include impacts of programmatic alternatives, detailed information on risk assessment and site characterization, and groundwater protection compliance strategies.

3.0 PROGRAM STRATEGY

3.1 PROGRAM OPTIMIZATION

Program optimization involves considering a variety of strategies and options to achieve site-specific groundwater cleanup objectives that are consistent with the current EPA regulatory framework and are acceptable to the NRC, states, tribes, and the public. These available strategies and options will be outlined in the PEIS. The DOE will pursue innovative technical approaches that will allow for the most feasible and cost-effective approach to compliance with regulatory requirements. Active implementation of this approach can be expected to have considerable success and result in substantial cost savings.

The advantages of program optimization include 1) achievement of full regulatory compliance, 2) consistency with the PEIS, and 3) greater potential for positive results early in the program (based on the observational approach).

3.2 THE ROLE OF RISK ASSESSMENT

Risk assessments will be used from the earliest stages to aid in the evaluation of sites during the groundwater restoration phase of the UMTRA Project. Risk assessments are conducted for the following purposes:

- Preliminary risk assessments are used to prioritize sites, scope data collection, and determine if a site presents immediate health risks.
- Baseline risk assessments fully integrate and interpret demographic, geographic, physical, chemical, and biological factors at a site to determine the extent of actual or potential harm to human health and the environment. This information is useful in determining the need for remedial action.
- Risk evaluations of remedial alternatives are performed to evaluate risks to human health and the environment associated with the various remedial strategies.

The information gathered for each of these risk evaluations is used to determine the need for subsequent evaluation. Several sites may be eliminated from active groundwater restoration consideration after a preliminary risk assessment if the groundwater protection standards are met and there is no current or future potential risk to human health and the environment. Likewise, much of the data from a baseline risk assessment can be used to support ACL or supplemental standard demonstrations or to identify sensitive habitats or receptors that may be of concern in selecting a remedy.

Initially, a baseline risk assessment will be performed at each UMTRA Project processing site to determine the potential site-related impact on human health and the environment. The risk assessment process is based in part on methods described in the EPA *Risk Assessment Guidance for Superfund* (EPA, 1989a). This process is divided into the following components: contaminant identification, exposure assessment, toxicity assessment, and risk characterization.

Contaminants of concern are identified by screening available hazardous substance data collected from the processing site. Selection of contaminants of concern may be based on toxicity, persistence, quantity, and mobility.

The objective of an exposure assessment is to identify actual or potential exposure pathways, to characterize the potentially exposed populations, and to determine the extent of the exposure.

Toxicity assessment considers the types of adverse health or environmental effects associated with individual and multiple chemical exposures, the relationship between the magnitude of exposures and the adverse effects, and related uncertainties such as the weight of evidence for potential carcinogenicity of a particular chemical in humans.

Characterization of the potential of risk to human health and the environment, based on the exposure scenarios, is the final component of the risk assessment process. The results of the risk assessment will indicate the degree of potential site-related risk to human health and the environment and will be used in part to determine the need for and extent of groundwater cleanup required at each site.

3.3 OBSERVATIONAL APPROACH

3.3.1 Concept

The observational method, as a concept, was originally associated with geotechnical engineering; however, it has more recently been applied to deal with the uncertainties of groundwater remediation projects. Systematic procedures for engineering under conditions of uncertainty (the observational method) were first developed by Terzaghi in 1945, and later summarized by Peck (1969). The observational method 1) establishes a remedial design based on most probable site conditions, 2) identifies reasonable deviations from those conditions, 3) identifies parameters to observe to detect deviations during remediation, and 4) provides contingency plans for each potential deviation.

The observational approach recognizes and responds to uncertainties (e.g., in subsurface conditions and chemical behavior) related to remediation at contaminated sites. These uncertainties can lead to unrealistic data collection activities at sites where it is not possible, desirable, or necessary to fully characterize the site before remedial activities begin. The observational approach uses existing site data to create a conceptual model of site conditions and applicable groundwater restoration strategies. This information is used to develop a groundwater restoration program based on the "most probable" site conditions. Reasonable deviations from these site conditions are identified, as well as the critical parameters that will be observed to detect potential divergence from the remediation goals. Contingency plans are developed to deal with potential divergences. This process allows a reasonable investigation to be performed and a contingency plan to be prepared for detecting and responding to the new information that will invariably improve the understanding of the site during remediation.

3.3.2 Application

The DOE has applied the observational approach successfully to the environmental restoration process (DOE, 1992d). Applying the observational approach to the groundwater restoration phase of the UMTRA Project offers the opportunity to reduce program time, costs, and risks. The essence of the observational approach is paraphrased in the following points taken from the report *Observational Approach Implementation Guidance: Year-End Report* (DOE, 1992d):

- The essence of the observational approach to a groundwater restoration program is that remedial action can and should be initiated without full characterization of the nature and extent of contamination. The philosophy of the approach includes the following ideas:
  - Uncertainties are inherent in a groundwater restoration program and cannot be completely eliminated regardless of characterization attempts.
  - Lengthy investigations and characterization studies do little to reduce inherent uncertainties at contaminated sites.
  - Confidence in any remediation effort is achieved only through field verification and monitoring of the site during and following remediation.
- Consistent with its philosophy, the observational approach provides a logical framework through which planning, design, and implementation of the remedial actions can proceed with increased confidence.
- The observational approach is consistent with both the Comprehensive Environmental Response, Compensation, and Liability Act and RCRA regulatory frameworks.

- Under the "traditional" cleanup approach, only probable conditions are explicitly determined and included in the design. The observational approach follows this tactic, but also incorporates the concepts of data sufficiency, identification of reasonable deviations, preparation of contingency plans, observation of the system for deviations, and implementation of contingency plans.

- The observational approach offers a decision framework (Figure 3.1). The iterative steps of characterizing a site, developing and refining a conceptual model, and identifying uncertainties in the conceptual model are similar in both the traditional and observational approaches. The concept of addressing uncertainties as reasonable deviations is unique to the observational approach and offers a qualitative description of data sufficiency for proceeding with site remediation.

- The observational approach is only a framework. Successful implementation of the framework requires tools that optimize the use of available information (e.g., expert judgment, numerical models, statistical techniques). The tools are necessary to provide decision makers with the information they need to define, identify, and assess the impact of reasonable deviations. These tools will vary from site to site.

3.4 STRATEGIES FOR MEETING THE GROUNDWATER STANDARDS

The DOE proposes to use a programmatic approach to comply with the proposed EPA groundwater protection standards (40 CFR 192) and to protect human health and the environment. This approach is documented and analyzed in the PEIS and will include risk assessments, site characterization using the observational approach, and development of compliance strategies for meeting the groundwater standards (Figure 3.2).

