STATE OF MISSOURI Mel Carnahan, Governor • David A. Shorr, Director

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL QUALITY

P.O. Box 176 Jefferson City, MO 65102-0176

August 7, 1997

Ms. Karen A. Reed
Department of Energy
Oak Ridge Operations
Weldon Spring Site Remedial Action Project
7295 Highway 94 South
St. Charles, Mo. 63304

RE: (1) Draft Proposed Plan for Remedial Action at Quarry Residuals Operable Unit of the Weldon Spring Site, June 1997

(2) Draft Feasibility Study for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site Weldon Spring Missouri, June 1997

Dear Ms. Reed:

The Missouri Department of Natural Resources has reviewed the above referenced documents and provides comments on each with the enclosures Attachments A and B. The Attachments are divided into two categories with Attachment A, General Comments, containing major issues and Attachment B, Specific Comments, containing specific comment on the referenced documents. Of major concern is the issue of protectiveness of the proposed alternative to human health and the environment. It is recognized that the "No Action Alternative" is a required consideration in the Superfund process, but that this serves as a baseline. However, neither the "No Action" or the "No Active Remediation with Monitoring," adequately address containment or mitigation of the contaminant levels that would meet ARARs or provide protection from further contaminant migration.

Alternative 4, as shown in the Feasibility Study, coupled with monitoring does appear to be potentially capable of meeting a containment performance level. However, the long term effectiveness and assurances that the St. Charles County water supply well field would be protected is not sufficiently justified. Similarly, Alternative 5 may achieve the appropriate level of protectiveness provided that demonstrated pilot scale studies are performed.

Alternative 3 does provide an active remediation with a proven technology, easily implementable that can meet the minimum containment requirement described in 40 CFR 300.430 (a) and could also meet the treatment preference. Based on the data collected in the Remedial Investigation, the lack of sufficient understanding of geochemistry, reduction zone definition, and contaminant transport, the interceptor trench and water treatment is the only

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reasonable action that meets the National Contingency Plan (NCP), Section 300.430(f).

Another remedial alternative that this office has suggested over the past several months is the installation of an extraction well through the sump area of the Quarry to an appropriate depth. This pump could serve to reverse the hydraulic gradient, thereby halting any further migration of the plume. This scenario did occur through natural causes during the 1993 flood and is documented in monitoring wells and sump level measurements at that time.

The additional information on the remaining volume of contaminants (yellow cake) in the cracks and crevices of the Quarry is needed to understand how this source will continue to feed the contaminant plume in the groundwater. This is a data gap that needs to be filled preferably during the feasibility study, and if not now, certainly during any further characterization efforts associated with a remedial action design.

With regard to the suggested position that a Technical Impracticability (T.I.) Waiver is applicable, this office as well as EPA policy and interpretation papers, hold that a T.I. should only be considered after an interim or full-scale remediation system is implemented and proves unsuccessful. Further, the cost issue plays a subordinate role when considering a decision for this option.

In summary, the draft proposed plan that has "No Active Remediation with Monitoring" as the preferred alternative is unacceptable. We would however, support an alternative that uses active remediation and achieves a measurable performance goal. The potential threat to the St. Charles County well field has to be adequately addressed. This office looks forward to working with the Department of Energy on resolution of the concerns and issues of this of the Quarry Residuals operable unit. Please contact Robert Stovall, at (573) 526-2736, if you have any questions or need clarification.

Sincerely,

HAZARDOUS WASTE PROGRAM

Larry Erickson, P.E.
Chief, DOE Unit
Federal Facilities Section

LE:rsg

Attachments

c: Dan Wall, EPA Region VII
St. Charles Citizens Commission

Attachment A
General Comments on the Proposed Plan and Feasibility Study
Quarry Residuals Operable Unit
Missouri Department of Natural Resources

RE: Review/Comment on *Proposed Plan for Remedial Action at Quarry Residuals Operable Unit of the Weldon Spring Site, June 1997*

General Comments

A. Proposed Remedial Action Alternatives

Two alternatives have been proposed for remediation of the quarry area. The first alternative is "No Action" which is to be used as a baseline. On a technical basis, the Missouri Department of Natural Resources, Hazardous Waste Program, would not accept a "no action alternative." The Department of Energy has proposed a second alternative which is "No Active Remediation with Monitoring." The primary technical concern with the second alternative is it does nothing to mitigate the concentration of radionuclides, primarily Uranium, and nitroaromatics in the groundwater or surface water. The primary mass transport mechanism to lower the concentration of Uranium to the proposed 30 pCi/l level is by dilution only.

B. Technical Concerns with Alternative Two "No Active Remediation with Monitoring Only"

The "No Active Remediation with Monitoring Only" proposal presented by the Department of Energy as the remediation method for the Quarry Residuals Operable Unit does not provide adequate protection to human health and the environment. There are too many unknowns regarding natural attenuation processes. Most metals, including Uranium, do not naturally attenuate in the environment. Previous data from the Remedial Investigation indicated that Uranium from the quarry may be migrating towards the St. Charles well field from south of the slough. The Department of Energy has stated that Uranium concentrations would be attenuated by reacting with iron or manganese hydroxides. It is difficult to prove that such attenuation would occur because this mechanism is dependent upon E_b (Specific Conductance) and to some extent pH. Reducing conditions in the slough area may actually mobilize Uranium as a contaminant because UO_2^{-2} ionic species is highly mobile in water as an ionic complex with carbonate. Migration of this ionic species in conjunction with colloidal particles in the groundwater is possible. The Remedial Investigation does not provide data to characterize that a reduction zone exits and the location of a reduction zone.

Treatment or containment of the contaminated ground water should be implemented to protect the St. Charles County well field, a major drinking water source.

RE: Review/Comment on Feasibility Study for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri, June 1997

General Comments

A. Alternative 2, No Active Remediation with Monitoring Only

Alternative 2 would provide for routine sampling of the groundwater for the contaminants of concern. However, the frequency of taking samples is not identified. The term "indefinite time frame" for monitoring is stated with no limit on the period for monitoring of the contaminants. Alternative 2 uses natural attenuation to attempt to lower the concentration of the contaminants, particularly Uranium. This alternative does not mitigate the migration of contamination of the contaminants toward the St. Charles well field. The primary contaminants are nitroaromatics, Uranium, thorium, radium-226, radium-228, and metals. This alternative provides for monitoring of the groundwater but provides no mechanism for cleanup.

The Department of Energy contends this alternative would reduce the toxicity and mobility of the contaminants of concern, primarily Uranium. The Department of Energy has proposed the following contingency measures with no indication of implementation of a time line in the event residual contamination would result in unacceptable concentrations in the St. Charles well fields:

- Develop an alternative water supply to the public
- Move the public drinking wells up stream away from the contaminant plume
- Install groundwater extraction and treatment facilities at a location south of Femme Osage Slough

This alternative does not comply with the requirements of the Department of Energy Order 5400.5 regarding protection of a public drinking water supply which is equivalent to the equivalent [protection] provided to the public by a public community drinking water standard in accordance with 40 CFR Part 141.

B. Federal Facilities Section's Position Regarding the Proposed Alternatives.

The alternative of "No Active Remediation with Monitoring Only" proposed by the Department of Energy does not adequately protect human health and the environment. On a technical basis natural attenuation is inadequate in protecting human health and the environment for the following reasons:

(1) Part of the natural attenuation process is strictly dilution of the concentration of the contaminants of concern. Dilution is the primary mechanism for reduction of the Uranium concentrations from 2800 pCi/l to 30 pCi/l proposed as an ARAR. Under the proposed remediation strategy, part of this dilution would take place if groundwater from the quarry were to mix with groundwater from the St. Charles well field.

(2) Natural attenuation does not mitigate or reduce the levels of the contaminants of concern to risk levels protective to human health and the environment. There are too many unknowns regarding the mechanisms for the natural attenuation processes cited here and the data from the Remedial Investigation for the Quarry Residuals Operable Unit does not adequately support that natural attenuation is actually occurring.

The data presented in the Remedial Investigation for the Quarry Residuals Operable Unit does not support this alterative and is inconclusive. The assumptions that redox potentials, E_h (specific conductance) and the mechanism of sorption of Uranium to the proposed 30 pCi/l concentration is not supported by hard data.

Other concerns are the 30 pCi/l ARAR in accordance with 40 CFR 192 proposed for the Uranium concentration in the groundwater, protective of human health, and whether lower levels should be considered as an ARAR because the point of compliance is not stated. It is extremely difficult to support the DOE position on this alterative without hard data to demonstrate that natural attenuation would effectively reduce contaminant levels below MCL limits for potential drinking water sources and also be protective to aquatic life. The EPA believes in accordance with 40 CFR 264 that remediation levels should generally be attained throughout the contaminated plume, or at and beyond the edge of the waste management area when the waste is left in place. This position is stated in Subchapter S 40 CFR 264, *"Potentially drinkable groundwater would be cleaned up to levels safe for drinking throughout the contaminated plume ...."*

However, the EPA acknowledges that an alternative point of compliance may be protective of human health and the environment under site specific circumstances. In determining where to draw the point of compliance in such situations, the lead agency will consider factors such as the proximity of the sources, the technical practicability of groundwater remediation at the specific site, the vulnerability of the groundwater, its possible uses, the likelihood of exposure, and similar considerations.

