UNITED STATES

NUCLEAR REGULATORY COMMISSION

REGION IV

URANIUM RECOVERY FIELD OFFICE
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MEMORANDUM FOR: Michael F. Weber
Geotechnical Branch
Division of Waste Management

FROM: Paul R. Hildenbrand, Project Manager
Licensing Branch 1
Uranium Recovery Field Office, Region IV

SUBJECT: REVIEW OF DRAFT WATER RESOURCES PROTECTION STANDARD REVIEW PLAN

Pursuant to your request dated August 14, 1985, I have reviewed the draft Standard Review Plan for water resources protection at UMTRA processing and disposal sites. I have attached a markup of the document for your use during the final revision process. Additionally, the following general comments are provided for your consideration.

- In its present form (July 30, 1985 revision), the document is not a very useful review guide. It is too long and devotes too much effort towards justifying the review. The purpose of the document should be to provide the reviewer a concise review methodology rather than a philosophical treatise justifying the need for the review.

- The document tends to repeat itself and also contains voluminous descriptive language which confuses and dilutes the objective of the document, rather than amplifying it. Keeping the document as short as possible without sacrificing clarity and completeness should be a primary concern. For example, Section III could easily be absorbed into Section II, eliminating considerable repetitive language without sacrificing document completeness.

- Technical documents are normally written in a 1.0, 2.0, etc. format rather than alphabetic characters and roman numerals. For example:

4.0 Water Resources Protection
4.1 Scope of Review
4.1.1. Site Characterization

Should you wish to discuss any of these comments or the markup itself, please call me.

Paul R. Hildenbrand, Project Manager
Licensing Branch 1
Uranium Recovery Field Office
Region IV

Attachment: As stated

~~Section~~ 4.0 Water Resources Protection

~~1.~~ Areas of Review (Scope)

Based on EPA's guidance in Subpart C of 40 CFR Part 192, the NRC staff has developed a systematic approach ~~to review~~ DOE's assessments of the need for and implementation of protective actions for water resources at designated UMTRAP sites. This review approach is illustrated in Figure 1. Once the review concludes that the sites are adequately characterized, ~~the impacts of~~ existing and potential water contamination will be ~~assessed to determine the need for protective actions~~. ~~If such a need is identified by DOE,~~ the ~~approach~~ proceeds with ~~analysis of potential implementation of the protective actions considering~~ such factors as the resource value of potentially affected waters, technical feasibility of protective actions, availability of alternative water supplies, and costs and benefits of protective actions. ~~The approach culminates in reviewing the selection and design of appropriate protective~~ actions for water resources at processing sites or disposal sites. Depending on the completeness and adequacy of DOE's assessments indicated in the early stages of reviews, NRC staff may request additional and clarifying information from DOE. Such requests may require iterative reviews to develop defensible conclusions about the need for and implementation of protective actions for water resources.

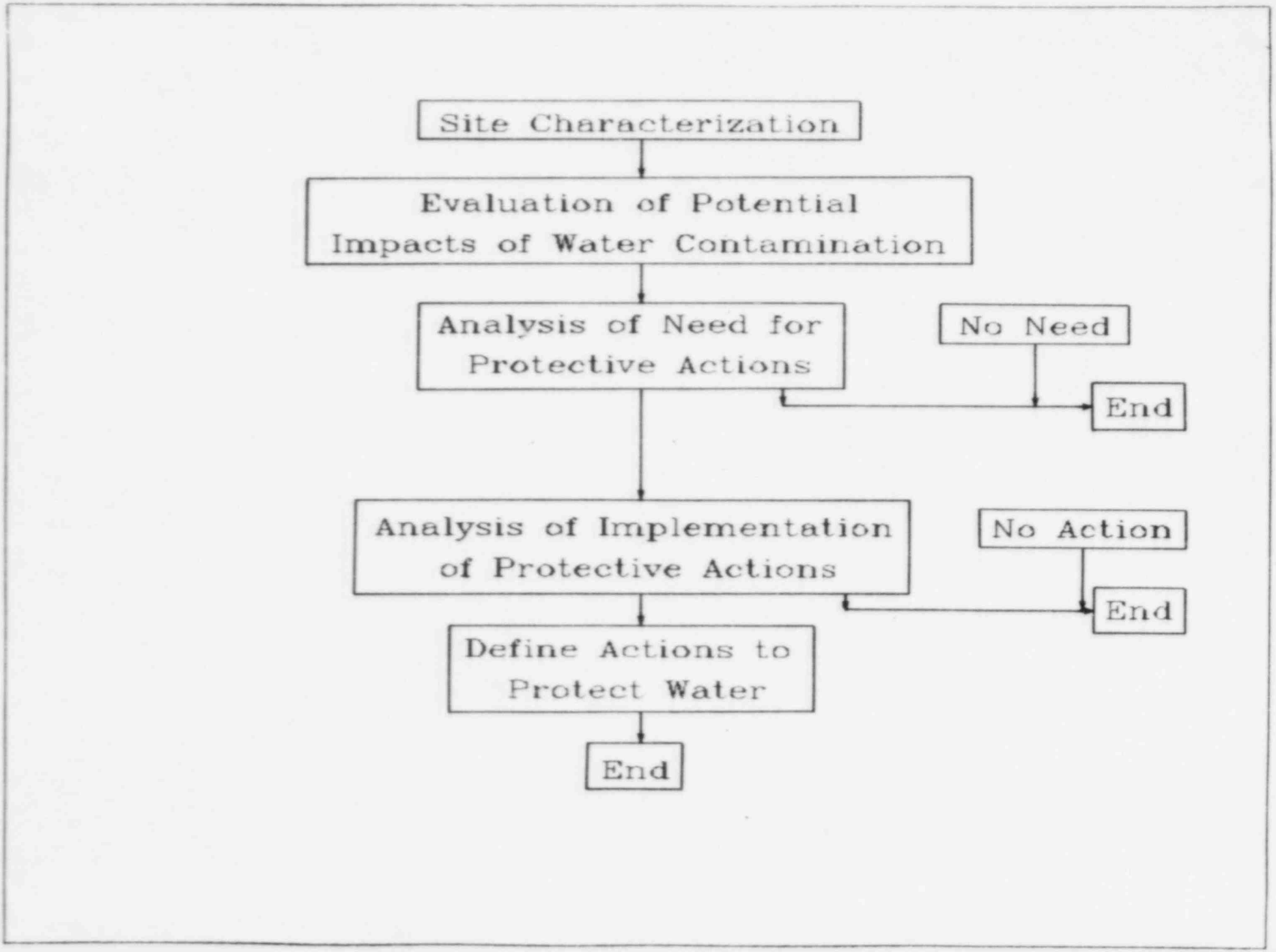
As components of this ~~approach~~, the NRC staff has identified four fundamental elements of NRC's ~~review~~ of Remedial Action Plans to verify and concur with DOE's ~~selection~~ and performance of protective actions for water resources, ~~including~~:

(1) Review of the ~~characterization of processing and disposal sites~~

Processing and disposal sites should be adequately characterized to provide a defensible basis for DOE to determine the need for and ~~evaluate~~ the implementation of protective actions for water resources. ~~In~~ the

4.1

Figure 1. Systematic Approach for Reviewing DOE's Selection of Protective Actions at UMTRAP Sites


Site Characterization
Evaluation of Potential Impacts of Water Contamination
Analysis of Need for Protective Actions
No Need
End
Analysis of Implementation of Protective Actions
No Action
End
Define Actions to Protect Water
End

For purpose of this SAR review, ~~review of water resources protection~~, the term site characterization includes (1) characterization of the inactive uranium processing facility, (2) characterization of ~~anthropic~~ Human activities and natural processes in the vicinity of sites, ~~relevant to the protection of water resources, and~~ (3) characterization of the hydrogeologic system at the processing and disposal sites, specifically background water quality, rate(s) and direction(s) of water flow, and extent of water contamination.

4.1.2

~~(2)~~ Review of existing and potential impacts ~~associated with water contamination~~ at processing ~~sites~~ and disposal sites:

Together with ~~Based~~ on the characterization of processing and disposal sites, assessments of existing and potential impacts of water contamination provide the basis for evaluating and selecting protective actions for water resources. Such ~~environmental impact~~ assessments should provide quantitative or semi-quantitative estimates of the consequences of human and environmental exposure to existing and potential water contamination. ~~In addition~~ Additionally, to adverse effects of contamination on environmental populations, these assessments should also take into consideration consider economic, aesthetic, and social impacts.