Site-specific compliance strategies for meeting groundwater protection standards would include one or a combination of the following:

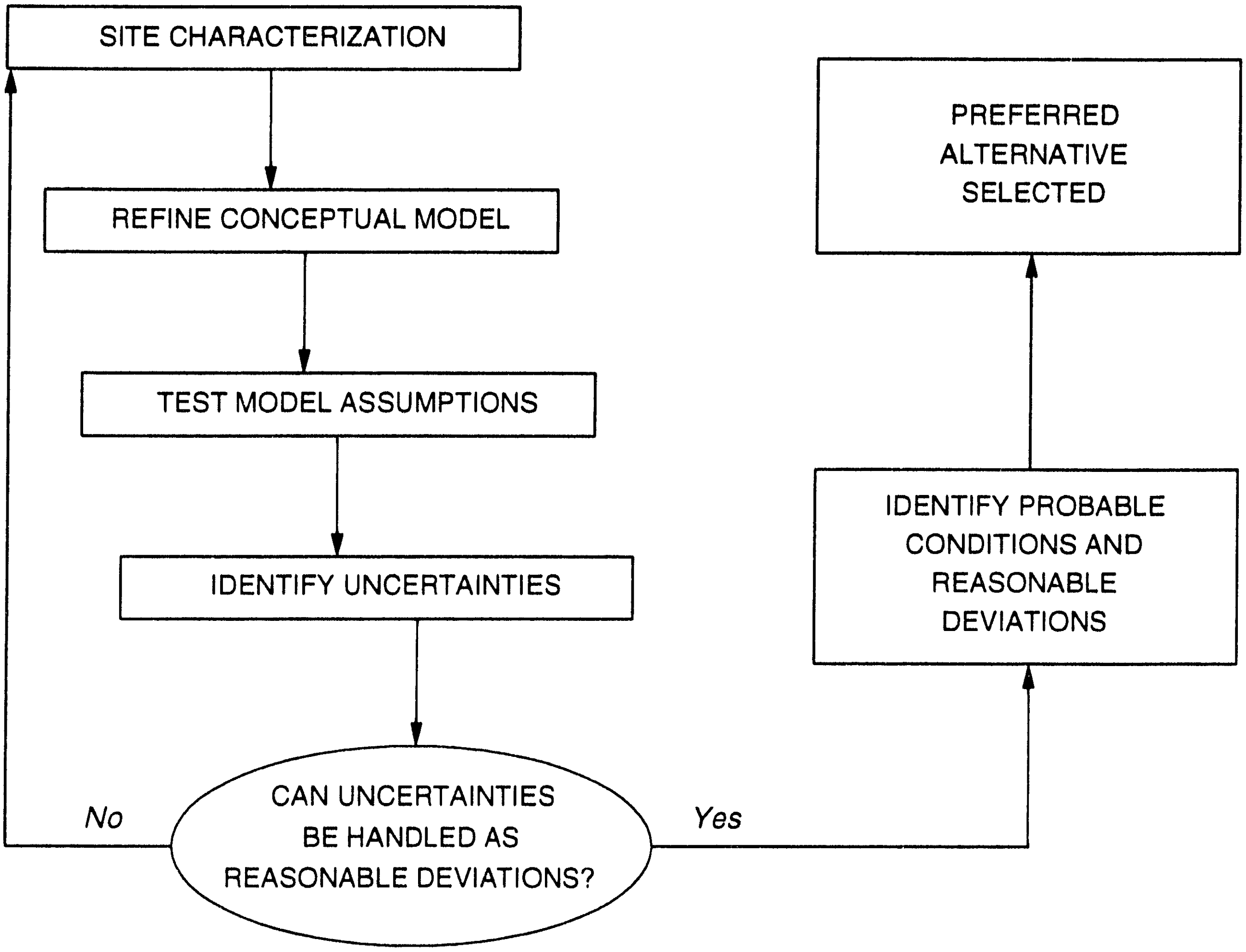
- No groundwater remediation. Meet established concentration limits (background levels, MCLs, or ACLs), or apply supplemental standards.

- Natural flushing with institutional controls.

- Active remedial technologies.

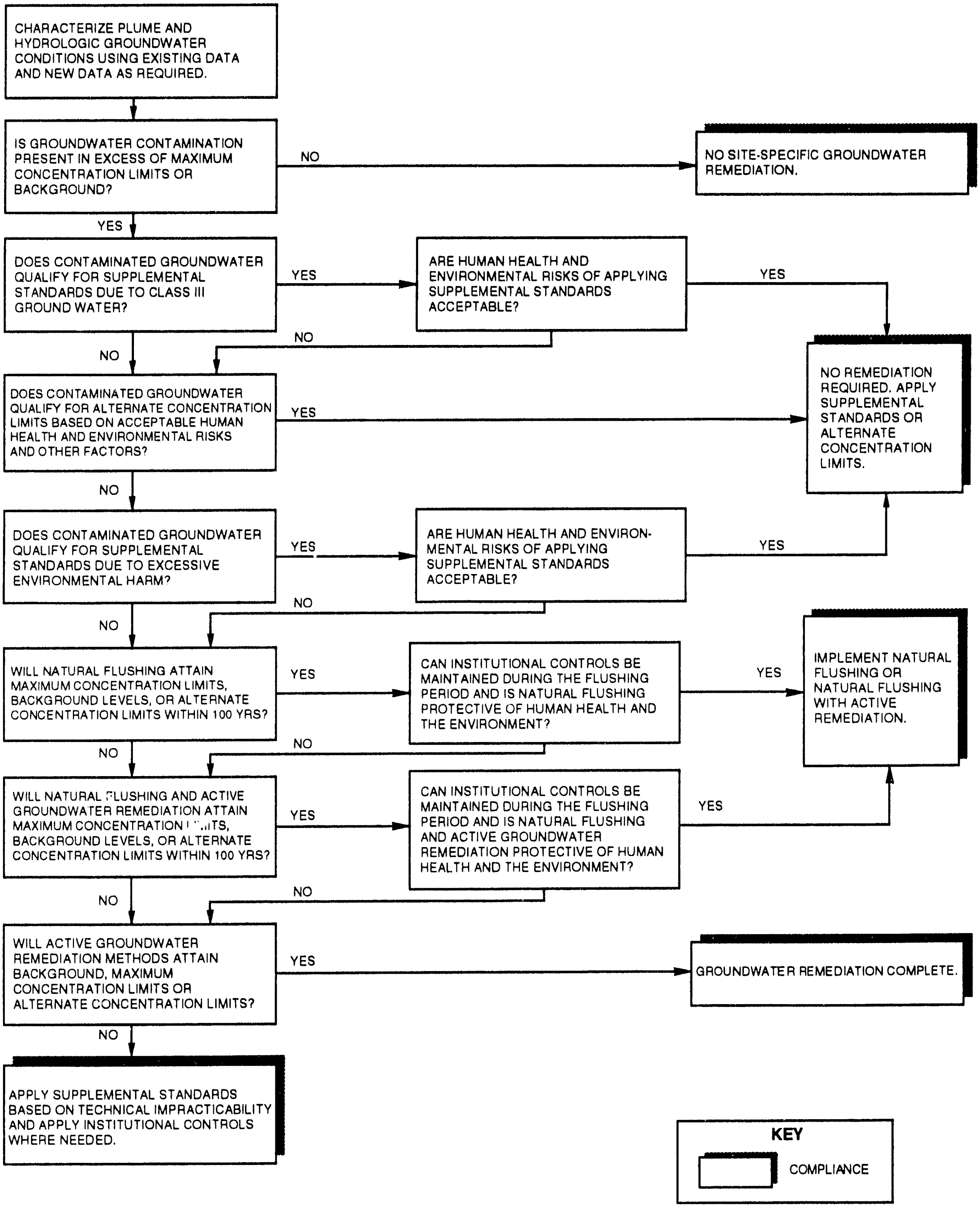
- Combination of natural flushing and active remediation.