Refer to **40 CFR 300.430 (f) (5) (iii) (A),** that the point of compliance for groundwater cleanup standards is at the appropriate locations in the groundwater. Also, **40 CFR Section 264.95, Point of Compliance,** states , *"The point of compliance is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units."*

The third alternative provided by the Department of Energy appears to be technically suitable in treating the contaminants of concern to levels which would be protective to human health and the environment. This alternative provides for collection of groundwater in an interceptor trench system and treatment of the groundwater in the Quarry Water Treatment Plant prior to discharge, along with monitoring to assess the effectiveness of the plan. This treatment technology was rejected primarily on the basis of cost, is already proven, and should not be dismissed on the useful life of QWTP equipment and cost considerations.

C. Applicable ARARs (ARARs=Applicable or Relevant & Appropriate Requirements)

The applicable ARARs to this alternative are the following:

Achieve a concentration of 30 pCi/l for the Uranium concentration in the groundwater which corresponds to a risk level of 10^{-5} in accordance with the Safe Drinking Water Act 40 CFR 141.11.

Safe Drinking Water Act MCLs would be applicable in accordance with 40 CFR 141.11 and 141.62. Missouri Drinking Water Regulations 10 CSR 60-4.030 would also be applicable, particularly for the MCL for Nitrate of 10 mg/l.

Regulation 40 CFR 192 may be applicable. This regulation is for Groundwater Standards for Remedial Action at Inactive Uranium Processing Sites. 40 CFR 192 Subparts A & B would be applicable as well as 40 CFR 192 Subpart C and Section 192.21. The Uranium present in the groundwater is the result of Uranium processing. Thus, the applicability of this ARAR here.

The Missouri Water Quality Standard 10 CSR 20-7.031(5) would be considered potentially applicable for nitrates and nitroaromatics. Water contaminants shall not cause or contribute to accedence of the following levels in aquifers. These criteria apply in part of the aquifer, including the point at which the pollutant enters the aquifer. Where potential uses are not impaired, alternative site specific criteria may be allowed. Those values listed as health advisory levels (as indicated below by an asterisk [*]) shall be used in establishing groundwater cleanup criteria until additional data becomes available to support alternative criteria or other standards are established. The following table provides the target limits:

Contaminant	Limits
Nitrate-N	10 mg/L
Nitrobenzene	17 ug/L
2,4-Dinitrotoluene	0.11 ug/L
1,3-Dinitrobenzene	1.0 ug/L*

The Safe Drinking Water Act 40 CFR 141, with a proposed MCL for Uranium of 20ug/l which approximately equal 30 pCi/l, would be an applicable or relevant and appropriate requirement.

State of Missouri Drinking Water Regulations 10 CSR 60-4.060 (1) (A), Maximum Radionuclide Contaminant Levels and Monitoring Requirements would be applicable to a potential drinking water source. This section states *"For radium 226, radium 228 and gross alpha particle radioactivity the maximum contaminant level (MCL) shall be— (A) Combining radium 226 and radium 228 five picocurie (5 pCi/l)."*

For groundwater remedial actions, CERCLA 121(d), states that a remedial action will attain a level or standard of control established under the Safe Drinking Water Act where such a level or standard of control is applicable or relevant, and appropriate to any hazardous substance, pollutant, or contaminant that will remain on-site.

Section 121(d) of CERCLA, also applies to the attainment of maximum contaminant level goals or MCLGs. MCLGs are relevant and appropriate requirements in accordance with 40 CFR 300.430 (e) (B) p 59, which states *"Maximum contaminant level goals (MCLGs) established under the Safe Drinking Water Act that are set at levels above zero, shall be attained by remedial actions for ground or surface waters that are current or potential sources of drinking water..."*

In accordance with CERCLA Section 121 (d) (2) (B) (ii), an ACL or alternate concentration level limit may be used provided action restoration of the groundwater to MCLs or non-zero MCLs is not practicable. CERCLA 121(d) (20)B (ii) states the use of ACLs is restricted to groundwater that discharges to nearby surface water and causes no statistically significant increase in the contaminants in the surface water. ACLs would only be ARARs if the groundwater could not be restored to MCLs for the contaminants of concern and only relevant and appropriate if the groundwater were to discharge to surface water and cause no significant increase in the contaminants in the surface water.

In accordance with 40 CFR 300.430(F) (5) (iii) (A), the point of compliance for groundwater cleanup standards is at appropriate locations in the groundwater. Alternative 2 proposed by the Department of Energy does not provide a point of compliance. In accordance with CFR 300.430(F) (5) (iii) (A), what would be the point of compliance for Alternative 2, No Active Remediation with Monitoring Only?

Furthermore the Preamble to Subpart S of 40 CFR 264 states:

"Potentially drinkable groundwater would be cleaned up to levels safe for drinking throughout the contaminated plume regardless of whether the water was in fact consumed. Alternative levels protective of the environment and safe for other uses could be established for groundwater which is not an actual or reasonably expected source of drinking water." Also, quoted from EPA Guidance document, Publication 9234.2-25, "Guidance for Evaluating the Technical Impracticability of Groundwater Restoration."

Subpart S 40 CFR, Section 264, (b) (3), states that *"the CAMU shall include uncontaminated areas of the facility only if including such areas for the purpose of managing remediation of waste is more protective than management of wastes at contaminated areas of the facility,"* (page 273) The term CAMU means, Corrective Action Management Unit as designated by the EPA Regional Administrator. For the protection of human health this subpart and section would be an ARAR.

D. Discussion of the Other Proposed Alternatives

Alternative 1: No Action

The no action alternative is used as a baseline and is by definition a zero cost and zero protection alternative.

The first alternative is a "no action alternative." This alternative is not protective to human health and the environment. "No action" does not comply with the ARAR for standard levels of Uranium in the groundwater in accordance with 40 CFR 192. The concentration of nitroaromatic compounds, 2,4-dinitrotoluene, nitrobenzene, and 1,3-dinitrobenzene exceed Missouri maximum contaminant levels.

Alternative 3: Treatment via Groundwater Removal with On Site Treatment.

Under the third proposed alternative, interceptor trenches would be used to remove groundwater from the aquifer and treated at the Quarry Water Treatment Plant or similar facility, and then discharged [into the Missouri River] to meet the proposed Uranium limit of 30 pCi/l.

The alternative proposed here is to construct an interceptor trench 30 feet in depth and 2000 feet long northeast of the Femme Osage Slough. The groundwater would be collected and extracted from the trench at a rate of 30 gpm to 50 gpm.

This alternative would be protective to human health and the environment depending upon the ability of the proposed treatment process to achieve the 30 pCi/l criteria for Uranium. The Quarry Water Treatment Plant has met this discharge level.

Implementation of this alternative should not present any technical difficulties. Construction of the interceptor trench would entail some difficulty during excavation of the trench to a depth of thirty feet. The treatment technology proposed in this alternative for treatment is known technology and is considered low risk. This alternative reduces the toxicity and mobility of all the contaminants of concern and is effective.

Alternative 4: Containment

The fourth alternative is containment by installation of a lateral barrier to contain the contaminated groundwater preventing migration of the contaminants of concern to the St. Charles well field. The barrier would use a vertical slurry wall consisting of bentonite. The slurry wall would be two to three feet into the bed rock, 2000 feet in length, and with a total depth of nine feet. The design hydraulic conductivity is 10^{-6} cm/sec. This alternative only provides containment of the contaminants but does not remediate them to levels which would be protective to human health and the environment.

The Department of Energy believes this alternative also provides a reduction in the risk to human health put provides no risk level for this alternative.

The Department of Energy and Argonne National Laboratories did not consider hydraulic containment as a containment strategy. Hydraulic containment with injection wells and pumping wells is a known technology for containment of contaminant migration in groundwater.

Alternative 5: In-Situ Treatment Using Permeable Barriers

This alternative provides for in-situ treatment using a permeable barrier. This alternative is essentially an adsorption bed to adsorb the contaminants into a solid media. Proposed sorbents include clinoptilolite, fly ash, and peat moss as adsorbent material. This alternative appears to be technically feasible but replacement of the adsorbent would be necessary once the adsorption capacity of the clinoptilolite bed is exhausted. No break through calculation has been provided.

The in-situ treatment method proposed by the Department of Energy would be to use a barrier of clinoptilolite for sorption of Uranium to achieve the 30 pCi/l concentration proposed as ARAR. The Department of Energy believes this alternative is protective to human health and the environment. Sorption of Uranium onto clinoptilolite is a function of the adsorption capacity of this material. No data has been provided to demonstrate that clinoptilolite can reduce Uranium concentrations to 30 pCi/l or less.