4.1.3

~~(3)~~ Review of the need for protective actions ~~for water resources~~ at processing and disposal sites:

An adequate ~~characterization of existing and potential impacts of water contamination promotes objective evaluation of environmental risks and needs for protective actions to reduce or eliminate environmental impacts.~~ Protective actions, include, ~~both~~ remedial actions taken to reduce, eliminate, or control existing water contamination ~~(i.e., remedial actions)~~, and preventive actions (ie, actions to reduce, eliminate, or control potential water contamination (~~i.e., preventive actions~~). The analysis of the need for protective actions should consider such factors as present and anticipated water uses in the vicinity of the processing and disposal sites; relevant Federal, State and local water quality standards for beneficial uses of water near the sites;

availability of alternative water supplies for replacement or supplementation of contaminated water resources; and ~~the characteristics~~ an evaluation of adverse impacts caused by water contamination.

4.1.4

(4) Review of ~~potential~~ proposed implementation of protective actions for water resources:

Assuming that DOE has identified a need for protective actions during their assessment, ~~has been identified under the previous review element~~, the reviewer will evaluate ~~potential~~ the proposal for implementation ~~of~~ these actions by considering such factors as the technical feasibility of the actions, value of water resources potentially affected by contamination, benefits and costs of the actions, and compliance with relevant Federal, State, and local laws for water protection. Through a deliberative and objective consideration of these and other factors, the NRC will determine whether DOE has appropriately selected and implemented protective actions for water resources.

4.2

~~II.~~ Acceptance Criteria (Purpose, objective)

Regulatory Basis and Specific criteria can introductory material and should be first front of the document followed by detailed explanation of each criteria.

4.2.1.

A. Regulatory Basis

The Environmental Protection Agency (EPA) issued standards for remedial actions at inactive uranium processing sites (Subparts A and B of 40 CFR Part 192) pursuant to Section 275 of the Atomic Energy Act (42 U.S.C. 2022). Data available to EPA when the standards were promulgated supported the decision not to issue general numerical water protection standards. As an alternative, EPA identified factors for consideration by implementing agencies (NRC, DOE) in establishing regulatory mechanisms to use in deciding, on a site-specific basis, whether a water problem exists and, if so, what remedial action is appropriate. Under Subpart C of 40 CFR Part 192, EPA has provided that judgements on the possible need for remedial actions should be guided by relevant state and federal water quality criteria for existing and anticipated uses of water resources and relevant considerations from EPA's standards for hazardous waste disposal. ~~Consistent with an optimized cost-benefit approach,~~

EPA also provided that remedial action decisions should consider the costs and benefits of the ~~remedial measures~~, including the extent and utility of the aquifer, the availability of alternative sources of water, and the potential for human exposure.

The NRC must find with reasonable assurance that Subparts A and B of 40 CFR Part 192 ~~will be satisfied prior to concurring with DOE's Remedial Action Plans.~~ Because EPA intended that protection of water be considered in the analysis for reasonable assurance of compliance with the provisions of 40 CFR Part 192 and because the DOE-NRC Memorandum of Understanding defines the EPA standards to include requirements for analysis and implementation of water protection measures as needed, the NRC staff has adopted EPA's approach in Subpart C of 192 as a mechanism to review DOE's Remedial Action Plans with respect to the protection of water resources. Prior to recommending concurrence with DOE's proposed remedial actions, NRC staff must conclude that DOE's selected and implemented protective actions for water resources in a logical, systematic, and defensible manner consistent with EPA's guidance in Subpart C of 40 CFR Part 192.

~~B.~~ Specific Criteria

DOE's assessments should provide or reference sufficient information to allow the NRC, as an independent reviewing agency, to verify the assessments and to reach comparable, but not necessarily identical, conclusions. Information submitted to support the selection of protective actions must be of sufficiently high quality so as to be verifiable and representative of site conditions. Table I summarizes the types of information that typically should be considered in DOE's assessments to facilitate the staff's review of the selection and implementation of protective actions for water resources. The following sections describe specific criteria for each review element.

TABLE I. NOMINAL INFORMATION NEEDS - WATER RESOURCES PROTECTION

REVIEW ELEMENT I. SITE CHARACTERIZATION

this may not be poss. the at some of the older sites due to lost records, or company no longer exists.

A. Facility Characterization

Bullet #2 would be included as part of bullet #1.

- Description of uranium recovery process
- Identification and relative quantification of process reagents
- Description of waste management practices
- Location of waste management areas
- History of waste management on-site

B. Vicinity Characterization

- Identification and description of local ~~anthropic~~ human activities that may significantly affect the hydrogeologic system ~~such as~~ ? such as ?
- Identification and description of natural processes that may significantly affect the hydrogeologic system ~~such as flooding, erosion~~ such as floods, seismic & tect activity, etc.

C. Hydrogeologic Characterization

- Conceptual models of the hydrogeologic system
- Hydrogeologic system interrelationships
- Characterization and monitoring protocol ? how about procedures?
- Topographic data
- Climatic data (precipitation, potential evaporation, temperature)
- Geologic data (stratigraphy, structural geology, lithology and mineralogy, geomorphology)
- Surface hydrogologic data (location, volume, flow rate, channel morphology, current patterns, bed load and suspended load fractions, uses, hydrographic modifications) ? what does this feel us about water contamina
- Subsurface hydrologic data (areal extent of aquifers, recharge-discharge relationships, geometries of hydrogeologic units, hydraulic head distributions and temporal variation, hydraulic properties, historical trends of hydraulic heads, uses, flow rates and directions, travel times)
- Background water quality
- Concentrations and values of ~~indicator constituents and~~ water quality parameters that exceed background and/or state or fed. water qual stds
- Contaminant transport data (dispersion coefficients, attenuative properties, effective porosity, solubility)

TABLE I. (Continued)

REVIEW ELEMENT II. IMPACT ASSESSMENT

A. Exposure Assessment

- Existing and predicted distributions of contaminants
- Locations and types of water uses
- Identification of exposed populations
- Characteristics of exposed populations
- Identification of exposure pathways
- Identification of significant contaminants
- Classification of water resources

B. Impact Assessment

- Dose-response relationships of contaminants and populations
- Short-term and long-term adverse effects
- Recommended tolerance or exposure limits
- Contaminant interactions (synergistic, antagonistic effects)
- Independent changes in populations
- Identification and characterization of adverse economic impacts
- Identification and characterization of adverse aesthetic impacts
- Identification and characterization of adverse social impacts

REVIEW ELEMENT III. ANALYSIS OF NEED FOR PROTECTIVE ACTIONS

A. Nature and Severity of Adverse Impacts
B. Water Use Characteristics, present and future
C. Relevant Water Quality Standards and Guidelines
D. Classification of Groundwater Resources based on EPA's Groundwater Protection Strategy
D. Availability and Characteristics of Alternative Water Supplies
E. Institutional Controls on Water Use

REVIEW ELEMENT IV. ANALYSIS OF IMPLEMENTATION OF PROTECTIVE ACTIONS

A. Identification of Needs for Protective Actions
B. Optimized Designs of Protective Actions
C. Estimated Value of Potentially Affected Water Resources
D. Identification, Evaluation, and Comparison of benefits and costs
E. Relevant Laws and Regulations for Water Protection
F. Availability and Characteristics of Alternative Water Supplies
G. Engineering Designs and Supporting Calculations for proposed Protective Actions

4.2.2.1

1. Review Element I: Site Characterization

4.2.2.1.1

a. Facility Characterization

Characterization of the inactive uranium processing facility will aid in evaluating existing and potential water contamination associated with the facility. Facility characterization should include such information as the description of the uranium recovery process at the facility, identification and relative quantification of reagents used in the milling process, and description of waste management practices (e.g., location of waste discharges, retaining structures for wastes, relative amounts of wastes, and history of waste discharges). This information supports DOE's characterization of contaminant source terms, operational effects of the facility on the hydrogeologic system, and background water quality.

~~b. Vicinity~~ Characterization

4.2.2.1.2

At some sites, local ~~anthropic~~ human activities and natural processes may significantly affect the hydrogeologic system, such that these activities and processes influence DOE's selection and performance of protective actions for water resources. Thus, human activities and natural processes should be considered in selecting and implementing protective actions for water resources at UMTRAP sites. In characterizing the extent of water contamination, for example, ~~anthropic~~ human activities may have significantly degraded groundwater quality and may complicate assessments that support selection and performance of protective actions. Potentially significant activities and processes include, but are not limited to, crop irrigation, mine dewatering, ore storage, municipal waste landfilling, geothermal springs, natural concentration of soluble salts by evaporation, and surface water recharge.