The approach to groundwater remediation and strategies for meeting the groundwater standards will likely be based on the results of site-specific risk assessments. If the no remediation or natural flushing strategies do not satisfy



SOURCE: BASED ON FIGURE 2.2 (DOE, 1992d).

FIGURE 3.1
DECISION FRAMEWORK FOR THE OBSERVATIONAL APPROACH



SOURCE: BASED ON FIGURE 2.1, DRAFT PEIS, 1993

FIGURE 3.2
APPROACH TO GROUNDWATER REMEDIATION

MAC: NONSITE/TAGR/FLWCHT

the regulatory requirements for compliance with groundwater cleanup standards at certain processing sites, active groundwater remedial technologies will be considered. Existing technologies for active groundwater restoration are being assessed to determine methods that may be applicable to achieve compliance with the groundwater cleanup standards.

3.4.1 No groundwater remediation

No groundwater remediation will be required at UMTRA Project processing sites where groundwater contamination related to uranium processing activities is not present (Figure 3.3). Nor will groundwater remediation be required at processing sites which have site-related groundwater contamination, but concentrations of hazardous constituents do not exceed background levels or the MCLs. There will also be situations where ACLs or supplemental standards are applied, and no groundwater remediation will be required. Under the no groundwater remediation option, it must be demonstrated that there will be no impact to human health and the environment as a result of site-related uranium processing activities.

3.4.2 Meeting established concentration limits

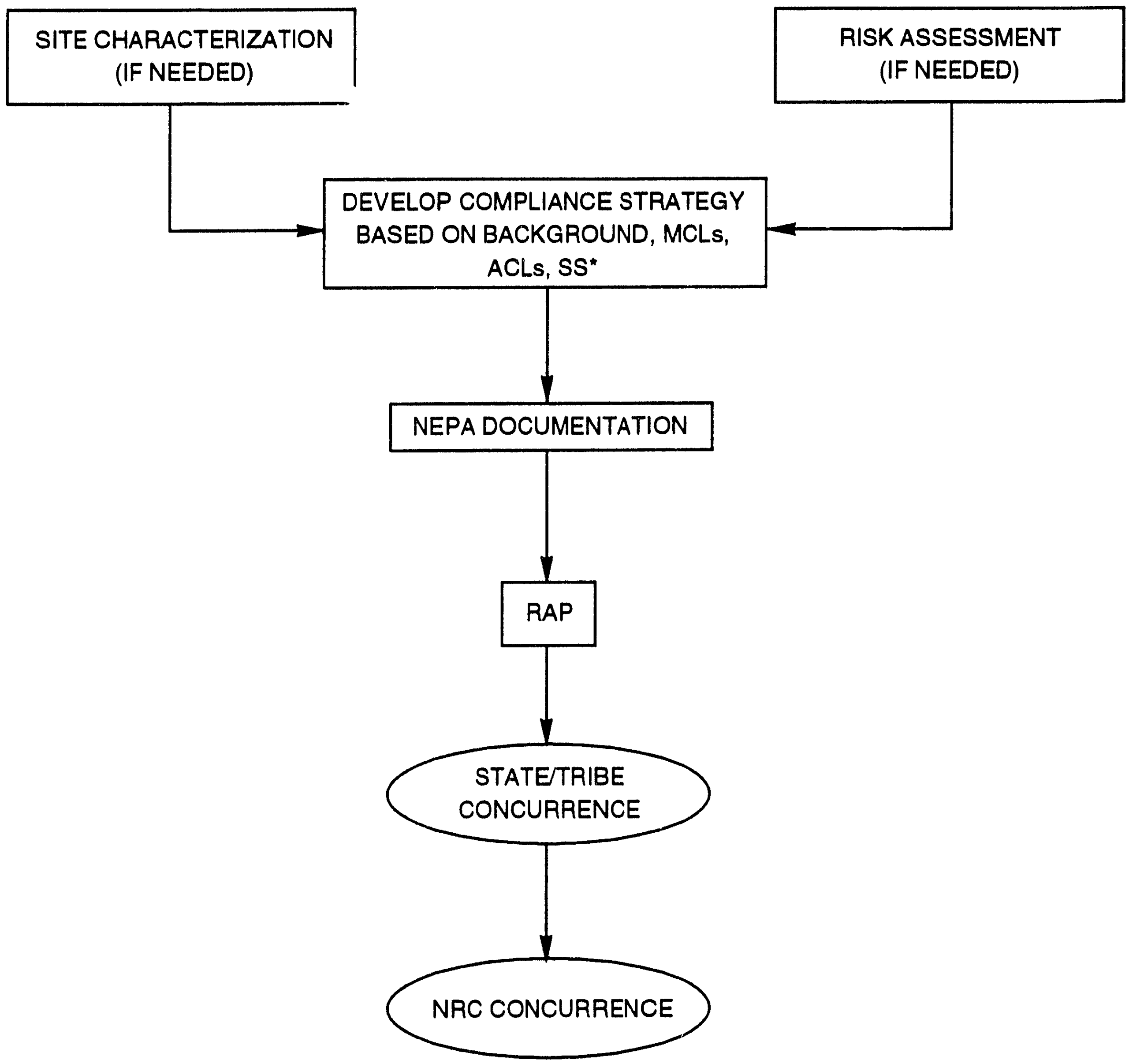
Compliance with the groundwater protection standards is achieved by meeting background levels, MCLs, or ACLs in groundwater [40 CFR 192.12(c)] or by applying supplemental standards (40 CFR 192.22).