Implementation of this alternative would be moderate or high risk because only five full scale in-situ treatment zones have been installed. No commercial application of this technology is available.

E. General Comments Continued: Technical Impracticability
(from EPA Guidance Document, 9234.2-25, dated September 1993)

The primary consideration for technical impracticability are engineering feasibility and reliability. Technical Impracticability waivers would be applicable only to ARARs that are used to establish cleanup performance standards or levels, such as chemical specific MCLs or state groundwater quality criteria.

A waiver of Technical Impracticability from an Engineering Perspective by the EPA would focus on the technical capability of achieving the clean up level with cost playing a subordinate role. Furthermore, the NCP preamble states that TI demonstration should be based on the following:

"....engineering feasibility and reliability, with cost generally not a major factor unless compliance would be inordinately costly."

The EPA believes that Technical Impracticability decisions should be made only after interim or full-scale aquifer remediation systems are implemented because it is often difficult to predict the effectiveness of remedies based upon limited site characterization data alone. Nevertheless, the presence of known remediation constraints such as DNAPLs (Dense Non-Aqueous Phase Liquids) fractured bedrock or other conditions are not by themselves sufficient to justify a Technical Impracticability waiver.

Therefore, an attempt at remediation of the groundwater in the aquifer would be necessary prior to the EPA granting a Technical Impracticability waiver. A demonstration must be made that the remediation is "technically impracticable." The components for a proposed Technical Impracticability wavier would include the following criteria:

1. Specific ARARs or media clean up standards for which a Technical Impracticability determination would be sought.

2. The area (spatial) over which the Technical Impracticability decision by the EPA would apply.

3. The conceptual model that describes the site geology, hydrology, groundwater contaminants sources, transport and fate.

4. An evaluation potential for restoration of the site including data and analysis that support any assertion that attainment of the ARARs or media cleanup standards is technically impracticable from an engineering perspective. This evaluation should include the following components:

a.) A demonstration that contamination sources have been identified and have been, or will be, removed and contained to the extent practicable.

b.) An analysis of the performance of any ongoing or completed remedial action.

c.) Predictive analysis of the time frame to attain required cleanup levels using available technologies; and

d.) A [field] demonstration that no other remedial technologies (conventional or innovative) could reliably, logically, or feasibly, attain the cleanup levels at the site within a reasonable time frame.

e.) Estimates of the cost of existing or proposed remedy options including construction, operations, and maintenance costs.

A Technical Impracticability waiver should not be a "blanket waiver" not to clean up the contaminants of concern at a site to meet the ARARs. The EPA will consider the technical feasibility for restoring some of the contaminants present in the groundwater and the potential advantages of attaining cleanup levels for some of the contaminants.

Restoration of contamination sources is critical to the success of aquifer restoration efforts. A demonstration that groundwater restoration is technically impracticable generally should be accompanied by a demonstration that contamination sources have been, or will be, identified or treated to the extent practicable.

If complete source removal or treatment is impracticable, use of migration control or containment measures should be considered. Physical and hydraulic barriers are proven technologies that are capable of limiting or preventing further contaminant migration from the source area.

The EPA will base Technical Impracticability decisions on an overall demonstration of the extent of such physical constraints at a site, not on restoration time frame analysis alone.

The EPA would require a demonstration that groundwater restoration is technically impracticable and this demonstration should provide evidence that contamination sources have been, or will be, identified and removed to the extent practicable. The use of migration control or containment measures should be considered when source removal or treatment is impracticable.

The EPA would reserve the right to require treatability or pilot testing to determine the actual effectiveness of a technology at a particular site. Treatability and pilot testing should be conducted with rigorous control and mass balance constraints. The EPA would consider pilot testing as part of the Technical Impracticability evaluation process.

In accordance with CERCLA any proposed remedial strategy implemented under a Technical Impracticability waiver must be protective to human health and the environment.

F. Characterization of Trichloroethylene Contamination

The Department of Energy needs to characterize the vertical and horizontal extent of migration of contaminants trichloroethylene and tetrachloroethylene for the Quarry Residual Operable Unit. The areas requiring characterization for these compounds would be north of the quarry, south of the quarry, between the quarry proper and the Femme Osage Slough, and south of the Femme Osage Slough.

Other Feasibility Study General Comments:

G. Reliance upon the natural processes (Preferred Alternative 2 - "No Active Remediation with Monitoring") of absorption, adsorption, precipitation, biodegradation, and other natural processes to reduce the uranium concentration from an average of 2,800 pCi/l to 30 pCi/l is questionable. It is stated on page 2-5 of the Feasibility Study (FS) that while there has been a reduction in the concentration of nitroaromatics since the completion of bulk waste removal from the quarry, the concentration of uranium has not decreased. This information does not support Alternative 2, which assumes that the concentration of uranium will be reduced by the aforementioned natural processes. Any additional information the DOE has that indicates the length of time that may be required for a significant reduction in uranium concentrations should be made available.

H. DOE's dismissal of one of the nine evaluation criteria (reduction of toxicity, mobility, and volume) as inapplicable because of the fact that treatment has not been proposed as one of the final alternatives seems appropriate.

I. Any of the proposed treatment technologies which involve injection of material into the aquifer would require a permit from DNR/DEQ-Water Pollution Control Program.

Attachment B
Specific Comments on the Proposed Plan and Feasibility Study
Quarry Residuals Operable Unit
Missouri Department of Natural Resources

RE: Review/Comment on Proposed Plan for Remedial Action at Quarry Residuals Operable Unit of the Weldon Spring Site, June 1997

Specific Comments on the Proposed Plan:

1. **Page 1, first paragraph**, define the terminology "groundwater in the quarry area." Please clarify if only the groundwater directly below the physical quarry is considered as part of the QROU. The Missouri Department of Health believes that to protect individuals from possible adverse health effects related to the site, all contaminated groundwater (including waters downgradient of the quarry which may be affected as a result of the disposal activities from the DOD and the DOE should be included).

2. **Page 1, last bullet,** please include "record of decision" in this statement.

3. **Page 4, fourth paragraph,** although the quarry pond is technically isolated from the immediately-surrounding surface water system, it directly contributes and interacts with the regional groundwater system, which in turn affects surface water systems downgradient.

4. **Page 6, first sentence,** states that"fine-grained deposits comprise the full thickness of the Little Femme Osage Creek and Femme Osage Creek alluvium." Deposits in these creeks are not exclusively fine-grained and range in size and distribution according to previous reports.

5. **Page 6, second paragraph, last sentence**, the text states that contact between the Kimmswick Limestone and the Decorah Group may provide the primary pathways for migration of contaminants from the quarry area. Concentrations of contaminants have been detected in the Plattin Limestone and this pathway should be considered.

6. **Page 6, Section 2.1.2 , Hydrogeology,** the first sentence refers to groundwater in the vicinity of the quarry in sandstone (among other strata). Please indicate what formation this sandstone belongs to.

Section 2.1.2, Hydrogeology, page 2-6, paragraph 2

7. The description of the alluvium in the RI and the Proposed Plan is not consistent. The differentiation between the two types of alluvium, tributary, and Missouri River alluvium is emphatic in the RI. The Proposed Plan however, identifies all the alluvium from the quarry bluff to the river as Missouri River alluvium.

Section 2.1.2, Hydrogeology, page 2-6, paragraph 4

8. Two pumping ranges for the St. Charles County wells are provided. The usual pumping rate is listed as 145 to 150 gpm, but a range of 2,300 to 2,400 gpm is not specifically described. Please explain whether this is the maximum pumping rate.

Page 8, Section 2.1.4.1, Residual Soil

9. What were the concentrations of the soils for Lead-210 and Thorium-228?

10. Page 8, first paragraph, the text states that contaminated groundwater is present primarily north of the slough. Please include that contaminated groundwater is present south of the slough as well.

11. Page 8, last paragraph, the text states that low levels of uranium are sorbed onto undisturbed soils between the quarry and the slough. Please clarify the meaning of "undisturbed."

12. Page 8, last sentence, the test describes that certain contaminants were found in the upper five foot level. Please include where these contaminants were found.

Section 2.1.4, Nature and Extent of Contamination, page 8, and title of Section 2.1.4.1., page 8.

13. The term "residual soil" is incorrectly used to identify all the soil types in the quarry area. Alluvial soils are also present in the quarry area and are included in the discussions in these sections.

Page 9, Section 2.1.4.2, Femme Osage Slough and Creeks, paragraph 3, first sentence

14. What is meant by the term low-level for the contaminants of concern?

15. Page 9, first sentence, the text mentions that surface water samples in the upper and lower slough show similar contaminant profiles. Please include a justification or reference for this statement.