~~The kinds of data and~~ information required for the NRC staff's review will be commensurate with the anticipated significance of releases from processing sites to the hydrogeologic system and will vary based on site-specific considerations. DOE's characterization should identify and describe those

activities and natural processes that may significantly affect the hydrogeologic system and influence the selection and performance of protective actions at the sites. Based on these ~~descriptions~~ assessments, DOE should demonstrate the significance of the activities relevant to the UMTRA Project.

4.2.2.1.3

c. Hydrogeologic Characterization

DOE's characterization of the facility and ~~vicinity characteristics~~ any outside influences to groundwater quality should be coordinated with the characterization of the site hydrogeologic system. By integrating information collected under these three components of site characterization, ~~DOE will develop~~ conceptual and analytical models of the hydrogeologic systems at processing ~~sites~~ and disposal sites may be developed by DOE. Characterization of the hydrogeologic system should assist ~~enables~~ DOE ~~to~~ in understanding the effects of contaminant sources and vicinity activities on water resources and to assess the impacts of existing and potential water contamination on humans and the environment. This understanding is manifested in the synthesis of conceptual and analytical models based on site-specific and regional information about hydrology, geology, topography, geochemistry, and climate. Specifically, hydrogeologic site characterization includes (1) determination of background water quality, (2) determination of rate(s) and direction(s) of contaminated water migration, and (3) determination of the extent of water contamination. Prediction of future contamination is included under Review Element II.

Is this necessary? In a review? It appears that we are telling DOE how they will do their assessments rather than how NRC Staff is to review them.

4.2.2.1.3.1 Background Water Quality

In addition to supporting the general characterization of hydrogeologic systems, background water quality inherently determines the best potential use category of affected water resources when compared with relevant water quality standards. Defensible characterization of background water quality also provides baseline concentrations used in characterizing the extent of water contamination and constitutes a principal consideration in DOE's evaluation of the need for and implementation of protective actions for water resources. Background water quality is defined as the quality of water that would be expected at a site if contamination had not occurred from the designated facility.

Unnecessary verbage. Justification should be stated in 191 section only under scope/objectives.

What is the source reference for this definition? EPA, NRC, ? Source should be cited.

This definition implicitly recognizes that background quality may not be equivalent to the water quality that existed prior to the operation of a uranium processing facility. For example, uranium mining developed concurrent been affe inappropri existed pr the mining also have equivalent activities under the sufficient processes designated lity has ould be ity that ibuted to ities may y is not milling reviously l include l natural ndent of

THIS STATEMENT CONTRADICTS THE DEFINITION

WHEN REVIEWING WATER QUALITY DATA ONE MUST RECOGNIZE THAT THE EXISTING WATER QUALITY MAY HAVE BEEN INFLUENCED BY ACTIVITIES UNRELATED TO THE MILLING PROCESS (IE., CONCURRENT MINING ACTIVITIES, PRIVATE, OR COMMERCIAL SEPTIC SYSTEMS, ETC.). THE REVIEWER SHOULD EVALUATE EXISTING WATER QUALITY IN RELATION TO THOSE PARAMETERS ONE WOULD EXPECT TO SEE AS A RESULT OF URANIUM MILLING PROCESS.

~~The kinds and amounts of~~ DATA information required for review of DOE's determination of background water quality should ~~be commensurate with the anticipated magnitude of potential impacts caused by water contamination associated with processing and disposal sites. Examples of the types of information to be reviewed~~ include the following: (1) maps ~~of sufficient detail~~ showing the location of background monitoring locations; (2) characteristics of ~~background~~ monitoring devices including wells, springs, community water supply sources, suction samplers and other sampling devices; (3) distribution and location of wastes at and near the site; (4) operational characteristics of the facility; ~~(5) description of~~ historical changes in hydraulic heads, flow directions, and flow rates relevant to the ~~location of~~ monitoring locations, including; ~~analytical~~ (6) water quality data for uranium, selenium, molybdenum, arsenic, sulfate, nitrate, ammonia, radium-226, major cations and anions, total dissolved solids, total organic carbon, total organic halogen, pH, and other constituents and parameters that may be necessary on a site-specific basis to characterize background water quality and the extent of any water contamination; (7) assessments of any observed variations in background water quality; (8) identification and characterization of any off-site ~~sources of~~ water

THIS SHOULD BE A PART OF FACILITY CHARACTERIZATION REVIEW.

IS A DEVICE?

URANIUM WASTES OR A TYPE OF WA

SO4 IS A MAJOR ANION

contamination; and protocols for sampling, analysis, preservation, transportation, and quality control of background water quality samples.

4.2.2.1.3.2 Rate and Direction of Contaminated Water Migration

Determination of the rate(s) and directions(s) of contaminated water migration is necessary to support DOE's characterization of background water quality and the extent of contamination under Review Element I, and predictions of contaminant concentrations and environmental impacts of water contamination under Review Element II of this plan. The kinds and amounts of information required for review of the characterization of water flow rates and directions should be commensurate with the anticipated magnitude of potential impacts caused by water contamination associated with processing and disposal sites; as well as the relative distance of user populations from existing and potential contamination associated with the sites. Characterization of water flow rates and directions includes both advection of groundwater and surface water, as well as advection, dispersion, and attenuated transport of contaminants from processing and disposal sites. Examples of the types of information to be reviewed include maps of sufficient detail to show the relationships of the sites to major hydrogeologic systems that could affect or be affected by the site; descriptions of the relations of components of the hydrogeologic system (e.g., surface water-groundwater relationships); climatic characteristics, including precipitation, evapotranspiration, and temperature; geologic characteristics, including stratigraphy, gemorphology, lithology, and structural geology; contaminant transport characteristics, including attenuative capacity, dispersion coefficients, contaminants, and effective porosity; surface water characteristics including location, volumes, flow rates, channel morphology, current patterns, bed and suspended load fractions, seasonal variations in flow rates, hydrographic modifications, and uses; and groundwater characteristics such as areal extent of aquifers, recharge-discharge relationships, geometries of hydrogeologic units, hydraulic head distributions and temporal variations, hydraulic properties of hydrogeologic units, historical trends in hydraulic head variation, uses, flow rates, travel times, and flow directions.

For the purpose of clarity, surface water review should be separated from groundwater review. It is difficult to tell what is being described. Perhaps a separate section for surface water review requirements is warranted.

4.2.2.1.3.2 Extent of Water Contamination

DOE's characterization of background water quality and of the rates and directions of contaminated water migration support the characterization of the extent of water contamination at designated processing sites. This characterization is essential to fully assess the impacts of existing and potential contamination, the need for protective actions, and implementation of such actions. The types and amounts of information required for this aspect of the review should be commensurate with the anticipated magnitude of potential impacts of water contamination associated with processing sites and the type of contamination. Submitted information should include the distribution and characteristics of wastes on-site, including wind blown contamination areas, tailings piles, raffinate ponds, evaporation ponds, ore storage areas, rubbish heaps and other sources of water contamination; characteristics of the hydrogeologic system (see information types described under rates and directions of water migration); background water quality; identification of hazardous constituents above background concentrations and reasonably expected to originate at processing and disposal sites; concentrations and values of indicatory water quality constituents and parameters, including pH, Ec, major ions, minor ions, trace constituents, uranium (natural), radium-226/228, and thorium-230; distributions of groundwater contaminants (i.e., maps and cross-sections showing constituent concentrations in three dimensions) at processing sites; and monitoring procedures used to characterize water quality, including collection, preservation, transportation, analytical, and quality control procedures.

Repetitious

Redundant

THIS DATA IS ALREADY REQUIRED IN EARLIER ELEMENTS

THIS PRETTY WELL COVERS EVERYTHING WHAT IS INDICATED?

X-SECTIONS ARE 2-DIMENSIONAL ONLY.

Redundant

4.2.2.2

2. Review Element II: Existing and Potential Impacts of Water Contamination

For the purpose of this SRP, water impact assessments consist of four component assessments: hazard evaluation, dose-response assessment, exposure assessment, and risk characterization. Hazard evaluations identify hazardous constituents and their toxicological characteristics. The dose-response assessment characterizes the responses of populations exposed to specific doses of contaminants. An exposure assessment characterizes the migration of constituents through the environment by identifying temporal and spatial distributions of contaminants, exposure pathways, contaminant doses, and

Review Element II goes beyond the scope of a hydrogeologic review. Very few, if any, hydrogeologists are qualified to assess or review intelligently toxicological effects of hazardous constituents. This is something that should be considered by environmental ists. and toxicologists in EA's and EIS's.

exposed populations. ~~As the fourth component assessment~~, Risk characterization translates the conclusions of the first three assessments into quantitative or semi-quantitative estimates of the risks of adverse impacts associated with exposure to ~~the~~ contaminants. Rigorous determination ~~of the risks of adverse impacts~~ requires the performance of each of the component assessments. Although the first three assessments are included under this review element, most of the risk characterization assessment is reviewed under Review Element III.