ACLs may be obtained under certain circumstances in lieu of meeting MCLs or background [40 CFR 192.12(c)(2)]. To obtain an ACL for any constituent in groundwater, the DOE would have to provide data to support a finding that the proposed ACL would not pose a substantial present or potential hazard to human health and the environment. In order to obtain an ACL, the DOE must demonstrate that the concentration is as low as reasonably achievable. The NRC is developing a guidance document for application of ACLs at Title II UMTRCA sites. When this guidance document is finalized, it is anticipated that similar procedures will be applicable to Title I (UMTRA Project) sites.

Supplemental standards under 40 CFR 192.22 may be applied in lieu of the standards of Subpart B if it is determined that any of the circumstances listed in 40 CFR 192.21 exist. The criteria for applying supplemental standards include the following:

- Remedial actions would pose a clear and present risk of injury to workers or the public [40 CFR 192.21(a)].

- Remedial actions would produce environmental harm that is clearly excessive compared to current and potential health benefits [40 CFR 192.21(b)].



* BASED ON CLASS III GROUNDWATER

FIGURE 3.3
NO REMEDIATION

- The estimated cost of remedial action would be unreasonably high relative to the long-term benefits [40 CFR 192.21(c) and (d)].
- There is no known remedial action [40 CFR 192.21(e)].
- The restoration of groundwater quality at any designated processing site is technically impractical from an engineering perspective [40 CFR 192.21(f)].
- The groundwater is Class III [40 CFR 192.21(g)].

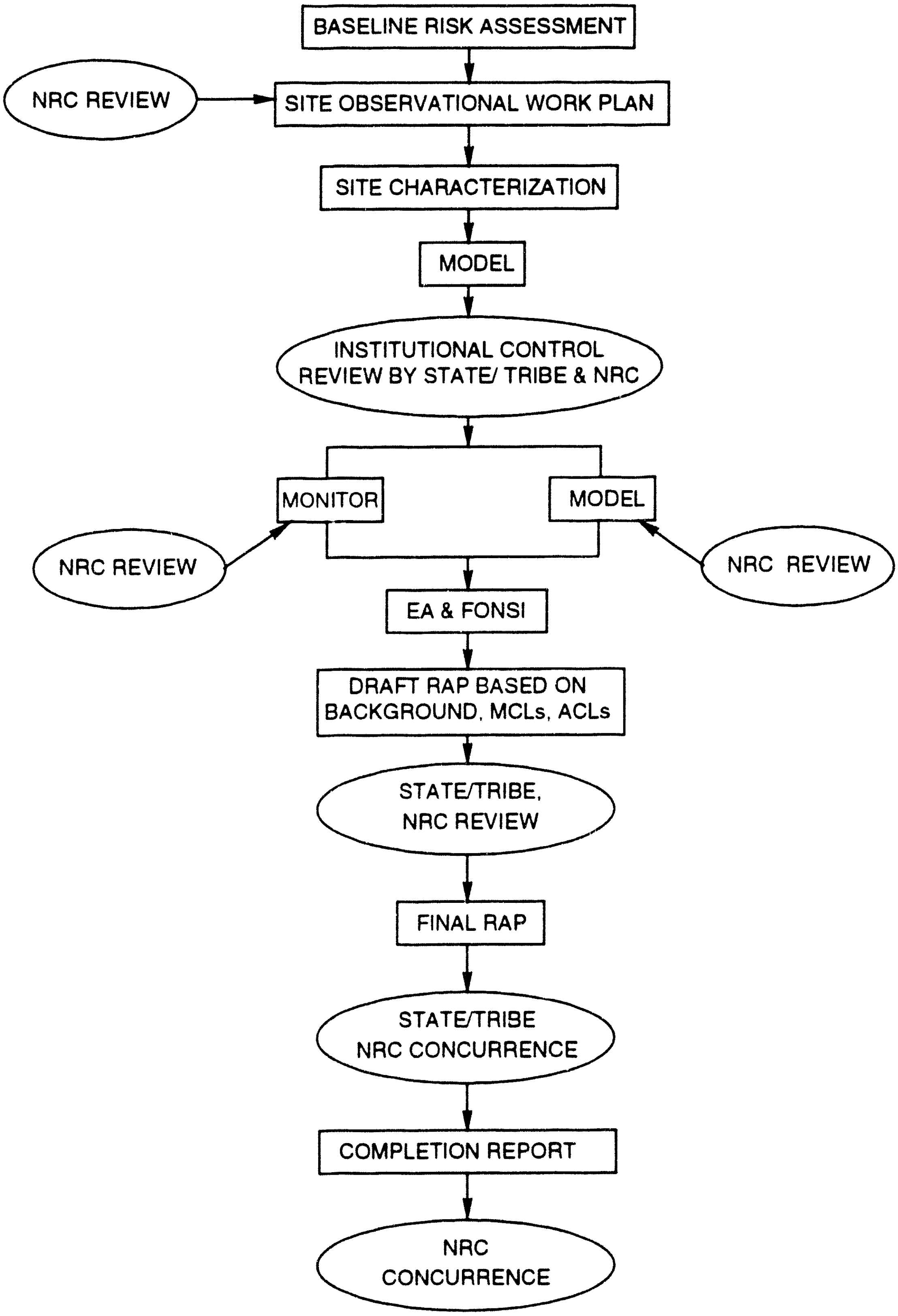
When one or more of the criteria of 40 CFR 192.21(a) through (g) apply, the DOE shall select and perform remedial actions that come as close to meeting the otherwise applicable standard as is reasonable under the circumstances [40 CFR 192.22(a)]. When 40 CFR 192.21(f) and (g) apply, the DOE shall apply any remedial actions for the restoration of contaminated groundwater that may be required to assure, at a minimum, protection of human health and the environment [40 CFR 192.22(d)].

3.4.3 Natural flushing

Natural flushing is an option under which the following conditions apply: 1) passive restoration can be expected to occur naturally in less than 100 years, and 2) groundwater is not now and is not currently projected to be used for a public drinking water supply [40 CFR 192.12(c)(4)]. Satisfactory institutional control of water use and an adequate monitoring program must be established and maintained throughout the remediation period (Figure 3.4).

The EPA observes that this approach is particularly appropriate if active groundwater restoration methods are impractical or if partially cleansed groundwater can achieve the levels required by the standards through natural flushing. Natural flushing is most viable when the contaminated aquifer discharges into a surface-water body that will not be adversely affected by the contamination.

Institutional controls will be required for the successful implementation of natural flushing. The institutional controls should be enforceable by permanent government entities or have a high degree of permanence. The institutional controls should be reliable for the natural flushing period. Possible institutional controls include 1) physical control of the land over the relic plume, 2) zoning restrictions, 3) property record annotations, and 4) restrictions on well installation. In some cases, providing an alternate water supply system may be a significant part of developing a viable institutional control plan. However, an alternate water supply should not by itself be considered an institutional control mechanism. The DOE may also consider seeking legislation or rule-making by an affected state or tribe to provide additional control mechanisms.