16. Page 9, sections of third and fourth paragraphs are duplications. Please correct.

Page 10, Section 2.1.4.3, Groundwater

17. The preliminary draft of this document cited a concentration of 0.10 ppb for nitroaromatics detected in six wells. Why was this concentration level deleted from this document?

18. Page 10, in Section 2.1.4.3, Groundwater, second paragraph, the text mentions that contamination is primarily north of the slough. Please include the presence of contamination south of the slough in this section.

19. Page 11, Section 3.1 Human Health, although DOE's position that the recreational visitor is the most likely scenario, potential risk to current and future residents in the St. Charles area and from the possibility of contaminant migration to the well field is of great concern. The Missouri Department of Health believes that the residential scenario should be considered with greater significance than what has been presented in this document.

Page 12, Section 3.1, Human Health

20. The risk number of 5×10^{-7} cited here for chemical carcinogenic risk does not correspond to the value for the chemical carcinogenic risk of 4×10^{-6} cited in the preliminary draft. The risk numbers cited in this revision of the document does not address the risk associated with a human receptor ingesting the groundwater. Why have the risk numbers been changed here?

The risk calculations presented here do not address a reasonable maximum exposure for a human receptor as a potential resident (i.e. residential scenario).

Page 12 and 13

21. The text in the first paragraph on page 12 states that aluminum, barium, manganese, and Uranium in the surface water in the Femme Osage Slough and Little Femme Osage Creek were identified as posing a moderate or extreme potential risk to aquatic biota. However, on page 13, last paragraph, the text states that "on the basis of the absence of any observable adverse effects to aquatic or terrestrial biota the current levels of contamination do not pose a future risk to biota at the site." Thus, remediation is not indicated. These two excerpts are contradictory. Please clarify.

Page 13, Section 3.2, Ecological Assessment, paragraph 2

22. Here it is stated that tissue samples of fish and small mammals had Uranium concentrations with in the range reported in the literature at which no adverse effects had been observed. The biouptake of radium is not considered and radium appears to bioaccumulate easier than Uranium. (Refer to the Remedial Investigation for the details)

Page 13, Section 3.3, Objectives of the Feasibility Study

23. The FS should also identify the procedures and technology which would effectively eliminate potential exposure to nitroaromatics and the other contaminants of concern in the groundwater.

24. Page 13, Section 3.3, first sentence states that the focus and the main objective of the FS are the identification of engineering options to reduce or remove uranium from groundwater. This is not totally correct. The Quarry Residuals Operable Unit also incorporates the residuals (including soils, sediment, etc.) left behind, i.e. remaining contamination in the northeast corner of the quarry.

25. **Page 13, Section 3.3,** last sentence refers to the remaining components of the Quarry Residuals Operable Unit have been determined not to require remediation. Please include justification for this determination and present whether everything in the quarry proper has been fully characterized. Also indicate which stakeholders had input into this decision and explain the the contradiction between this assumption and the risk found for aquatic biota as noted above.

Page 14, Section 3.3, Objectives of the Feasibility Study, Paragraph 3

26. The statement here regarding surmised migration of Uranium towards the existing county well field is not correct. Monitoring well RMW-2 had already detected Uranium which would indicate that migration of Uranium towards the well field is occurring. As stated in the letter to K. Reed of the Department of Energy on June 13, 1997, the Remedial Investigation is not complete regarding this aspect.

27. **Page 14, third paragraph,** the text notes that migration of Uranium is possible and that impact has not been indicated from monitoring wells south of the slough. Previous documents have indicated at least two wells have shown Uranium levels are at or slightly above background levels. This statement should be qualified.

28. **Page 14, Section 3.4,** please include the reason why the purpose of identifying a goal has been chosen as "lessening the potential for migration of Uranium to the St. Charles County well field" rather than "reducing the Uranium concentration."

Page 15, Section 3.4, Remediation Goals for Groundwater at the Quarry Area, Paragraph 2

29. This paragraph does not address applicable, relevant, and appropriate requirements for the other contaminants of concern, particularly nitroamatics and 2,4-dinitrotoluene.

Page 15, Section 3.4, Remediation Goals for Groundwater at the Quarry Area, Paragraph 3

30. This paragraph does not address the risks associated with the other contaminants of concern, particularly nitroaromatics and 2,4-dinitrotoluene.

31. **Page 15 third paragraph,** the remediation goal is to lessen the potential for migration. Please indicate why in this document the discussion is centered on reducing Uranium concentrations.

Page 15, Section 3.4, Remediation Goals for Groundwater at the Quarry Area, Paragraph 4

32. Does the risk number of 10^{-5} stated for both carcinogenic and systemic effects of Uranium consider the exposure risk of a human receptor to the other radionuclides present, particularly radium-226, and radium 228?

Page 16, Section 4, Summary of the Preliminary Alternatives, Paragraph 2.

33. The No Action Alternative #1 is not protective to human health and the environment and it should be stated here.

Page 16, Section 4, Summary of the Preliminary Alternatives, Paragraph 3

34. The alternative of No Active Remediation with Monitoring does not reduce the concentration of the contaminants of concern via natural attenuation. The concentrations of the metals, lead, silver, chromium, and zinc will not be reduced by natural attenuation. The concentration of Uranium and the other radionuclides contaminants will also not be reduced by natural attenuation. The nitroaromatics may be reduced by natural attenuation, however, the Remedial Investigation document provides no technical evidence that this process would occur here.

This alternative is not protective to human health and the environment because the contaminants of concern can not be mitigated to levels which would be protective.

35. What is the depth of the proposed interceptor trench?

Section 4, Summary of Preliminary Alternatives, page 16, Paragraph 4.

36. The intent of Alternative 3 was presumed to prevent the migration of contaminated groundwater to the St. Charles County well field with an interceptor trench. It is stated at the end of this paragraph that the purpose of this alternative is to contain any potential migration of contaminants to the slough. The slough has already been impacted by contaminated groundwater. Please explain.

Page 17, Section 4, Summary of the Preliminary Alternatives, Paragraph 1

37. What is the depth of the slurry wall?

38. What is meant by "minimal leakage potential" and what is the rate in GPM or GPM/sq feet?

Page 17, Section 4, Summary of the Preliminary Alternatives, Paragraph 2

39. What is the depth of the permeable barrier?

40. How effective is clinoptilolite in removal of the other contaminants of concern, particularly metals and nitroaromatics?

Page 19, Section 5.1.2, Alternative 2, No Active Remediation with Monitoring, Paragraph 1

41. The data presented in the Remedial Investigation does not support the hypothesis that the concentration of Uranium would be attenuated by reacting with iron or manganese hydroxide or by precipitation of Uranium in the slough area where reducing conditions occur.

Page 20, Section 5.1.2, Alternative 2, No Active Remediation with Monitoring, Paragraph 1

42. Uranium has been detected in monitoring well RMW-2 at an average concentration of 5.67 pCi/l. Are the current concentration of Uranium increasing in RMW-2, and what are the concentration levels? The detection of Uranium in this well shows that Uranium is migrating towards the St. Charles county well field.

43. Page 20, first paragraph, the text states that monitoring data from wells south of the slough indicates that Uranium concentrations should be at background levels. This statement should be qualified. At least two wells have shown Uranium levels are at slightly above the background levels.

Page 20, Section 5.1.2, Alternative 2, No Active Remediation with Monitoring, Paragraph 2

44. Where would the seven additional monitoring wells be placed? How deep would these wells be and in what geological formations would they be screened?

45. Page 20, third paragraph, the text states that under Alternative 2, hazardous substances would remain on site at concentrations above health based levels, and that reviews would be conducted every five (5) years. Documents should be developed regarding actions to be taken in the event contamination levels exceed certain risk levels. These documents should be incorporated or referenced in this document.

Page 22, Section 5.2.1, Overall Protection of Human Health and the Environment, Paragraph 1

46. The no action alternative proposed by the Department of Energy is not protective to human health and the environment.

47. The presence of contaminants of concern in the cracks and fissures in the quarry particularly the contaminants of concern, Uranium, radium-226, and radium 228 are a potential risk to human health because of gamma radiation emitted by these radionuclides. The Remedial Investigation and the Baseline Risk Assessment have not yet identified the quantity of contamination or the fate and transport of contaminants to the groundwater. This information is still needed before an accurate Feasibility Study can be done.

48. Alternative 2, no active remediation with monitoring only, is not protective to human health and the environment because this alternative does not reduce the Uranium concentrations or the concentrations of the other contaminants of concern to concentration levels which would meet the residential risk scenario for a human receptor exposed to the contaminants of concern.

Page 22, Section 5.2.1, Overall Protection of Human Health and the Environment, Paragraph 2

49. The lack of definition of E_h values for Uranium and the variation of pH for the groundwater near the slough would make natural attenuation highly improbable. Also metals do not naturally attenuate in the environment. Therefore, Alternative 2 is not protective to human health and the

environment. Monitoring for the contaminants does not reduce the concentrations of the contaminants of concern or mitigate the risk to potential receptors.