Under certain circumstances, however, the conclusions of one of the supporting assessments may appropriately reduce the scope of the other supporting assessments. For example, a conclusion that no adverse impacts would result from environmental exposure to a particular constituent regardless of its concentration, within practical limits, would eliminate the need for detailed assessments of risk and exposure. Similarly, a conclusion that a constituent will never reach environmental populations because of permanent attenuation would eliminate the need for a detailed assessment of its dose-response characteristics. Consequently information submitted in the impact assessment will be expected to vary in scope and amount based on similar considerations.

~~The information submitted should be commensurate with the anticipated magnitude of existing~~ and potential ~~impacts of water contamination associated with processing and disposal sites~~. ~~Information needs~~ for the impacts assessment can be divided into several categories: ~~those that support~~ evaluations of human health impacts, ~~those that support~~ evaluations of environmental impacts, and ~~those that support the~~ exposure assessment common to both types of impact assessments such as predictions of temporal and spatial variations of contaminant concentrations and identification of exposure pathways.

Impact assessments should begin with an ~~assessment~~ of the existing spatial distribution of contaminants and predictions of contaminant concentrations using appropriate and defensible estimation techniques. The purpose of these predictions is identify and characterize environmental exposure pathways from contaminant sources to exposed populations. Anticipated future events that may

significantly influence hydrogeologic systems and environmental exposure to contaminants should be identified and accounted for in predicting ranges of estimated concentrations. Based on information under Review Element I, the environmental pathway assessment should develop reasonable and conservative estimates of the geographic and temporal distribution of concentrations of contaminants in groundwater and surface water. Transfer of contaminants from aqueous media to other environmental media may need to be considered on a site-specific basis.

The environmental pathway analysis should include such information as transport characteristics of contaminants (e.g., sorption, speciation, biodegradation constants, bioaccumulation factors, plant up-take factors); identification of degradation and decay products of the contaminants including predicted concentrations if toxic and significant; duration of contaminant migration and statistical representation of the concentrations relevant to duration of exposure and toxic characteristics of the contaminant (i.e., average daily concentration over lifetime for carcinogenic contaminants, mean daily concentration for acutely toxic contaminants, mean annual concentrations for chronically toxic contaminants); temporal variability of contaminant concentrations; spatial distribution of contaminants; water and solid quality monitoring data characterizing existing concentrations used to validate predicted contaminant concentrations; identification of exposure pathways for contaminants; and classifications of affected water resources based on the classification scheme discussed under review procedures for Element II.

Generally, the most significant exposure pathway considered in the human impact assessment is human consumption of drinking water from contaminated surface and groundwater resources. Exposure pathways of potentially lesser importance include ingestion of contaminated food and dermal contact via bathing or recreation pathways. Assessments of human health impacts should assume representative populations, including particularly sensitive populations such as institutionalized patients, infants, and elderly individuals. The human impact assessment constitutes a dose-response assessment based on predictions of contaminant concentrations, anticipated exposure pathways, and available toxicological and epidemiological information. The assessment should

distinguish between the health impacts of toxic (threshold) and carcinogenic (non-threshold) contaminants. Other impacts, such as mutagenic, teratogenic, and synergistic impacts, should also be considered in the assessment if they are identified in comprehensive literature searches. The information accompanying human impact assessments should justify significant assumptions invoked in preparing the assessment, as well as assess the significance of uncertainties in the health assessment.

Additionally, information related to social, economic, and environmental impacts potentially caused by water contamination should be submitted. This information should include inventories of exposed non-human species and populations of terrestrial and aquatic wildlife, agricultural crops and animals, and plants; selection and justification of indicator species; recommended tolerance or exposure limits for exposed contaminants and exposed populations; interactions of contaminants and their cumulative effects on exposed populations; anticipated or likely changes in populations or species independent of exposure; identification and description of adverse economic impacts (e.g., increased maintenance costs, decreases in agricultural productivity, land value depreciation, etc.), identification and description of aesthetic impacts (e.g., changes in water taste and appearance, etc.), and identification and description of adverse social impacts (e.g., social disruption, inconvenience in locating and developing alternative water supplies, etc.).

4.2.2.3

~~3.~~ Review Element III: Analysis of the Need for Protective Actions

Descriptions of existing and potential impacts caused by water contamination provide a defensible basis to assess the need for protective actions for water resources at UMTRAP sites by estimating the risks that the impacts will occur. Protective actions may be necessary to prevent future water contamination, abate existing contamination, partially clean-up or restore contaminated water resources, or avert exposure to contaminated water resources. In the analysis of the need for protective actions, the impacts determined under Review Element II ~~are~~ should be evaluated in light of their relative probability of occurrence by

considering such factors as existing and anticipated water uses, institutional controls on water use, relevant Federal, State, and local water quality standards, and the characteristics of adverse impacts estimated under Review Element II.

~~The kinds~~ of information required for this aspect of the staff's review ~~will be affected by~~ site-specific factors and the conclusions ~~verified~~ under Review Element II. This information ~~should~~ should generally include, but ~~is~~ not, be limited to, information verified in Review Elements I and II, ~~characteristics of~~ water uses in the vicinity of processing and disposal sites (e.g., locations, types, intended uses, rates of withdrawal/injection, statutory and legal restraints on use, etc.), relevant water quality standards and guidelines, classifications of groundwater resources based on EPA's Groundwater Protection Strategy, and availability and characteristics of alternative water resources and comparison of these resources to present water supplies, ~~and other~~ information relevant ~~to the need~~ for water protection. In addition to information provided or referenced by DOE, the staff ~~will~~ should use other sources of information as appropriate. Such information may be requested from organizations such as local water-supply companies or agencies, regional water commissions, State ~~agencies,~~ and Federal agencies, and local water users.

~~Water quality standards relevant to water supplies for human consumption~~ Relevant drinking water standards include the NIPDWR and NSDWR maximum contaminant levels in 40 CFR Part 141 and 143, as well as ~~relevant~~ State and local water quality standards developed under Federal or State statutes (e.g., Safe Drinking Water Act). For water resources whose background concentrations exceed the limits provided in the above standards, other water quality standards appropriate for the intended use will be considered as relevant criteria. Table II provides nominal water quality criteria that ~~will~~ should be used along with relevant State and local standards during the staff review.

4.2.2.4

~~4.~~ Review Element IV: ~~Analysis~~ Review and Selection of the Implementation of Protective Actions

If a need for remedial actions ~~to protect water water resources~~ is identified under Review Element III, the review proceeds ~~to evaluate the~~ with an evaluation of DOE's selection,

TABLE II. WATER QUALITY CRITERIA FOR DOMESTIC AND AGRICULTURAL USES

CONSTITUENT	MAXIMUM CONCENTRATION LIMIT (mg/l) DOMESTIC USE*	AGRICULTURAL USE°
Ammonia (as N)	0.05(R)	---
Arsenic	0.05(P)	0.2(L); 0.10 to 2(I)
Barium	1(P)	---
Cadmium	0.010(P)	0.05(L); 0.01 to 0.05(I)
Chloride	250(S)	---
Chromium	0.05(P)	1.0(L); 0.1 to 1.0(I)
Copper	1(S)	0.5(L); 0.2 to 5.0(I)
Iron	0.3(S)	5.0 to 20.0(I)
Lead	0.05(P)	0.1(L); 5.0 to 10.0(I)
Manganese	0.05(S)	0.2 to 10(I)
Molybdenum	---	0.01 to 0.05(I)
Nickel	---	0.20 to 2.0(I)
Nitrate (as N)	10(P)	100(L)
Selenium	0.01(P)	0.05(L); 0.02(I)
Sulfate	250(S)	---
Vanadium	---	0.1(L); 0.10 to 1.0(I)
Zinc	5(S)	25(L); 2.0 to 10.0(I)
Combined Radium-226 and Radium-228 (pCi/l)	5(P)	---

*NIPDWR and NSDWR standards in 40 CFR Parts 141 and 143; Primary (P) required limits and Secondary (S) recommended limits for public water systems. Recommended limit (R) for ammonia in drinking water is from National Academy of Science, "Water Quality Criteria, 1972," EPA-R3/73-033, 1973.