NOTE IN ORDER FOR THIS PROCESS TO BE IMPLEMENTED, IT IS ASSUMED THAT VIABLE INSTITUTIONAL CONTROLS EXIST.

FIGURE 3.4
NATURAL FLUSHING

3.4.4 Active remediation technologies

Active groundwater restoration methods will be considered at certain processing sites in conjunction with available passive techniques if supplemental standards, ACLs, or natural flushing will not satisfy the regulatory requirements for compliance with the groundwater cleanup standards (Figure 3.5). Several methods of active groundwater restoration may be used to achieve compliance with the groundwater cleanup standards. These include plume management and redistribution, secondary source remediation ("hot-spot" removal), bioremediation (particularly for nitrate), extraction and land application, *in situ* treatment, and other innovative technologies. The active groundwater restoration methods may be used individually or in combination with other groundwater cleanup strategies. New and innovative technologies will be evaluated and considered for certain site-specific situations.

3.5 REMEDIAL ACTION DECISION-MAKING

Although the physical, chemical, and risk characteristics of the UMTRA Project sites vary, a common decision-making process for attaining compliance with the groundwater cleanup standards is proposed for all sites in the PEIS. The final action will be announced in the PEIS Record of Decision. The approach to groundwater remediation is shown in Figure 3.2.

The first decision point in this process comes after determining whether there is any site-related groundwater contamination that exceeds background levels or MCLs. For those sites with no groundwater contamination, no remediation is required.

Supplemental standards may be applicable at those sites where certain criteria can be met, including 1) groundwater is classified as a limited use resource (Class III), 2) restoration of groundwater is technically impractical, 3) no remedial action is known, 4) groundwater restoration would cause excessive environmental harm, or 5) the remedial action would present a risk to workers or the public.

For those sites with contamination, selected data are collected and evaluated and a baseline risk assessment is performed. If there is an acceptable level of risk from the contamination and certain conditions exist, an application for ACLs will be prepared.

If the baseline risk assessment shows that the groundwater risk is unacceptable, the site will be investigated using the observational approach and a remedial action will be selected. Natural flushing will be considered first if appropriate institutional controls exist. If it can be demonstrated that contaminant concentrations can be reduced to MCLs or background levels within 100 years

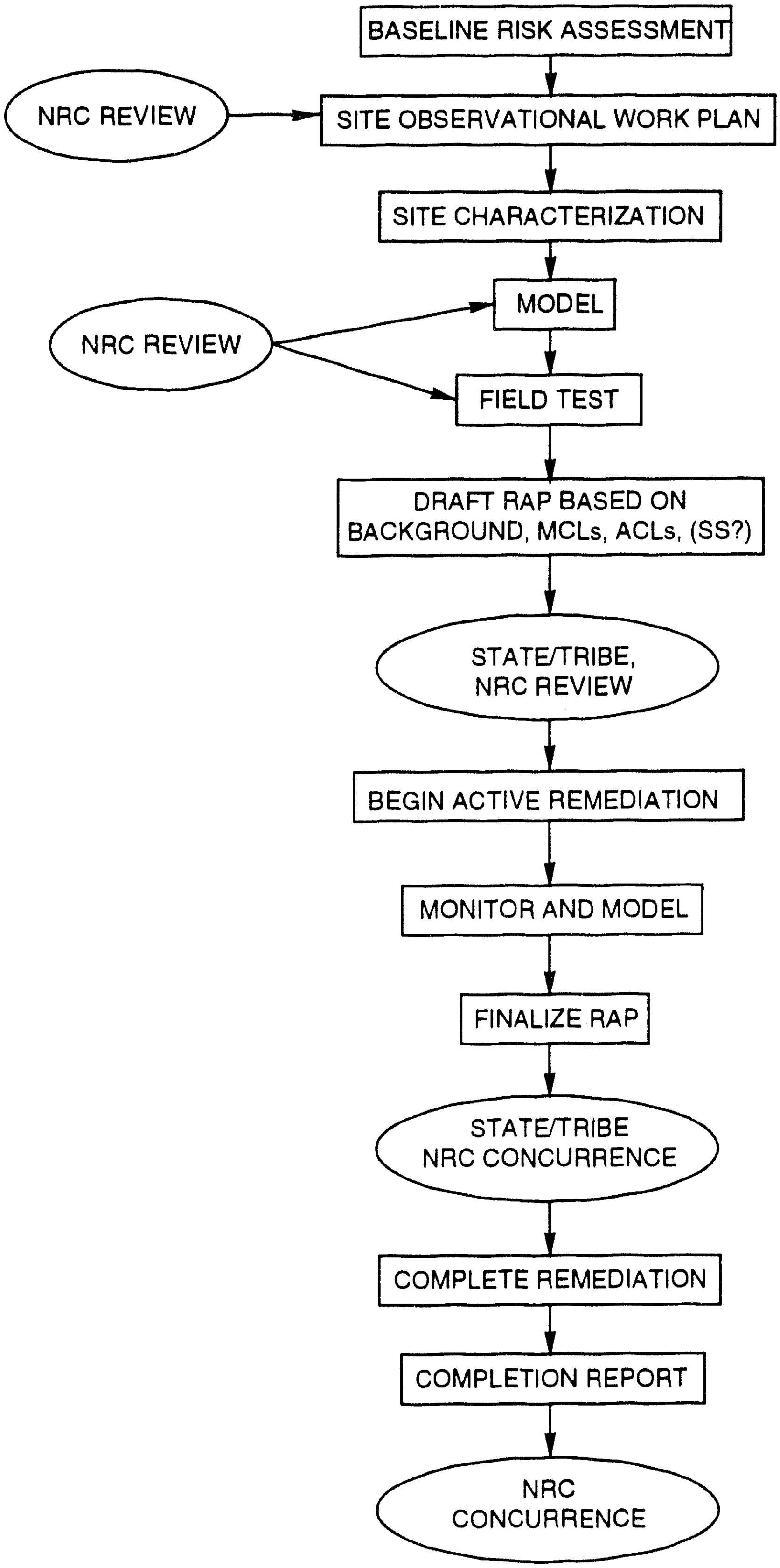


FIGURE 3.5
ACTIVE REMEDIATION

and that human health and the environment will be protected during this period, remediation can be considered to be complete. Alternatively, an ACL application may be filed to show that human health and the environment will be protected, even if MCLs or background will not be achieved in 100 years.

In other cases, it may be determined that natural flushing is not acceptable and active groundwater remediation technologies must be considered. These technologies include plume management and redistribution, secondary source remediation ("hot-spot" removal), bioremediation (particularly for nitrate), extraction and land application, and other innovative technologies. For any of these technologies, when background groundwater quality, MCLs, or ACLs are achieved, the remediation can be considered to be complete. In cases where active groundwater remediation does not achieve compliance, supplemental standards, based on technical impracticality, would be applied.