Page 23, Section 5.2.1, Overall Protection of Human Health and the Environment, Paragraph 1

50. We presume the contingency measures would be addressed in the feasibility study. It would be appropriate to add a statement to this effect in this section.

Page 23, Section 5.2.2, Compliance with Potential ARARs

51. The term "reasonable amount of time" is subject to interpretation. The technologies identified may be able to meet the CERCLA requirements of 40 CFR Part 192. Waiving the standard of 30 pCi/l for the Uranium concentration in the groundwater because of technical impracticability is not a logical assumption because the alternatives presented are technically feasible.

52. Page 23, Section 5.2.2, the document states that a waiver from the relevant and appropriate standard of 30 pCi/l would be requested due to technical impracticability. Please indicate if this waiver would be disqualified in the event of land use change in the future. To waive remediation would be premature. Technology changes. With known migration of contaminants off site into the well field it may become necessary to remediate the source material/plume if the Uranium levels south of the slough reach action levels. The ability to take health protective actions in the future must be preserved.

53. The text indicates that only Uranium is the contaminant to be remediated. Please discuss at that levels the nitroaromatics exist and would these contaminants need to be remediated.

Page 23, 5.2.3, Long-Term Effectiveness and Permanence

54. The statement that "unacceptable impacts to human health and the environment" would not be expected to occur, presumes natural attenuation mechanisms which have not been adequately substantiated by data in the Remedial Investigation. Metals do not attenuate naturally in the environment into compounds which would not present a health risk. Monitoring only detects concentration levels of the contaminants of concern. The second alternative provides for no active remediation of the contaminants of concern. The alternatives proposed provide no long term effectiveness or permanence in reducing the concentrations of the contaminants of concern.

Page 24, Section 5.2.4, Reduction of Toxicity, Mobility and Volume Through Treatment

55. Both alternative 1 and alternative 2 proposed do not reduce the toxicity, mobility, and volume of the contaminants of concern. Therefore compliance with 40 CFR Section 192 may not be possible with these two alternatives.

Page 24, Section 5.2.5., Short Term Effectiveness

56. Both alternative 1 and alternative 2 do not provide short term effectiveness in reducing the toxicity, mobility, and volume of the contaminants of concern in the soils, surface water, and groundwater.

Page 25, Section 5.2.6, Implementability, Paragraph 3

57. The statement that no permits or licenses would be required for on site activities may not be totally correct. Depending upon the type of remedial activities contemplated permits or compliance with the substantive requirement of a permit would be required.

Section 5.2.7, Cost, page 25.

58. The cost of alternative 2 is estimated at $6.9 million for 30 years, but only an additional $1.1 million for the next 70 years. This suggests that the monitoring will be greatly reduced after the first 30 years. Please explain.

Page 26, Section 5.4, Preferred Alternative, Paragraph 1

59. The statement that "it is unlikely for unacceptable levels of Uranium to occur at the St. Charles well field" is not correct. Uranium has been detected at an average (mean) concentration of 5.67 pCi/l in monitoring well RMW-2 which would indicate that Uranium is migrating towards the St. Charles well field. This statement is not supported by the Remedial Investigation document. Also, a peak value of approximately 10.5 pCi/l for Uranium has been detected in monitoring well RMW-2 (RI page 9-28). Current monitoring data has not been included in the Remedial Investigation. Other than the graph on page 9-28 of the RI which provides historical trends of the Uranium concentration in this well, no specific data has been provided in the Remedial Investigation document.

Page 27, Table 5.1

60. Alternative 1 highlighted in the table is not protective to human health and the environment. Alternative 2 is not protective to human health and the environment.

RE: Review/Comment on Feasibility Study for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri, June 1997.

Specific Comments Regarding the Feasibility Study Document

Section 1.1.1, Par. 1

1. It is our understanding that the NPL listing was essentially due to the proximity to the St. Charles water supply well field and the potential for contaminated groundwater to impact a municipal water supply. DOE should acknowledge that fact here.

2. Page 1-4, Figure 1.2, last sentence under the figure states that dashed lines identify waste stored at the chemical plant as a result of completed response actions. It is MDOH's understanding from previous reports that the quarry pond water was treated and released into the Missouri River, not stored at the Chemical Plant.

Section 1.1.1, Pg. 1-6

3. We would be surprised if there has never been a discharge to surface water. The topography of the quarry suggests that the quarry pond could have overtopped in the past. Also, secondary porosity features (fractures, partings, etc.) may have discharged to surface water as well as to groundwater. We doubt the statement "the quarry pond is isolated from the surface water system" can be supported. The secondary porosity features are above the water table here and flow may be horizontal in addition to vertical infiltration to the water table. We would consider discharge to the Little Femme Osage Creek to be a possibility. In the RI, Page 7-5, four metals and three radiochemical parameters significantly exceed background in the Little Femme Osage Creek surface water. Page 7-9 in the RI indicates that overland discharge from the quarry occurred during a USGS study. Page 7-10 indicates that the sediments in the Little Femme Osage Creek have elevated sulfate, and Uranium 238.

Page 1-10, Section 1.1.2.2, Hydrogeology

4. We presume the pump rate stated for the St. Charles County wells of 2300 to 2400 gpm is for each well. Is this correct?

Section 1.1.2.2, Hydrogeology, page 1-11, paragraph 2

5. It is stated that recharge of the Missouri River alluvium results primarily from the Missouri River, intermittent surface flooding and discharge from the bedrock. It should be noted that recharge by infiltration of precipitation is also a primary mechanism.

6. Page 1-16, the first full paragraph refers to sediment sample contaminant concentrations. The second paragraph begins to refer to surface water samples, but then starts discussing contaminated sediment samples. Please edit this.

7. Page 1-18, second paragraph, the text refers to groundwater contamination being primarily limited to the area north of the slough. Please include that contamination, at or slightly above background level, is located south of the slough.

8. Page 1-18, third paragraph, please clarify that uranium concentrations may not decrease in the future.

Section 1.2.3, Pg. 1-18

9. We would not characterize the monitoring system as extensive. For alluvial wells, only about 10 wells actually impact knowledge of plume extent. Twenty of the 30 alluvial wells appear to be separated by significant distances from the known plume. Wells at the edge of the plume are contaminated without adjacent clean wells to define the plume limits. This is a very minimalist system, functionally.

Page 1-22, Section 1.3.1.1, Exposure Scenarios

10. This section does not address a residential exposure scenario. A residential risk scenario should be addressed for a potential human receptor ingestion of the groundwater. Where will residential risk scenario for exposure of a human receptor to the groundwater be addressed?

11. Page 1-22, Section 1.3.1.2, second paragraph, the text states that monitoring data at locations south of the slough have yielded concentrations significantly lower than 21 pCi/l.

Define the meaning of significant. Please indicate what the highest Uranium concentration of well RMW-2 has been.

Page 1-23, Table 1.2, Summary of Human Health Risks

12. For the quarry proper and the fractures, human receptor exposure to external radiation presents the highest risk, 1×10^{-5} for the quarry proper and 2×10^{-5} for the quarry fractures. Exposure to a human receptor would most likely be from gamma radiation from the radionuclide contaminants. Will the contamination in the fractures be remediated to minimize this exposure risk?

13. Page 1-25, first and second paragraphs, the text states that the quarry proper, slough and creeks have been determined to not need remediation for the recreational scenario. Please provide justification for this determination. Further, the Proposed Plan stated that there is a moderate to extreme risk to aquatic biota (page 12 and 13) in these areas. However, page 1-24 of the FS excludes biota. Please clarify this discrepancy.

14. Page 1-25, second paragraph, the text states that residual contaminant levels at the quarry proper have been determined to be within the acceptable range of 1×10^{-4} to 1×10^{-6}. Please indicate what is meant by "acceptable?" According to EPA, risks falling below 1×10^{-6} are acceptable risks, risks falling above 1×10^{-4} are not acceptable. When the risk fall between 1×10^{-4} and 1×10^{-6}, risk managers take into consideration other factors when making a final determination regarding what is acceptable.

15. Page 1-24 and 1-25, the text states that impact from Uranium contamination has not been indicated in data from monitoring south of the slough. This is not accurate. Well RMW-2 has shown Uranium concentrations at or slightly above background levels.

Page 1-25, Section 1.4, Objectives of the Feasibility Study, Paragraph 3

16. The residential risk scenario for a potential human receptor exposure to the groundwater should be considered here. Low well pump rates do not preclude the use of the groundwater as a residential well drinking water source.

Section 1.4, Objectives of the Feasibility Study, page 1-25, paragraph 1.

17. Further explanation is needed to show how the preferred alternative, Alternative 2, can achieve the objectives of: 1) reduce or remove Uranium from the groundwater, or 2) effectively limit the potential for exposure by monitoring alone.

Section 1.4, Objectives of the Feasibility Study, page 1-25, paragraph 3.