°Based on National Academy of Science, "Water Quality Criteria, 1972," EPA-R3/73-033, 1973; recommended limits for Livestock (L) and Irrigation (I) uses.

implementation, and engineering of the proposed actions. Selection of protective actions involves adjusting the conceptual designs of these actions to optimize their efficiency and effectiveness in protecting water resources, while providing a reliable information base to conduct such assessments as cost-benefit analyses and technical feasibility evaluations. Even though protective actions may be optimized and selected, their implementation depends on the consideration of several factors including technical feasibility, availability of alternative water supplies, value of potentially affected water resources, compliance with relevant regulations, and the benefits and costs of the actions. If an action is selected for implementation, the review proceeds with an evaluation of the conceptual design and engineering of the action.

Information included in the analysis of implementation of protective actions will be affected by site-specific factors and commensurate with the need defined under Review Element III. This information should generally include evaluations of a representative range of alternative conceptual designs for protective actions, characteristics and availability of alternative water supplies potentially needed to supplement and replace existing supplies; estimation of the value of water resources to be protected; identification, evaluation, and comparison of benefits and costs of protective actions; Federal, State, and local laws and regulations relevant to water protection; and the selection of designs for protective actions. The protective action designs must be accompanied by evaluations of their effectiveness in reducing contaminant concentrations in water and environmental impacts.

As an example of the types of information that should accompany a protective action design, the analysis of a hydraulic barrier (e.g., bentonite slurry wall) should include such information as spatial dimensions of the barrier; spatial orientation of the barrier relative to the contaminated area and hydrogeologic barriers; method of excavation; hydraulic properties and geochemical characteristics of the barrier; evaluation of the compatibility of the barrier with anticipated geochemical conditions; anticipated changes caused by the barrier on the local hydrogeologic system; method of keying the barrier into adjacent hydraulic barriers; barrier constituent mixture ratios, design

specifications, mixing methods, and confirmation techniques; and anticipated performance and durability of the hydraulic barrier.

III. Review Procedures

This section essentially regurgitates what has already been said in previous sections. Too Repetitive & is unnecessary.

A. General

DOE has the ultimate authority and responsibility for selection and performance of protective actions at designated processing and disposal sites. The purpose of the NRC staff review is not to duplicate DOE's efforts, but rather to verify DOE's site characterization and protective action selection. In conducting reviews of DOE's characterization and selection, the staff will not establish generic numerical criteria, unless such criteria are found to be necessary to discharge NRC's oversight responsibilities under UMTRCA. Instead, the NRC staff will focus its review on technical and procedural aspects of DOE's support for its selection of protective actions.

The NRC staff may reduce its review effort in response to satisfactory conclusions at early stages of the review, which may obviate the need for subsequent elaborative reviews. For example, DOE may defensibly conclude that no need exists for water protection at a particular site, in which case further assessment of the potential implementation of protective actions and the review of DOE's assessment is not warranted. Thus, the staff's review of DOE's selection would be abbreviated.

As a part of the review, NRC staff may conduct literature surveys, data assessments, and performance evaluations as needed to audit DOE's assessments and independently verify DOE's selection of protective actions. The staff may select any assertion, interpretation, representation, procedure, technique, calculation, computation, or conclusion for detailed review as a part of the verification process. When preliminary reviews indicate that supporting information is ambiguous, incomplete, inadequate, or incorrect, the staff will notify DOE of this indication and may proceed independently to review DOE's assessments in as much detail as the staff determines appropriate for the

purposes of the UMTRA Project. In general, however, the staff will focus such detailed reviews on information that is considered by the staff as significantly affecting or supporting DOE's selection and performance of protective actions.

In discharging its oversight responsibilities in the UMTRA Project, NRC may compliment and supplement, as necessary, DOE's assessment of the need for and potential implementation of protective actions for water resources. Where necessary information is lacking from DOE's assessment and is readily available, NRC staff will identify such information based on limited literature surveys, site visits, and other investigations the staff implements in its review. Relevant information will be considered in the staff's review and used to assess the adequacy of DOE's selection of protective actions.

B. Review Element I

NRC staff will review DOE's hydrogeologic characterization of sites to determine if these assessments develop an accurate, defensible, and sufficient understanding of the hydrogeologic system, as well as to determine if the following three criteria have been satisfied:

(1) Has background water quality been adequately established?

(2) Have the rate(s) and direction(s) of contaminated water migration been adequately determined?

(3) Has the extent of water contamination associated with the designated uranium processing site been adequately characterized?

Satisfaction of these three criteria inherently affects DOE's decisions about the impacts of water contamination, the need for action to mitigate adverse impacts, and the potential implementation of protective actions for water resources.

In reviewing DOE's assessment of background water quality, the reviewer will determine whether this assessment establishes, with reasonable assurance, the quality of water that would exist if the resources had not been contaminated by uranium processing sites. At alternate disposal sites, the review will determine whether background water quality has been established with reasonable assurance.

The reviewer will evaluate information relevant to the establishment of background quality including, but not limited to, conceptual and analytical hydrogeologic models, water quality data, facility characteristics, monitoring protocol, and vicinity characteristics. Information reviewed will be commensurate with the anticipated magnitude of potential impacts of waterborne contamination from the sites. As an example of a review consideration, the reviewer will evaluate the proximity of background monitoring locations to the waste management areas (e.g., tailings ponds, raffinate ponds, ore storage areas, etc.). The purpose of such an evaluation is to determine whether the monitoring locations are sufficiently distant from waste management areas to yield representative samples of background water quality considering the operational history and hydrogeologic characteristics and responses at the site. On the basis of this and similar types of considerations, the reviewer will determine whether DOE's monitoring protocol and characterization program reasonably provide water samples whose quality is representative of background water quality at processing and disposal sites.

At sites where water samples representative of background quality cannot be collected because of justifiable reasons (e.g., entire aquifer is contaminated by seepage of tailings solutions), the reviewer will evaluate (1) DOE's justification for not characterizing background water quality and (2) DOE's assessment that establishes reasonably conservative estimates for appropriate water quality parameters. At these sites, the reviewer will evaluate sufficient information to confirm DOE's establishment of background water quality or determine that DOE's estimates are not reasonably conservative. In the latter situation, the reviewer may propose reasonably conservative estimates of appropriate water quality parameters depending on the adequacy of

site characterization, availability and quality of appropriate data, and the anticipated magnitude of potential impacts associated with water contamination by processing and disposal sites.

The establishment of background water quality may also be complicated at sites where existing or potential water contamination may affect water quality in several aquifers or water bodies. The reviewer will confirm that DOE has established background water quality for each aquifer potentially affected by contamination from the processing and disposal sites, and for surface water bodies that receive discharge from aquifers or recharge aquifers potentially affected by the processing and disposal sites.

In reviewing DOE's characterization of the rate(s) and direction(s) of contaminated water migration at processing and disposal sites, NRC staff will determine whether these characterizations are conservative and appropriate representations of the hydrogeologic system and, therefore, adequate to support assessments and conclusions regarding the impacts of water contamination, the need for protective actions, and potential implementation of protective actions. The scope of the staff review includes consideration of site-specific and regional (i.e., beyond the immediate zone of influence of the site) information on the physical and hydrogeological characteristics of groundwater and surface water systems. This information must be sufficiently detailed to provide the basis for assessments of the need for and implementation of protective actions for water resources. The reviewer will also evaluate anticipated or potential changes in flow rates and directions of contaminated water migration caused by reasonably foreseeable events. In addition, the reviewer will consider historic changes in flow rates and directions that may have been caused by the operation of the processing facility or vicinity activities.

In support of this review, the reviewer will consider the appropriateness and adequacy of hydrogeologic characterization techniques, methods, and approaches that support the determination of water flow rates and directions. The

reviewer will verify that the characterization programs used accepted and defensible hydrogeologic practices.

The reviewer will ensure that DOE has adequately determined the flow rate(s) and direction(s) of contaminated and potentially contaminated water at processing and disposal sites. The reviewer will ensure that sufficient information has been provided to assess anticipated effects of the hydrogeologic system on processing and disposal sites. The reviewer will confirm that the hydrogeologic characterization is adequate with respect to relevancy, completeness, reliability, and accuracy of input to the assessments of the impacts of contaminated water, the need for water protection, and the potential implementation of protective actions for water resources.

The reviewer will determine whether DOE's hydrogeologic characterization provides an adequate and accurate representation of the extent of contaminated water associated with the processing site. The scope of this review includes consideration of site-specific information on the physical, hydrological, and chemical characteristics of the uranium processing activities, vicinity activities and natural processes, and the hydrogeologic system affected or potentially affected by the site. The reviewer will verify that this information is sufficiently detailed to provide an adequate basis for assessing existing impacts of water contamination.