4.0 DATA REQUIREMENTS

4.1 DATA QUALITY OBJECTIVES AND MINIMUM DATA REQUIREMENTS

DQOs are qualitative and quantitative statements specified to ensure that data of known and appropriate quality are obtained during site characterization activities (EPA, 1987). To ensure that the data generated during site characterization activities are adequate to support agency decisions, a clear definition of the objectives and the method by which decisions will be made must be established early in the program planning process. These determinations are facilitated through the development of DQOs. DQOs are applicable to data collection activities and are determined based on the end uses of the data to be collected. The level of detail and data quality needed will vary based on the intended use of the data.

DQOs are developed through a three-stage process: identify decision types, identify data uses and needs, and design a data collection program (EPA, 1987). These stages should be undertaken in an interactive and iterative manner, whereby all the DQO elements are continually reviewed and reevaluated. This process supports the observational approach to be implemented during this phase of the project.

Minimum data requirements for the groundwater restoration phase of the UMTRA Project will vary by site, depending on the complexity of the site, the degree of site-related risk to human health and the environment, and the possible remedial action scenarios considered. Existing data will be used where applicable, and additional data will be acquired as needed. Evaluation of existing data and acquisition of additional data will be done in the context of the observational approach for program optimization. Data will be collected and evaluated according to procedures outlined in the TAGR, the QAIP (DQOs), the SOWPs, and applicable procedures.

4.2 DATA REQUIREMENTS

4.2.1 No groundwater remediation

No groundwater remediation may be needed at some of the UMTRA Project processing sites where groundwater contamination related to uranium processing activities does not exist. For cases where insignificant site-related contamination exists, the no remediation option would require a demonstration that there will be no impact to human health and the environment if no groundwater cleanup action is taken. Site-specific conditions must be carefully evaluated using existing site characterization data and additional data, as necessary, to conclusively make this demonstration.

4.2.2 Alternate concentration limits

To obtain an ACL for any hazardous constituent in groundwater, the DOE would have to provide sufficient data to demonstrate that the proposed ACL would not pose a present or potential hazard to human health and the environment. A risk assessment would be an integral part of the ACL process to determine the extent of site-related contamination in groundwater, contaminant pathways, and possible receptors.

4.2.3 Supplemental standards

Data for applying supplemental standards must demonstrate that the supplemental standards will come as close to meeting the otherwise applicable standards as is reasonably achievable under the circumstances [40 CFR 192.22(a)]. Protection of human health and the environment shall be demonstrated when applying the technical impracticality or Class III groundwater criteria [40 CFR 192.22(d)]. This evaluation will be based on existing site characterization data and additional data as necessary. In some instances, the case for supplemental standards may have been demonstrated during the surface remediation phase of the UMTRA Project where contaminated materials were stabilized in place or on the site, and this demonstration may be applicable to the groundwater restoration phase of the UMTRA Project.

4.2.4 Natural flushing

Existing or additional site characterization data would be required to 1) evaluate hydrogeologic conditions at the site, 2) support modeling activities that would demonstrate the effectiveness of natural flushing to achieve the required compliance with the groundwater cleanup standards, and 3) design a groundwater monitoring system.

4.2.5 Active groundwater restoration

Data requirements for active groundwater restoration methods would generally be more detailed than for other strategies. Additional site characterization data would be required, along with existing data, to evaluate the more complex site conditions necessitating this level of groundwater cleanup activity. These data would include aquifer characteristics, geochemical conditions, contaminant distribution, and engineering parameters to facilitate evaluation of the system and design of the appropriate groundwater cleanup technologies to comply with the standards.

5.0 SITE IMPLEMENTATION

This section discusses the development of a conceptual site model, approach to site characterization, development of remedial action alternatives, selection of the groundwater restoration method, and remedial design and implementation in the context of site-specific documentation in the SOWP and the RAP.

5.1 SITE OBSERVATIONAL WORK PLAN

Application of the observational approach to the groundwater restoration phase of the UMTRA Project will be advantageous and cost-effective. The existing data base will be evaluated with regard to data validity and usability for the groundwater restoration phase. The most probable site conditions will be determined and a conceptual model formulated for each site. Additional data needs to substantiate the most probable site conditions will be determined, and data will be collected based on DQOs and implemented within the concept of the observational approach. Uncertainties will be identified and evaluated in the context of contingency planning, impacts, risk evaluation, and failure modes.

The SOWP will define the technical scope, objectives, and strategy for the anticipated activities at the site from characterization through engineering design and remediation. The SOWP will present the conceptual model based on existing site information, identify uncertainties, address the uncertainties with additional site characterization as needed, and provide a means to assess the impact of reasonable deviations.

The SOWP will provide guidance and documentation for field sampling and testing activities by defining the data collection objectives and methods to be used. Specifications for collecting and analyzing environmental samples, field testing, and the QA evaluation and management of data will be provided in SOPs and the QAIP. Site-specific measures for ensuring health and safety at the sites that are not identified in the *Environmental, Safety and Health Plan* (DOE, 1992c) will be included in the SOWP.

5.1.1 Review of existing data

Site characterization activities have been conducted under Subpart A of 40 CFR 192 to define the geologic, hydrogeologic, geochemical, geotechnical, and radiological conditions at the processing and disposal sites for purposes of designing and implementing the surface remediation phase of the UMTRA Project. Site characterization activities have been performed by several contractors for the DOE since the early 1980s. The current TAC has performed site characterization activities in accordance with guidance in the TAD (DOE, 1989). These activities were performed using UMTRA Project SOPs and applicable QA/QC procedures. Consequently, relevant site characterization data are applicable to the groundwater restoration phase of the project. Much of the characterization data from the processing sites can be used as the basis for considering the need for and extent of groundwater restoration and for assessing different groundwater restoration methods. Results of these site characterization activities are available in site-specific surface remediation RAPs and EAs.

The extent of site characterization data collected at the processing sites during the surface remediation phase depended on the selection of the preferred disposal alternative. Processing sites involving the stabilization-in-place or stabilization-on-site options were characterized in greater detail to justify the option, provide data for disposal cell design, delineate the extent of subsurface contamination, and generate a defensible groundwater protection compliance strategy. Processing sites where contaminated materials were to be removed for off-site disposal were characterized to a lesser extent; that is, by generally defining tailings-related groundwater contamination and ascertaining that existing conditions at the processing site would not adversely impact human health and the environment during the interim between the two phases of the UMTRA Project. The sites where surface remediation activities were completed, or were in progress prior to issuance of the proposed EPA groundwater regulations in September 1987, were generally characterized to a lesser extent because of different requirements under the earlier regulations.