18. Several reasons are provided for why shallow groundwater north of the Little Femme Osage Slough (slough) is not expected to be used for a domestic water source in the future. There should also be some mention of the need for deed restrictions to prevent individuals from drilling private wells in this area.

Section 1.4, Objectives of the Feasibility Study, page 1-25, paragraph 4.

19. The statement that the data has not indicated migration of uranium south of the slough is not totally correct. The RI indicates that concentrations of Uranium have been detected at three locations south of the slough, including monitoring well RMW-2.

Page 1-25, Section 1.4, Objectives of the Feasibility Study, Paragraph 4, (continued on page 1-26)

20. The statement that migration of Uranium towards the well fields has not been indicated as a result of the monitoring data from the production wells is not correct. Uranium has been detected in monitoring well RMW-2.

Page 1-26, Section 1.5, Determination of Remedial Goals for Groundwater at the Quarry Area, Paragraph 2

21. Safe Drinking Water Act MCLs would be applicable in accordance with 40 CFR 141.11 and 141.62. State of Missouri Drinking Water Regulations 10 CSR 60-4.030 would also be applicable particularly for the MCL for Nitrate of 10 mg/l. The regulation 10 CSR 60-4.060 maximum radionuclide contaminant levels and monitoring requirements would be applicable to potential drinking water sources. This section refers to radium-226 and radium-228 gross alpha particle activity which shall have a maximum MCL of 5 pCi/l for radium-226 and radium-228.

Page 1-27, Section 1.5, Determination of Remedial Goals for Groundwater at the Quarry Area, Paragraph 2

22. The risk level for the residential risk scenario for a potential human receptor should be addressed here.

23. Page 1-27, second full paragraph, the text states that if reduction [of uranium] could be achieved at the 30 pCil level, the incremental effects on Uranium concentration at the well field could be decreased 100-fold. Please indicate if the remediation goal is to decrease Uranium concentrations. On page 14, Section 3.4 of the Proposed Plan, according to this plan, the purpose of identifying the remediation goal was not to reduce the Uranium concentrations to achieve risk reduction, but to lessen the potential for migration of Uranium to the well field. These two documents are not supporting the other. Please clarify this discrepancy.

Page 2-1, Section 2.1, Screening Criteria Paragraph 2

24. Why are the other contaminants of concern, metals, nitrates, radium-226, radium-228, thorium-230, and thorium-232, not addressed here in addition to the contaminants Uranium, and nitroaromatics?

Figure 2-1, Pg. 2-3

25. Another significant technology for containment is groundwater pumping which generates hydraulic control over contaminant plumes. This comment also applies to Section 2.2.3.

Section 2.2.2, Natural Processes, page 2-5, paragraph 3 and page 2-8, Table 2.2

26. Recharge from the infiltration and precipitation at the quarry may also come into contact with inaccessible Uranium left behind in bedrock fissures. This may contribute to the continuing occurrence of Uranium in groundwater and may account for the lack of Uranium concentration reductions following bulk waste removal.

Section 2.2.2, Natural Processes, page 2-5, paragraph .

27. The statement that "the farthest extent from the quarry of the migrating Uranium contamination in the groundwater is the approximate location of the slough," is not totally accurate.

Page 2-5, Section 2.2.2, Natural Processes, Paragraph 2

28. The detection of Uranium in monitoring well RMW-2 indicates that Uranium is migrating towards the St. Charles well field. Natural attenuation of Uranium would depend upon several factors, the sorption capacity of the soil, pH, E_h (specific conductance) of the groundwater, and Uranium concentration in the groundwater. The Remedial Investigation does not provide hard data or mass transport calculations to substantiate the natural attenuation of Uranium by any of these mechanisms.

Page 2-5, Section 2.2.2 Natural Processes, Paragraph 3

29. The Uranium concentration is being reduced through dilution only. Although dilution may reduce the Uranium concentration in the groundwater, it does not reduce the carcinogenic risk to human receptors who would consume the groundwater.

Page 2-5, Section 2.2.2, Natural Processes, Paragraph 4

30. If reducing conditions are present reduction of UO_2^{+2} from +6 oxidation state of Uranium to the +4 oxidation state would involve cathodic and anodic reactions similar to the following:

$$UO_2^{+2} + 4H^+ + 2e^- = U^{+4} + H_2O = U^{+4} + e^- = U^{+3} \text{ and } H_2O - 2e^- = H^+ + 0.5\ O_2 \text{ and}$$
$$0.5\ H_2O = e^- = H^+ + 0.25\ O_2$$

For Fluoride complexes of U^{+4} the solubility of Uranium would increase. For example, the solubility of UF_4 in water is 1×10^{-4} Moles/L. Other water soluble compounds of Uranium are $UO_2SO_4{*}3H_2O$ at 18.9 g per 100 g of water, and $UO_2(NO_3)_2{*}6H_2O$ at 0.540 g per gram of water. Most of the complexes of the uranyl ion with inorganic compounds are colorless and readily soluble in water.

Thus reduction of Uranium from the +6 to the +4 oxidation state by a cathodic/anodic process generates hydrogen ions which may increase the pH and increase the solubility of Uranium ionic species. The Remedial Investigation for the Quarry Residuals Operable Unit provides very limited data for redox conditions E_h (specific conductance) as field measurements but provides no calculations or hard data to substantiate the existence of redox conditions for Uranium oxidation state reduction. Therefore, reduction of Uranium in the form of UO_2^{+2}, may actually increase the solubility of Uranium in the form of UF_4.

Page 2-6, Section 2.2.2, Natural Processes, Paragraph 3

31. Sorption of Uranium is cited here as a mechanism for reduction of Uranium concentration. However, the Remedial Investigation for the Quarry Residuals Operable Unit does not provide site specific K_d data values for the sorption of Uranium on different types of soils. Sorption of the Uranium onto soil particles would depend upon the cation exchange capacity of the soil, the pH, and possibly the redox potential of the Uranium ionic species. The Remedial Investigation provides no hard data to support whether the sorption of Uranium from the groundwater into the soils would reduce the groundwater Uranium concentration. Therefore additional site specific K_d data for Uranium is necessary to support the hypothesis that sorption of Uranium is occurring in the soil.

Section 2.2.2, Natural Processes, page 2-6, paragraph 1

32. There is apparently some confusion about the relationship between grain size and porosity. This discussion states that "the coarse-grained composition of the alluvium in the aquifer south of the slough results in much higher porosity than is found in the fine-grained alluvium in the aquifer north of the slough." Porosity generally increases with decreasing grain size (see Fetter, 1988).

Section 2.2.2, Natural Processes, page 2-6, paragraph 1.

33. It is possible that limited mixing of uncontaminated groundwater from the Missouri River with contaminated groundwater north of the slough occurs in the vicinity of the slough where the coarse-grained alluvium begins, but the majority of the mixing would occur closer to the river.

Page 2-7, Section 2.2.2, Natural Processes, Paragraph 1

34. Biological processes for Uranium reduction are speculative at best. Biodenitrification of the nitroaromatic compounds in the soils via biological processes may occur, but would depend upon the pH and temperature. High concentrations of metals particularly Arsenic, and Lead may inhibit this process. The document should be changed to incorporate this statement or a similar statement.

Page 2-7, Section 2.2.3.1, Barrier Walls

35. While this alternative may stop contaminant migration, it does not reduce the concentrations of the contaminants of concern. Alternatives which provide a reduction in the concentrations of the contaminants of concern, particularly Uranium, would be preferable as a remediation method.
How will the effectiveness of containment be monitored? What are the triggers for remedial action if containment fails?

Section 2.2.3.1, Barrier Walls, page 2-7

36. Under normal circumstances, it would be expected that bentonite slurry walls should last indefinitely, with little or no maintenance (i.e. slurry walls installed beneath dams, where maintenance would not be possible).

37. Page 2-8, Table 2.2, under column "Effectiveness" and row "natural processes," the text states that bulk waste has been removed. Please indicate the whereabouts of the waste that was located within the northeast corner of the quarry.

Section 2.2.3.1, Pg. 2-7

38. We are not aware of any maintenance requirements for a bentonite and cement-based slurry wall. Although some studies have shown increasing hydraulic conductivity with time, this has occurred with organic and hydrocarbon wastes, probably through alteration of the clay structure by stripping bound water or flocculation. However, any Uranium passing through this low permeability material will possibly precipitate on cation-exchange sites in the bentonite and would not be expected to alter conductivity or reduce the effectiveness of the barrier.

39. Page 2-8, Table 2.2, under column "Effectiveness," and row "Electrokinetics", page 2-10, Section 2.2.4.2, and page 2-12, last paragraph, the text states the effectiveness of remediation for Uranium is not well established. Please provide documentation regarding this.