The reviewer will ensure that DOE has adequately characterized the extent of water contamination associated with uranium processing sites. The reviewer will confirm that characterization of the spatial distribution of contaminants is sufficient to support assessments of anticipated impacts of contaminated water resources and to evaluate the appropriateness of remedial action measures. The reviewer will verify the characterization with respect to relevancy, completeness, reliability, and accuracy of input to the assessments of the impacts of the contaminated water, the need for water protection, and potential implementation of protective actions for water resources. The reviewer will confirm that the characterizations of background water quality

and the extent of contamination were conducted in accordance with accepted and defensible techniques, approaches, and practices.

C. Review Element II

NRC staff will review DOE's impact assessment to determine whether the assessment adequately identifies and assesses the risks of adverse impacts associated with existing or predicted water contamination. This review will consist of a coordinated interdisciplinary approach involving hydrogeological, geochemical, geological, social, environmental, and human health aspects. NRC staff will review the characterization of population exposure including prediction of temporal and spatial distributions of contaminant concentrations in the environment and identification of physical pathways for migration of the contaminants to exposed populations. Concurrent and subsequent to this review, NRC staff will review DOE's assessment of impacts of water contamination on human and environmental populations, including DOE's identification of health, aesthetic, economic, and social impacts.

The scope of the exposure characterization review includes (1) the assessment of existing contaminant distributions, (2) prediction of temporal and spatial distributions of contaminant concentrations in the environment, (3) identification of physical pathways of contaminant migration the site to exposed populations, and (4) assessment of water quantity impacts caused by or associated with water contamination and/or protective actions to reduce such contamination. In addition, the review evaluates whether the information provided in these assessments provides an adequate basis for characterizing human and environmental impacts.

The scope of the impact characterization review includes (1) evaluation of the detrimental effects associated with exposure to contaminants, (2) assessment of population responses to contaminant doses, (3) identification and characterization of exposed populations, (4) characterization of adverse effects on human and environmental populations, and (5) evaluation of the assumptions invoked and uncertainties associated with the impact assessment.

The review will be divided into a review of potential impacts of water contamination on human health and a review of potential impacts on environmental populations (i.e., terrestrial and aquatic wildlife, plants, and agricultural crops and animals).

The reviewer will verify DOE's identification, description, and assessment of the adverse impacts of water contamination on human and environmental populations. In reviewing exposure characterization, the reviewer will verify DOE's assessment of existing water contamination based on the distribution of contaminant concentrations in three dimensions. The reviewer will ensure that the prediction techniques (e.g., analytical, numerical, and stochastic models) provide reasonable representations of the performance of the natural system based on comparisons of these predicted results with existing water quality data and other hydrogeologic information verified under Review Element I. Based on existing and anticipated distributions of humans, wildlife, plants, and agriculture on and near the site, the reviewer will verify that the composition and characteristics of sensitive human and environmental populations have been adequately determined based on local and regional environmental surveys and comprehensive literature searches. The reviewer will determine that direct pathways for contaminant migration and population exposure have been adequately determined and appropriately represented in DOE's assessment.

If existing contamination has caused or is causing social, aesthetic, or economic impacts, the reviewer will verify that these impacts have been identified and characterized in the assessment. Should protective actions be selected for implementation under Review Element IV, the reviewer will ensure that DOE's assessment identifies and characterizes water quantity impacts caused by or associated with protective actions to prevent, control, or restore contaminated water resources. The reviewer will ensure that DOE's characterization of adverse economic, social, and aesthetic impacts is adequate with respect to relevancy, completeness, and accuracy for cost-benefit evaluations under Review Element IV.

The reviewer will confirm that DOE has adequately assessed impacts of water quantity that often accompany water contamination such as those relating to increased or decreased availability of water resources. The reviewer will ensure that those water users currently or potentially impacted by alterations in water quantity and availability have been identified and that any such impacts have been assessed adequately. The reviewer will ensure that the possibility for inequalities between water use for remedial action and existing and known future water rights and allocations have been considered. The reviewer will ensure that the probable nature and extent of such inequalities have been adequately described in DOE's assessment.

The reviewer will verify DOE's assessment of the impacts of water contamination on human health. The purpose of the health assessment is to characterize the impacts of water contamination and contaminant exposure on human health. The reviewer will generally assume that the most significant pathway for human exposure to waterborne contaminants is the consumption of drinking water, unless scoping assessments indicate other exposure pathways (e.g., dermal contact, food ingestion) may be more important. As an example of such an exception, food ingestion may be considered more significant at a site where contaminated groundwater is used for irrigation of garden vegetables, but not used for direct consumption.

Consistent with this assumption, the reviewer will classify sites into two categories: sites where contamination may affect currently potable water resources (Class A) and sites where contamination may affect water resources that are not currently useable for human consumption (Class B). For the purposes of this plan, a water resource will be classified as potable if the total dissolved solids (TDS) concentration does not exceed 3,000 mg/l in water representative of background quality. At Class A sites where the background TDS concentration in groundwater does not exceed 3,000 mg/l, the reviewer will assume that an individual withdraws groundwater from affected aquifers anywhere along the edge of the site that is hydraulically downgradient from existing contamination or stabilized tailings. Similarly, at Class A sites where the background TDS concentration in surface water is less than 3,000 mg/l, the

USING TDS AS SOLE CRITERIA ~~APPEARS ARBITRARY~~. A WATER RESOURCE MAY BE LESS THAN 3000 MG/L TDS BUT CONTAIN RA, SE OR SOME OTHER CONSTITUENT THAT RENDERS IT UNPOTABLE.

reviewer will assume that an individual withdraws and consumes water from surface water bodies hydraulically downgradient from existing contamination or stabilized tailings. Both assumptions are invoked for Class A sites for the purpose of characterizing human health impacts regardless of present or anticipated use of water resources that may be contaminated by the sites.

At Class B sites, the reviewer will review human health impacts with respect to the location(s) of the nearest, downgradient, existing or anticipated water use. The reviewer will not evaluate human health impacts at those sites where background TDS concentrations exceed 10,000 mg/l in local groundwater and surface water resources, unless such an evaluation is warranted because of existing or anticipated water uses that could directly or indirectly impact human health.

The reviewer will verify that DOE's assessments provide reasonable determinations of potential health risks to existing and anticipated human populations near the sites. The reviewer will ensure that the populations assumed in the impact assessment are representative of existing or anticipated populations, including sensitive populations (e.g., pregnant women, infants, elderly, institutionalized patients). In the absence of such sensitive populations, the reviewer will assume a standard person of 70 kilogram mass that consumes 2 liters of drinking water per day for evaluations of health impacts. The reviewer will ensure that all significant contaminants identified under Review Element I are considered in these evaluations. The reviewer will ensure that the evaluation distinguishes between contaminants that yield toxic (threshold) effects and those that yield carcinogenic (non-threshold) effects and assesses these effects on human health accordingly. Other adverse effects such as mutagenic, teratogenic, and synergistic effects should be considered if they are identified in comprehensive literature searches of existing toxicological and epidemiological information.

The reviewer will confirm that DOE's assessments of human health impacts are based on conservative assumptions and yield reasonable estimates of potential impacts of water contamination. The reviewer will also determine that

uncertainties in the assessments are identified and adequately discussed in terms of the sensitivity of estimated health impacts to these uncertainties.

Similar to the review of human health impacts, the reviewer will verify DOE's assessment of adverse impacts of water contamination on environmental populations, including terrestrial and aquatic wildlife, plants, and agricultural crops and animals. The reviewer will use the exposure pathways and contaminant concentrations verified in the exposure characterization as the basis for the assessment of environmental impacts. The reviewer will generally focus this review on comparing existing and predicted contaminant concentrations with chronic toxicity levels for plants and animals, but may also include consideration of bioaccumulation of contaminants and food web interactions based on comprehensive literature searches.

In reviewing impacts of water contamination on aquatic life, the reviewer will generally assume conservatively low estimates of dilution potential such as the 7-day 10-year low flow of streams and rivers and conservatively high estimates of groundwater discharge to receiving surface waters. Comparison of dissolved contaminant concentrations with relevant Federal and State surface water quality criteria will generally substitute for the review of detailed assessments of impacts on aquatic life, but more detailed information such as suspended contaminant migration pathways, sediment accumulation, and bioaccumulation may be needed if they are identified as being significant in comprehensive literature searches.

The reviewer will verify assessments of agricultural impacts considering both direct and indirect exposure pathways, including crop impacts, reduced productivity, and bioaccumulation of contaminants. For example, livestock may consume contaminated water and feed, as well as suffer dermal exposure during grazing. Similar to the review of aquatic impacts, the reviewer will compare reasonably conservative estimates of existing or potential contaminant concentrations with relevant Federal and State water quality criteria for agricultural uses. For constituents that are not covered by such criteria, the

reviewer will evaluate DOE's assessment of agricultural impacts based on information identified in comprehensive literature searches.