5.1.2 Conceptual model

A conceptual model of each site will be established based on existing data and enhanced as needed by procuring additional data. The conceptual model will be a key feature in applying the observational approach and will likely be reevaluated and refined throughout all phases of remedial activities. The procedure using the observational approach will be to refine the conceptual model, test model assumptions, identify uncertainties, and perform additional characterization as needed to reduce critical uncertainties.

Information on the contaminant sources, pathways, and receptors at a site will be used to develop a conceptual understanding of the site to evaluate potential risks to human health and the environment. The conceptual site model should include known and suspected sources of contamination, types of contaminants and affected media, known and potential pathways for migration, and known or potential human and environmental receptors. This effort will help in identifying locations where additional characterization will be necessary and in identifying potential groundwater restoration technologies.

5.1.3 Site characterization

Additional data needs will be identified based on the initial conceptual site model. More detailed characterization data may be needed, particularly at processing sites that were minimally characterized because contaminated materials were moved to an off-site disposal cell. A certain level of characterization data will be necessary for all sites.

Site characterization activities will be undertaken in accordance with the observational approach and in conjunction with the SOWP, DQOs, data collection objectives, applicable SOPs, and best management practices. The magnitude of the site characterization effort will be guided by the level of existing data and the perceived needs for additional data to adequately conceptualize the site and develop remedial alternatives for groundwater restoration.

Hydrogeologic and geochemical characterization

Hydrogeologic characterization data will be used during the groundwater restoration phase to define and assess in more detail the groundwater system and the extent of contamination related to uranium processing activities at the UMTRA Project sites. Site characterization data will also be needed to develop and evaluate groundwater restoration alternatives for the remedial design and to implement the remedial action. The hydrogeologic environment needs to be assessed and evaluated in terms of the hydrogeologic framework, hydraulic parameters, background groundwater quality, groundwater contamination related to site activities, and current and potential uses of groundwater. Additional hydrogeologic characterization will probably be necessary at each processing site to provide a more detailed understanding of the hydrogeologic framework for refining conceptual site models, performing treatability investigations, developing groundwater cleanup alternatives, and designing remedial groundwater cleanup systems.

Background groundwater quality and the distribution of hazardous constituents in groundwater in potentially affected aquifers at the processing site should be evaluated using statistical methods to assess the extent and magnitude of groundwater contamination resulting from uranium processing activities. Some additional sampling and analyses may also be necessary to support the risk assessment.

Geochemical characterization of aquifer materials is an integral part of the remediation process. The composition of the aquifer matrix affects the groundwater quality through dissolution, precipitation, and adsorption mechanisms. Generally, high concentrations of elements dissolved in groundwater favor precipitation as the primary mechanism for removal of constituents. Low concentrations favor adsorption-desorption reactions to control the concentrations of inorganic constituents. Groundwater at most of the UMTRA Project processing sites being considered for remediation contains hazardous constituents at concentrations below their respective saturation indices. As a consequence, adsorption-desorption reactions are the primary mechanism controlling the concentrations of hazardous constituents. The geochemical characterization of the aquifer matrix materials should allow prediction of 1) the total mass of hazardous constituents within the aquifer, and 2) the potential for release of these constituents from the matrix to the groundwater.

Groundwater modeling

Groundwater modeling will be applied as needed for characterization, design, and regulatory compliance purposes during the groundwater restoration phase of the UMTRA Project. Groundwater modeling will be used as a predictive decision-making tool for understanding and assessing complex hydrogeologic systems. Modeling results will be used within the context of the uncertainty in conceptualization and parameter estimation inherent in groundwater models. Groundwater models will be used to predict and evaluate groundwater flow, solute-transport, and geochemical reactions.

Groundwater flow modeling will be conducted primarily to evaluate and design groundwater restoration alternatives. Emphasis will be on saturated flow modeling rather than unsaturated flow modeling. Flow modeling will be conducted to assess the effects of extraction and injection wells, drains, trenches, hydraulic barriers, and boundary conditions. Flow modeling will also be used to design pilot-scale tests of groundwater restoration methods and to develop full-scale groundwater restoration designs.

Solute-transport modeling will play a major role in evaluating and designing groundwater restoration methods. Solute-transport modeling will be used to 1) predict compliance with the groundwater cleanup standards, 2) evaluate the effects of natural flushing and support arguments for ACLs or institutional controls, 3) predict the effects of groundwater restoration at sites stabilized in place, and 4) assess potential points of exposure.

Geochemical modeling will be conducted to evaluate natural flushing and the geochemical processes that control contaminant adsorption and desorption. Geochemical models will be used to 1) determine equilibrium species of hazardous constituents, 2) assess saturation indices of minerals precipitated in the contaminated zones to predict their long-term stability, and 3) determine the potential for contaminants to attenuate along flow paths.

Statistical analysis of groundwater quality data

Statistical methods will be employed to help comply with the groundwater cleanup standards, in the cleanup demonstration, and as an integral part of the cleanup monitoring program. The guidelines for statistical analysis of groundwater data at RCRA facilities (EPA, 1989b) will be followed or adapted whenever necessary to conduct the various statistical comparisons.

Background concentrations for constituents will be described as to distribution, average value, and amount of variability. Statistical comparison of the background distribution of a constituent to the MCL or proposed concentration limit for constituents without MCLs is needed to set and justify the groundwater cleanup standard for that constituent. Baseline concentrations of constituents in monitoring wells will be statistically characterized and compared to background in order to assess the extent of tailings-related groundwater contamination present when the groundwater cleanup program begins.

At regular intervals during the cleanup monitoring program, water-quality data from background and point-of-compliance (and point of exposure, if applicable) wells will be statistically compared with each other, to their historical values, and to the established standard for each constituent. The purpose of these comparisons will be to detect changes in background, to assess the effectiveness of the cleanup activities, and to measure compliance with the groundwater cleanup standards.

5.2 REMEDIAL ACTION PLAN

The RAP is the evaluation and design document submitted to the NRC and states/tribes for concurrence. This document will contain the details of site characterization performed to support the conceptual model of the site, the development of remedial action alternatives, remedial action selection, the implementation plan for the remedial design and remedial action, the compliance strategy for groundwater protection, and the groundwater monitoring plan. These details will be presented in the context of the observational approach and will reflect the dynamic and iterative nature of the process. The method and conditions for terminating groundwater restoration remedial activities at the sites will also be discussed in the RAP.

5.2.1 Site characterization results

The RAP will contain a section describing the results of site characterization activities performed during the groundwater restoration phase of the UMTRA Project. The characterization activities will cover all facets of the program, from additional site characterization to enhance the conceptual model of the site, to activities related to development of remedial action alternatives, to implementation of the remedial design and remedial action.

5.2.2 Development of remedial action alternatives

Remedial action alternatives designed to comply with groundwater protection standards will be developed on a site-specific basis, considering factors and criteria developed by applying the observational approach. Potential groundwater cleanup strategies include no remediation, natural flushing, or active groundwater restoration. The active groundwater restoration technologies may be used individually or in combination with other groundwater cleanup strategies. Using the observational approach, remedial action alternatives will be developed and considered using existing site-specific data, with as little additional site characterization as needed to reasonably determine site conditions and evaluate viable groundwater restoration alternatives.