Section 2.2.3.2, Pg. 2-9

40. The greater difficulty in injecting an immobilizing agent would be permeability contrasts and obtaining uniform injection. We do not believe the "low" hydraulic conductivity would preclude this technology. Wherever the alluvium includes coarse materials at depth with conductivity contrast to the shallow "tight" soils, significant difficulty can be expected in achieving uniform injection. This comment also applies to the in-situ treatment technologies where injection is involved. (Pages 2-9 to 2-10, Section 2.2.4, In-Situ Treatment).

41. Monitoring the effectiveness of in-situ treatment has a high degree of uncertainty. Many of the in-situ treatment technologies are still in the developmental stage and may be difficult to apply for full scale remediation of contaminated aquifers.

Page 2-10, Section 2.2.4.2, Electrokinetics

42. The consideration of this technology may be a viable option. For ex-situ treatment of the contaminants of concern, particularly Uranium, this technology does have merit and can be implemented.

Page 2-10, Section 2.2.4.3, Reactive Walls

43. The consideration of this technology does have merit. The type of adsorbent used would have to be capable of removal of Uranium, metals, and the organic compounds.

Page 2-11, Section 2.2.4.5, Phytoremediation

44. Consideration of this technology does have merit. One approach would be to use a barrier trench to extract the groundwater and then pump into a constructed wetland system for phytoremediation. This technique would be useful for biouptake of both organics and metals. Plant types which may be used are, common reed, duckweed, and water hyacinth. Constructed wetland systems are currently in use for wastewater treatment.

45. Page 2-11, second full paragraph, the text states that a reactive wall/barrier, once it reached saturation levels with the contaminant, would need to be excavated and replaced. Please include where this waste would be disposed.

Page 2-12, Section 2.2.4.6, Summary

46. The consideration of the use of electrokinetics or electrolytic processes should not be totally rejected. Ex-situ treatment of the groundwater by an electrochemical process does have merit. A bank of electrolytic cells could be used in series for removal of Uranium and metals from the groundwater. Deposition of the metals would be either on the cathode or anode of the cell, depending upon the type of metals used in electrolytic cell construction and the media for the electrolysis. An interceptor trench could be used to collect the groundwater for treatment.

Section 2.2.5.1, Pg. 2-13

47. Hydraulic fracturing using a proppant will produce fractures in alluvium, contrary to statements here. In fact, the first fractures attempted in the oil industry were in shallow soils so that the fractures could be excavated for study. Shallow fractures tend to be horizontal pancakes, although absolute horizontal orientation is not the case. Also, hydraulic fractures that are pumped at high rates and propped early in the pumping schedule tend to form fairly uniform horizontal circles with little "fingering." As far as fracturing the plattin, we suspect the formation is already fractured to some extent and if this is truly a concern for such a scenario, it should currently be a concern.

Section 2.2.5.3, Pg. 2-14

48. We don't understand what the difficulty is with 50 gpm. This rate will exert significant hydraulic control. In fact, the aquifer will probably be dewatered in the vicinity of the trench. Further, and most significantly, by placing a geomembrane on the "downgradient" side of the excavation, a barrier to flow is also constructed. This barrier would minimize "clean" downgradient water drawn back to the trench and would help prevent further downgradient migration.

Page 2-16, Section 2.2.6, Ex-Situ Treatment, Paragraph 2

49. The consideration of the use of newer technologies should not be totally rejected. Magnetic separation of the metals could be accomplished by chemical flocculation with alum, ferric chloride, magnetite, and polymer. The resulting floc could be separated using an electromagnet under continuous flow conditions. LNL at Los Alamos NM has done work using this method for separation of Uranium and other radionuclides from wastes. Full scale magnetic separation processes are currently being used in Europe, particularly Germany and the Netherlands, for removal of heavy metals from surface waters. Enviromag B.V. has developed a process and an Aquamag[R] electromagnetic filter which has been used for heavy metal removal from wastewater.

50. **Page 2-19, under the row "Removal" and column "Technology Type"**, please discuss if DOE is considering a combination of technologies.

Page 3-3, Section 3.2.2, Factors Specific for Each Preliminary Alternative l, Paragraph 1

51. The first alternative stated here of no action is not protective to human health and the environment. The no action alternative does not comply with the ARAR standard levels of Uranium in the groundwater in accordance with 40 CFR 192. The concentration of nitroaromatic compounds, 2,4-dinitrotoluene, nitrobenzene, and 1,3-dinitrobenzene exceed Missouri Maximum Contaminant Levels. The no action alternative is used here as a baseline and is by definition a zero cost and zero protection alternative.

Page 3-4, Alternative 2, No Active Remediation with Monitoring, Paragraph 1

52. Natural attenuation does not reduce the concentrations of metals, Uranium, and the other radionuclides. Sorption of metals onto clay particles, may retard Uranium migration, but E_h (Specific Conductance) and pH may alter the cation exchange capacity of the clay soil thus making the adsorption process ineffective. Where is the point of compliance for Alternative 2?

53. Dilution and dispersion may reduce the concentration of a contaminant of concern, but on a mass basis the contaminant still exists, but is spread over a larger liquid volume. Natural Attenuation processes do not adequately reduce the toxicity of the contaminants of concern for human and ecological receptors.

Page 3-4, Alternative 2, No Active Remediation with Monitoring, Paragraph 2

54. Once the contaminants of concern enter the vicinity of the public well fields, dilution and dispersion of the contaminants of concern, particularly Uranium should not be considered as part of the "natural attenuation process".

55. The existence of a redox barrier at the slough which would retard the migration of Uranium requires further definition. Additional data for the existence of the redox barrier is needed in the Remedial Investigation to support this hypothesis.

56. **Page 3-4**, the text states that groundwater removal has been determined to be technically impracticable and remedial measures would be unable to significantly speed up remediation. Clarify how active remedial measures would be unable to significantly speed up remediation.

Section 3.2.2.2, Pg. 3-4

57. How does the facility propose to handle the situation if monitoring shows failure of this alternative? DOE has not confirmed that this attenuation is currently occurring, so how can it be accepted as a remediation alternative?

Section 3.2.2.2, Pg. 3-4 and 3-5

58. The assertion that this groundwater is unsuitable for consumption is based on low well yields. However, these waters are hydraulically connected to the more permeable portion of the alluvium and a short distance from an existing receptor.

Page 3-5, Alternative 2, No Remedial Action with Monitoring, (Continued) Paragraph 2

59. Data for site specific K_d values for both Uranium and nitroaromatics are lacking in the RI. The octanol-water coefficient for dinitrotoluenes are low. Thus, there is a potential for transport of 2,4-dinitrotoluene in the groundwater. The solubility of 2,4-dinitrotoluene in water is 270 ppm. Therefore, the presumption that the contaminants have a low-mobility particularly the Uranium and nitroaromatic compounds is not adequately supported by the data presented in the Remedial Investigation.

Page 3-5, Alternative 2, No Remedial Action with Monitoring, (Continued) Paragraph 3

59. The "low level" of contaminants may be at concentrations which exceed the MCL levels or proposed MCL levels for the contaminants of concern, Uranium, nitroaromatics, mercury, and cadmium for potential drinking water sources. (Refer to page 9-16 of the RI).

Page 3-5, Alternative 2, No Remedial Action with Monitoring, (Continued) Paragraphs 4 & 5

60. There is a potential for exposure of a human receptor to groundwater at the quarry area based upon the recreational visitor scenario or the residential scenario. What is the point of compliance for this alternative?

Section 3.2.2.2, Pg. 3-5

61. The assertion that these are low levels is inaccurate. Levels significantly above drinking water standards are present and can not be defined as "low."

Section 3.2.2.2, Pg. 3-5

62. The assertion that Uranium is a low-mobility contaminant is inaccurate. Uranium is frequently mined where it has been concentrated by groundwater flow and precipitation. There is not adequate proof to assert that precipitation is occurring at the slough currently.

Section 3.2.2.2, Pg. 3-5

63. The assertion that there is a low potential for exposure is speculative when you consider the possibility of further contaminant movement, as is the low demand assertion.

64. Page 3-5, last paragraph, the text refers to Goffredi, 1997 publication. Please indicate if the EPA has sanctioned this report.

Section 3.2.2.2, Pg. 3-6

65. The monitoring system is inadequate to determine whether the currently identified movement south of the slough is an "isolated case." Also, the volume of contaminated water/aquifer may be significantly different than as stated here. Page 3-6, Paragraph 1, Large Volume, Long Duration Release.

66. Uranium has migrated beyond the boundary of Femme Osage Slough. Uranium has been detected in monitoring well RMW-2 which indicates that the Uranium is migrating towards the St. Charles well field.

Page 3-7, Paragraph 1, Low Biotic/Abiotic Decay Potential, Paragraph 1, First Bullet

67. Biodegradation of nitroaromatic compounds can occur depending upon the presence of microorganisms capable of denitrification of nitroaromatic compounds. The pH of the soils and groundwater would be a very important factor because denitrifying microorganisms can only tolerate a very narrow pH range, typically 7-8. High concentrations of metals particularly arsenic, and lead can inhibit the biodegradation process.