At the conclusion of the review of contamination impacts, the reviewer will ensure that hydrologic alterations affecting water quality have been adequately identified and that their effects on water users or water use areas have been adequately described. The reviewer will evaluate impacts on the basis of altered water quality, taking into account the nature of the impact, the duration when the impact will be experienced, and the number of water users or extent of water resources affected. The reviewer will confirm that adverse impacts such as contamination induced biotic changes, loss or reduction of unique habitats, and jeopardization of endangered or protected species are adequately identified and assessed. The reviewer will also confirm that the impact assessments are adequate with respect to relevancy, completeness, reliability, and accuracy of input to the assessments of the need for and implementation of protective actions for water resources.

D. Review Element III - Analysis of the Need for Protective Actions

NRC staff will review DOE's analysis of the need for protective actions to determine whether this need has been adequately and objectively analyzed. Based on the environmental impacts verified under Review Element II, the analysis of the need for protective actions should defensibly assess the probability of contaminant exposure to human and environmental populations by considering such factors as existing and anticipated local water use, existing and anticipated land use, and the distribution of environmental populations in the vicinity of sites. For the purposes of this plan, the reviewer will identify a need for protective actions when there is a reasonable probability of occurrence of significant adverse impacts on human or environmental populations.

The scope of the staff review includes (1) consideration of the nature and severity of adverse impacts of water contamination on anthropic uses of water resources for domestic, municipal, agricultural, industrial, mining, and

recreational purposes, (2) consideration of the nature and severity of adverse impacts of water contamination on environmental (non-human) populations, (3) characterization of consumptive and non-consumptive water uses in the vicinity of sites, (4) characterization of adverse impacts on humans and the environment caused by alterations in water quantity and/or quality associated with protective actions at processing and disposal sites, (5) consideration of relevant Federal, State, and local water quality standards, and (6) consideration of the availability and characteristics of alternate water resources that may be necessary to replace or supplement contaminated water resources affected by remedial actions.

The reviewer will verify that DOE's consideration of adverse impacts on human and environmental populations identified under Review Element II is reasonably complete and accurate. For each of these impacts, the reviewer will ensure that DOE has determined reasonable and conservative estimates of their probability of occurrence. The reviewer should recognize that many such estimates are difficult to establish quantitatively, so defensible qualitative determinations may be generally substituted for quantitative determinations. Examples of such qualitative determinations include reasonably likely (i.e., event has occurred in the past or available information indicates the event will occur during the stabilization period), reasonably unlikely (i.e., event has occurred in the past but will probably not occur during the period of stabilization because initial incentives for occurrence have been removed, or available information indicates that no incentives for such occurrence are currently identifiable based on foreseeable technological developments), and uncertain (i.e., available information is insufficient to develop qualitative estimates of the probability of occurrence).

In reviewing qualitative determinations of event probabilities, the reviewer will consider such factors as existing and anticipated water uses, and water quality criteria for appropriate uses. In general, the reviewer will limit consideration of water uses to existing and anticipated water uses within five kilometers of the site; existing use may include past use even though water resources are not presently being used. Anticipated water use includes only

those uses that the reviewer is reasonably sure will occur. For example, land adjacent to a site may have been purchased for crop cultivation, which will require groundwater withdrawal from a contaminated aquifer when the land is cultivated. At sites where DOE concludes water treatment is required prior to water use based on background quality alone, the reviewer will confirm DOE's assessment of the effectiveness of the treatment in protecting exposed populations.

The reviewer will also consider aquifer classifications based on EPA's Ground Water Protection Strategy (ca. August, 1984) and clarifying guidance pursuant to the Strategy. In the Strategy, Class I aquifers are defined as irreplaceable sources of drinking water or aquifers that support unique ecological environments. The reviewer will automatically conclude that there is a need for protective actions to prevent or control contamination of Class I aquifers. Class II aquifers are defined in the Strategy as current or potential sources of drinking water and water for other beneficial uses. The Strategy identifies the TDS concentration of 10,000 mg/l as an arbitrary criterion to distinguish between Class II and III aquifers. The reviewer may consider unidentified potential future uses of Class II aquifers, although such uses will not be considered for Class III aquifers unless the aquifers are currently being used.

The reviewer will partially confirm DOE's assessment of existing and anticipated water use by comparing background water quality with relevant Federal, State, and local water quality standards. When these water quality standards are inconsistent, the reviewer will give preeminent consideration to local and State standards rather than Federal standards. Appropriate water quality standards will be selected for the review based on background water quality, existing and anticipated uses, and legal considerations. For example, the reviewer will consider water quality criteria for irrigation use in comparison with background water quality if the water resource will likely be used for irrigation, but not for livestock watering or human consumption. The reviewer will verify DOE's assessment of water use based on demography of the

site vicinity, demographic projections, zoning patterns, and average and maximum projected population growth.

At sites where institutional controls may preclude existing and future water uses, the reviewer will verify that these controls will prevent exposure of human and environmental populations to contaminants and that the controls encompass the existing and conservatively projected extent of contaminated water or that portion of the contaminated water that is considered to cause significant adverse impacts on the environment. Such controls may include State and local regulations restricting water extraction, new well and intake prohibitions, and closure orders for existing wells and surface water intakes. Institutional controls may also include deed restrictions with enforceable covenants that accompany ownership of the land and subsurface rights, provided that these covenants apply to existing and future holders of the deed and rights. The reviewer will ensure that termination provisions for the deed restriction may only be executed after water contamination no longer presents a hazard to humans and the environment. The reviewer will also confirm that the restriction is accompanied by provisions for monitoring programs sufficient to determine the termination of water contamination hazards and that a durable local or State administrative agency has sufficient authority to regulate violation of the deed restriction and execute the termination provision.

After completion of the review, the reviewer will ensure that DOE has adequately analyzed the need for protective actions and that the analysis is objective and technically defensible. The reviewer will ensure that the information provided by DOE and assembled during the review is accurate, complete, relevant, reliable, and sufficient to support the analysis of the need for protective actions for water.

If DOE determines that there is no need for protective actions and the reviewer verifies this determination, then the reviewer will terminate the review with a finding that there is no need for protective actions for water resources from existing and potential contamination associated with inactive uranium processing sites and alternative disposal sites. However, if DOE decides to

implement protective actions because such a need exists or because of policy or legal considerations, the reviewer will acknowledge DOE's decision and continue the review process with Review Element IV.

E. Review Element IV

NRC staff will review DOE's analysis of potential implementation of protective actions to determine whether the analysis is adequate, objective, and technically defensible. The scope of the review includes (1) identification of a reasonable range of optimized protective actions that address the needs identified under Review Element III; (2) consideration of such factors as technical feasibility, availability of alternative supplies of water, value of potentially affected water resources, compliance with relevant regulations, and benefits and costs of protective actions; (3) selection of appropriate protective actions for water resources; and (4) evaluation of engineering designs of the selected protective actions relative to their purposes identified by DOE. Review of item (4) will be coordinated with staff reviews of construction engineering. The purpose of the design review is to ensure that DOE's selected protective actions have been accurately recorded in the Remedial Action Plan and to determine the practical extent to which these protective actions will protect water resources from existing and potential contamination.

In reviewing the analysis of potential implementation of protective actions, NRC staff will synthesize verified conclusions from Review Elements I, II, and III. In addition, the reviewer will evaluate such information as the identification of water impacts to be avoided or mitigated by the protective actions; proposed designs of the actions; consideration of the availability and characteristics of alternative water supplies; estimation of the value of water resources to be protected; identification, evaluation, and comparison of the costs and benefits of protective actions; and Federal, State, and local laws and regulations for the protection of water resources. In reviewing the potential implementation of protective actions based on this information, the

reviewer will consider the adverse impacts that should be mitigated or eliminated by protective actions as verified under Review Element III.

Based on the needs for protective actions identified under Review Element III, the reviewer will verify DOE's selection and optimization of a reasonable range of alternative protective actions. Protective actions may include any combination of actions to prevent future contamination, control and abate existing contamination, clean-up existing contamination, and restore existing contamination. The reviewer will confirm that the actions selected have been optimized to improve their efficiency and effectiveness in satisfying the needs for protective actions. The reviewer will determine that the analytical calculations performed by DOE in optimizing the designs of the protective actions provide representative approximations of the performance of the hydrogeologic system under analysis. The reviewer will also ensure that the suite of optimized protective actions represents a range of feasible alternatives independent of their costs and compliance with pertinent regulations.