During the process of developing reasonable remedial action alternatives, treatability investigations may be undertaken if necessary to evaluate the feasibility of various active groundwater restoration alternatives. Treatability investigations would be conducted on a bench scale (laboratory) or on a pilot scale (field). The purpose of these investigations would be to provide sufficient data to allow groundwater restoration alternatives to be fully developed and evaluated and to support the design of the selected remedial alternative. The investigations are also designed to evaluate technologies, optimize costs, and reduce performance uncertainties for active groundwater restoration alternatives.

5.2.3 Selection of groundwater restoration alternative

Groundwater restoration alternatives must be developed based on site-specific conditions and possible deviations in these site conditions. By applying the observational approach, the DOE will be able to reduce the number of possible remedial action alternatives for each site. This will facilitate the decision-making process.

Selection of the preferred remedial action alternative will be based on evaluation of several regulatory, technical, and policy criteria. These include protection of human health and the environment; compliance with groundwater cleanup standards; short-term effectiveness; long-term effectiveness and performance; reduction of toxicity, mobility, or volume; implementability; cost; and state, tribal, and community acceptance.

After the remedial action alternatives have been evaluated relative to the above criteria, a comparative analysis will be conducted to determine the relative performance of each alternative. The comparative analysis should identify the advantages and disadvantages of each alternative relative to the others so that the key tradeoffs are apparent to the decision-maker. Results of the comparative analysis, combined with risk management judgments, become the rationale for selecting the preferred remedial action alternative and preparing the proposed remedial action plan.

5.2.4 Remedial design and implementation

The remedial design will be done in the context of the observational approach, as outlined in the SOWP, with the preliminary work being accomplished in the earlier phases of the groundwater restoration phase. As the concepts are modified and refined, the design will become more focused and applicable to site-specific conditions. Progress during the design phase will be documented in the status reports (SR) and distributed to the appropriate regulatory agencies to provide a status update, allowing for issues to be identified, discussed, and resolved as the program progresses. The final design will be documented in the RAP, which will be the vehicle for concurrence from the NRC and states/tribes. Upon concurrence, the remedial action will be implemented.

5.3 STATUS REPORT

The site-specific SR will provide an interim report on groundwater restoration activities to the NRC and state/tribal regulatory agencies. The SR will be an informative document rather than a concurrence document. However, information provided in the SR will allow for issues to be identified, evaluated, discussed, and resolved as the project progresses. This concept will contribute to the successful application of the observational approach in implementing the groundwater restoration program. The SRs will be prepared on a scheduled basis, as determined by site-specific conditions.

6.0 GROUNDWATER MONITORING

Groundwater monitoring will be implemented as necessary during and after groundwater restoration activities to evaluate the effectiveness of the remedial action, to demonstrate compliance with the EPA groundwater cleanup standards, and to ensure protection of human health and the environment. The groundwater monitoring program will consist of baseline, detection, and compliance monitoring. Groundwater monitoring will also provide the basis for determining when groundwater restoration objectives have been met and when compliance activities are complete. Because groundwater contamination problems and groundwater remediation scenarios are site-specific (based on hydrogeologic complexity, magnitude of contamination, and potential impact on human health and the environment), the number and location of monitor wells, analytes evaluated, and sampling frequency will be contingent on site conditions and the selected remedial action. The groundwater monitoring program will be designed and implemented in conjunction with the observational approach.

Groundwater monitoring will not be needed at sites not targeted for groundwater restoration. Sites with supplemental standards as the compliance strategy may require monitoring to demonstrate protection of human health and the environment. Sites where ACLs are applied would require groundwater monitoring to demonstrate that the selected remedial action is effectively maintaining the proposed ACLs of hazardous constituents as established. At sites where natural flushing is the compliance strategy, groundwater monitoring would be needed to evaluate the progress of contaminants through the system during the remediation period (less than 100 years). Active groundwater restoration methods would require monitoring to track the effectiveness of the remedial action.

7.0 LICENSING

The UMTRCA, as amended, authorized the DOE, upon completion of the remedial actions, to care for the permanent disposal sites under a general license issued by the NRC to ensure future protection of public health and safety. The NRC licensing regulations, 10 CFR 40.27, *General License for Custody and Long-term Care of Residual Radioactive Material Disposal Sites*, took effect on November 30, 1990 (55 FR 45591). A disposal site comes under the general license after the NRC concurs in the DOE certification that all remedial actions were completed in accordance with all applicable standards.

There are three types of disposal sites: 1) those where the residual radioactive materials are stabilized in place (SIP) at the designated processing site, 2) those where the residual radioactive materials are moved but stabilized on-site (SOS) in a disposal cell within the designated processing site boundary, and 3) those where the residual radioactive materials are moved to an off-site area. In all three cases, there is a potential need for additional remedial action to clean up the groundwater beneath the processing site that was contaminated as a result of the uranium processing activities.

For Title I disposal sites where the tailings are not being moved off-site (SIP and SOS), the NRC will allow licensing and certification to occur in two steps (if needed) to avoid lengthy delays in licensing the surface cleanup. Because groundwater restoration activities could take decades to complete, 10 CFR 40.27(b)(2) allows this two-step approach for those disposal sites where the residual radioactive materials have not been relocated off-site and there are continuing groundwater restoration requirements. This allows the DOE to complete all remedial actions except groundwater restoration, which include complying with the groundwater protection standards addressing the design and performance at the disposal site for closure and licensing.

For the first step, when the surface remedial action activities are completed at the processing and disposal sites, the NRC will concur in the DOE certification that all remedial actions, except for groundwater restoration activities at the processing site, were completed in accordance with all applicable requirements. The general license will be in effect for these disposal sites after the surface remedial action activities are completed so the long-term care of the residual radioactive materials and the disposal site can begin.

The second step in the certification, concurrence, and licensing process is completed when the NRC concurs in the DOE certification that all groundwater restoration requirements at the processing site have met the proposed EPA standards.

For disposal sites where the residual radioactive materials were relocated and where no preexisting groundwater contamination exists as a result of the uranium processing activities, the NRC will license the disposal site in one step. However, for the processing sites where the residual radioactive materials remain at the processing site, the NRC will need to concur in the DOE certification that all remedial action except groundwater restoration has been completed. Certification and concurrence that groundwater restoration requirements at the processing site have met the EPA standards also will be completed as a separate activity.

8.0 LIST OF CONTRIBUTORS

The following individuals contributed to the preparation of this report.

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D. Thalley	Technical editing
E. Bond	Graphic design
L. Keith, C. Slosberg	Text processing

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