After review of DOE's selection of alternative protective actions, the reviewer will verify DOE's assessment of the technical feasibility of implementing these actions. Reviews of the technical feasibility of protective actions will vary based on site-specific considerations, such as the characteristics of the affected hydrogeologic system, characteristics of the contamination problem, and the needs to protect human and environmental populations from water contamination. The reviewer will verify DOE's assessment based on hydrogeologic information evaluated under Review Element I and the optimization calculations discussed above. For example, installation of a bentonite slurry wall may be identified as an alternative protective action, but effective performance of the slurry wall depends upon the characteristics of the aquitard beneath the barrier. If a suitable aquitard does not exist beneath the proposed barrier, the reviewer would confirm DOE's conclusion that installation of the slurry wall is not technically feasible.

The reviewer will confirm DOE's assessment of availability and characteristics of alternative water supplies that may be needed to replace or supplement existing supplies. Unabated contamination from sites may affect existing water resources to the extent that they can no longer be used without incremental treatment to accommodate the contamination effects. In such situations, the reviewer will place emphasis on considering the availability and characteristics (e.g., capital and operational costs, suppliable rates, quality) of alternative water supplies. The reviewer will consider that the absence of readily available alternative water supplies on a local or regional scale increases the significance of potential contamination of existing supplies, as well as the potential value of the existing water resources.

The reviewer will verify DOE's estimation of the current and projected value of water resources that may be affected by contamination from the site. The reviewer will begin the verificatic by confirming that all potentially affected water resources are considered by DOE in estimating resource values. Based on information such as appropriated rights to water resources, costs of bottled water, availability of alternative water supplies, and projected populations, the reviewer will confirm that DOE's value estimates are reasonable and conservative in that they tend to overestimate the value of water resources to be protected. In general, the reviewer will consider that the value of potentially affected water resources may be approximated as the product of the safe yield of the potentially affected resource and the unit cost of supplied water depending on its intended purpose (e.g., cost of potable water for drinking water supplies). This resource value will be considered as a benefit in the cost-benefit evaluation.

The reviewer will confirm that DOE has committed itself to compliance with all relevant Federal, State, and local regulations and statutes in performing remedial actions under Title I of UMTRCA. The responsibility to identify and comply with all such regulations and statutes resides with DOE and not with the NRC reviewer. In general, DOE's commitment to comply should satisfy the NRC's review responsibilities, unless the reviewer is aware of other regulations and statutes that have not been specifically identified. In this case, the

reviewer will inform DOE of such regulations for DOE's consideration and compliance. Final authority for determining compliance with all such regulations and statutes resides with the agency or administrative body charged with implementing these regulatory programs (e.g., the Environmental Protection Agency for NPDES permitting).

The reviewer will confirm that DOE's assessment presents an accurate and defensible analysis of the costs and benefits of the protective actions, including those protective actions required by law or regulations outside of UMTRCA. The reviewer will confirm that DOE has identified and valued potential direct and indirect benefits of the protective actions, including human health, environmental, aesthetic, economical, and social benefits. The reviewer will also confirm that DOE has accurately characterized the costs associated with alternative protective actions that have been optimized for maximum effectiveness in protecting humans and the environment. The reviewer will consider costs such as capital costs for implementation, operation and maintenance costs for continued operation, and depreciation and discount modifications to projected costs. The reviewer will evaluate the assessment methodology and costing assumptions used by DOE to estimate costs for alternative protective actions. The reviewer will confirm that benefit-cost factors are duly considered in DOE's selection of preferred actions. If protective actions cannot be identified to reduce environmental impacts for a reasonable expense and the actions are not required by law, the reviewer will recommend that the impact be accepted without mitigating protective actions and that the impact be unequivocally acknowledged in DOE's Remedial Action Plan.

Based on considerations of technical feasibility, regulatory compliance, availability of alternative water supplies, and costs and benefits of protective actions, the reviewer will verify DOE's selection of protective actions to implement. These protective actions may range from no action to restoration of existing contamination and effective prevention of future contamination, including provisions for institutional control of contaminated water resources. The scope of the review will vary based on DOE's selection of protective actions, the characteristics of the affected hydrogeologic system,

and the needs for protective actions. For example, DOE may decide to construct a slurry wall, in which case the reviewer would confirm DOE's design with respect to compatibility of the slurry wall with anticipated geochemical conditions, barrier wall composition and mixture ratios, design specifications, methods of determining the walls effectiveness, method of trench excavation and wall construction, contact with adjacent aquitards, hydraulic properties and geochemical characteristics, and projected changes in the hydrogeologic system caused by wall construction. For an aquifer restoration program, the reviewer would confirm such design aspects as the characteristics of surface treatments, installation and construction of withdrawal and injection wells, projected performance of the restoration system, pumping rates and locations, disposal source for treatment wastes (both solid and liquid), characteristics of treatment wastes, methods of determining system effectiveness, and duration of system operation. The reviewer will determine that the design complies with state-of-the-art practices in designing and implementing protective actions for water resources based on existing literature.

The reviewer will confirm that the protective actions selected by DOE to protect water resources can achieve practical levels of mitigation. This confirmation includes verification by the reviewer that (1) each action is reasonable (i.e., involves methods and techniques that are appropriate and achievable on a site-specific basis), and (2) the actions are specific, unambiguous, and designed such that their implementation and the results of their implementation can be verified through subsequent field reviews, inspections, and characterizations.

When adverse impacts are identified for which no protective actions have been selected, the reviewer will verify that there are no actions that could be appropriately recommended for consideration in the Remedial Action Plan. If protective actions can be identified, designed, and practically implemented to protect water resources, but have not been identified or selected by DOE, the reviewer will recommend that such actions be considered prior to concurrence with the Remedial Action Plan.

If DOE concludes, after due consideration of the factors listed under this review element that protective actions for water resources are not appropriate under Title I of UMTRCA, the reviewer will concur with this conclusion or indicate deficiencies in the conclusion. When DOE selects designs for protective actions for water resources, the reviewer will confirm that the actions are reasonable, that with effective implementation the actions have a reasonable probability of achieving their stated objectives, and that the actions have been accurately and unambiguously included in the Remedial Action Plan for designated uranium processing sites.

IV. Evaluation Findings

At the conclusion of the review, the reviewer will determine if DOE's proposed actions to protect water resources ~~comply with reasonable assurance~~ are in accordance with EPA's guidance in Subpart C of 40 CFR Part 192. If DOE's hydrogeologic assessments satisfy the review criteria and procedures under each of the four review elements in this plan, the reviewer will conclude that DOE has provided reasonable assurance of compliance with the EPA standards for protection of water resources. Based on this conclusion, the reviewer will recommend that NRC concur with DOE's Remedial Action Plan with respect to water resources protection. However, if the reviewer concludes that the review elements have not been satisfied, then the reviewer will document the specific reasons why DOE's assessment has not demonstrated compliance with the EPA standards. This documentation will be in the form of official comments to DOE that identify the inadequacies of DOE's assessment, specify the technical basis for the reviewer's conclusions, and describe alternative approaches to resolve the inadequacies.

During the review, the reviewer will document his/her conclusions and the bases for these conclusions in the form of a Technical Evaluation Memorandum (TEM). The Water Resources Protection TEM will be prepared in draft form subsequent to the review of DOE's Draft Remedial Action Plan and then finalized when NRC concurs with DOE's selection of remedial actions for designated processing sites. Consistent with the four review elements in this plan, the reviewer will conclude the following before recommending complete

concurrence with DOE's Remedial Action Plan:

1. Processing and disposal sites have been adequately characterized, including characterization of the uranium processing facility, anthropic activities and natural processes in the vicinity of the site(s), background water quality, rate and direction of contaminated water flow, and extent of existing water contamination;

2. Human health and environmental impacts caused by water contamination at processing and disposal sites have been adequately identified and characterized;

3. The need for protective actions for water resources at processing and disposal sites has been adequately identified and assessed; and

4. Potential implementation of protective actions for water resources has been adequately evaluated and protective actions that have been selected for implementation have been appropriately described in the Remedial Action Plan.

Based on these four conclusions, the reviewer will conclude the Water Resources Protection TEM with a statement that DOE's proposed remedial actions comply with reasonable assurance with the EPA standards in 40 CFR Part 192. In addition to this paramount conclusion, the TEM will identify aspects of the review that were emphasized, deviations of the review from the review criteria and procedures detailed in this plan, justifications for these deviations, and a list of unresolved issues that require confirmatory assessments at the conclusion of the water resources review.

V. References

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