68. Section 3.2.2.2, Alternative 2, "No Active Remediation with Monitoring," page 3-7, top, and page 3-8, paragraph 1, hydraulic conductivities of 1×10^{-3} to 1×10^{-5} cm/s are generally not considered "low." Most references classify permeabilities in this range as "moderate."

Section 3.2.2.2, Pg. 3-7

69. Hydraulic conductivities of this order are not considered excessively low.

Page 3-8, Paragraph 1, Low Hydraulic Conductivity of the Contaminated Aquifer, Paragraph, 1 First Bullet

70. The contaminants of concern particularly Uranium, may be present in the lower aquifers based upon the underlying stratigraphy of this area. Low well yields do not preclude the use of technologies to remove groundwater from the aquifer at low flow rates. An example would be an interceptor trench.

Section 3.2.2.2, Alternative 2, No Active Remediation with Monitoring, page 3-8, paragraph 1.

71. When considering remedial alternatives fractures should not be viewed as an adverse characteristic of the shallow aquifer. On the contrary, the presence of fractures in the shallow bedrock is probably the main factor responsible for contaminant migration from the quarry to alluvial aquifer and those fractures could possibly be used to extract and/or treat the contaminated groundwater at a faster rate than the other proposed alternatives.

Page 3-9, Paragraph 1

72. Institutional controls may be effective in precluding the installation of residential wells in the quarry area, but the major concern is the migration of the contaminants of concern particularly Uranium, towards the St. Charles well field. Attenuation of the contaminants of concern to health based levels in a short distance through the aquifer is based upon speculation. The Remedial Investigation does not provide data to substantiate this mechanism.

73. The data presented in the Remedial Investigation for the Quarry Residuals Operable Unit is based upon field measurements for E_h, and K_d values from the literature for Uranium. There are no chemical thermodynamic calculations in the RI to support the hypothesis that a redox zone exists for reduction of Uranium to an insoluble form. The K_d values for Uranium sorption are not site specific and no site specific data is included for Uranium sorption on the soil types present at the quarry site. No data is presented for biodegradation particularly the rate constants from the Monod equation applicable to biodegradation of nitroaromatic compounds.

Page 3-9, Paragraphs 2 and 3

74. If monitoring is considered as an alternative, the number of monitoring wells needs to be specified, including the locations of the monitoring wells. Will wells be strategically placed a distance from RMW-2 to determine the extent of Uranium migration?

Section 3.2.2.2, Alternative 2, No Active Remediation with Monitoring, page 3-9, paragraph 2.

75. There is no time-frame indicated between the arrival of unacceptable concentrations at the well field and the initiation of contingency measures. (Note: The DOE stated in a meeting on July 1, 1997, that they have a contingency plan (1992) that includes the requested information and that they will have it revised and inserted in the next version of the FS).

76. Page 3-10, first paragraph, the text notes that hazardous substances would remain in the groundwater at concentrations above health based levels. Please explain if it is acceptable for contaminants to remain above health based levels without remediation.

Section 3.2.2.2, Alternative 2, No Active Remediation with Monitoring, page 3-10, paragraph 2

77. Not all of the source material has been removed, as indicated here. Uranium remaining in bedrock fractures may continue to contribute contamination to the alluvial aquifer.

Page 3-11, Section 3.2.2.3, Alternative 3, Groundwater Removal with On-Site Treatment, Paragraph 1

78. The use of an interceptor trench is a good idea. If an extraction flow rate of 50 gpm can be obtained, the groundwater can be collected and treated. Treatment of the groundwater to mitigate the concentration of the contaminants of concern to levels which would meet drinking water MCLs could be accomplished by treatment of the groundwater through the Quarry Water Treatment Plant. The Quarry Water Treatment Plant utilizes treatment technologies which have been proven and presents low technical risk for mitigation of the contaminants. Other than the cost criteria, why was this alternative rejected?

Section 3.2.2.3, Pg. 3-11

79. We don't know what is unconventional about an interceptor trench or "french drain." This method has been around for a very long time and is well accepted. Also, it appears 1500 feet would be an adequate length for the trench. DOE actually acknowledges that delineation of the plume remains a necessary activity here.

Page 3-14, Section 3.2.2.3, Paragraph 1

80. The 17,000 cubic yards of soil excavated during the construction of the interceptor trench will contain nitroaromatics particularly, 2,4-dinitrotoluene. The contaminant 2,4-dinitrotoluene would be considered a mixed waste in accordance with 40 CFR 261.32 and Section 261 Appendix VIII, which lists 2,4-dinitrotoluene as K111 listed waste. How will these contaminated soils which contain listed waste be treated prior to placement into the disposal cell?

Page 3-14, Section 3.2.2.3, Paragraph 5

81. The use of the Quarry Water Treatment Plant (QWTP) to treat the groundwater appears to be a good technical alternative because it is based upon known technology and is proven. This alternative is capable of treatment of the contaminants of concern and would be protective to human health and the environment.

Page 3-18, Section 3.2.2.4, Alternative 4, Containment

82. The alternative of containment does not mitigate the concentrations of the contaminants of concern to levels which would be protective to human health and the environment. Because of the fracture flow characteristics of the deeper aquifers, the alternative of a containment wall using a bentonite material would only contain contaminants in the alluvium. A barrier wall would not contain the contaminants of concern in the deeper aquifers.

Section 3.2.2.4, Alternative 4, Containment, page 3-19, paragraph 1

83. The topic of this section is "Containment." The discussion about a bentonite-based mixture absorbing metals such as uranium is unclear. It is also unclear how or why water would be able to pass through the "containment" wall. Please explain this apparent discrepancy.

Section 3.2.2.4, Pg. 3-19

84. What is the basis for preferring cement-bentonite back fill only in steep-sloped areas? We are not aware of this preference.

Section 3.2.2.4, Alternative 4, Containment, page 3-21, paragraph 1

85. According to the FS, materials with 30% of the particles finer than the number 200 sieve are considered adequate. It should be noted that, in order to be classified as a silt (ML) or clay (CL or CH), 50% of the total material must pass the Number 200 sieve.

Page 3-21, Section 3.2.2.4, Alternative 4, Containment, Paragraph 3

86. How will the 8,600 cubic yards of soil excavated during the construction of the slurry wall be treated? Since the soils excavated will contain nitroaromatics particularly 2,4-dinitrotoluene, which would be considered mixed wastes 40 CFR 261.32 and Section 261 Appendix VIII K111 waste. Soils which would contain this waste would have to be treated prior to placement into the disposal cell.

Page 3-21, Section 3.2.2.4, Alternative 4, Containment, Paragraph 3

87. The air monitoring needs further description regarding the actions to be taken. How extensive will the air monitoring be?

Section 3.2.2.4, Pg. 3-21

88. We don't see any reason for using borrow soil in construction of a soil-bentonite slurry wall. If the soil is contaminated, soil adjacent to the wall will be contaminated. Returning this material to the excavation should not be a significant problem.

Page 3-22, Alternative 5, In-Situ Treatment Using Permeable Barriers

89. This alternative is technically feasible. We presume the zeolite would function similar to an ion exchange resin for Uranium, and metals removal. A potential problem would be possible degradation of the zeolite by the presence of the organics and fouling of the adsorption sites. Have any pilot or full scale studies been conducted for removal of Uranium from groundwater or surface waters with clinoptilolite? Can PMC/DOE provide some data which would indicate that this process can effectively adsorb Uranium and metals? What is the point of compliance for Alternative 5?

Page 3-23, Alternative 5, In-Situ Treatment Using Permeable Barriers, Paragraph 3

90. If the fractures exist in the bedrock, the base of the proposed treatment wall would be difficult to seal. The existence of fractures in the deeper underlying aquifers would still allow transport of the contaminants of concern towards the St. Charles well field. Mitigation of the contaminants of concern present in the alluvium to acceptable levels protective to human health and the environment may be technically feasible by a installation of a permeable barrier. However, the barrier would not be capable of removal of the contaminants of concern from the deeper aquifers.

Page 3-24, Alternative 5, In-Situ Treatment Using Permeable Barriers, Paragraph 3

91. We would like to see some of the adsorptive capacity data for Uranium on clinoptilolite media from the Morrison and Spangler report dated 1992. Is this data available? Please provide a copy of this report for MDNR review.

Page 3-24, Alternative 5, In-Situ Treatment Using Permeable Barriers, Paragraph 2

92. Based upon the volume of the proposed permeable barrier system, how long can the zeolite material adsorb Uranium until breakthrough occurs?

Page 3-25, Alternative 5, In-Situ Treatment Using Permeable Barriers, Paragraph 3

93. Please refer to the previous comments regarding excavated soils which contain 2,4-dinitrotoluene as a contaminant.

Section 3.2.2.5, Alternative 5: In-situ Treatment Using Permeable Barriers, page 3-25, paragraph 1.

94. Excavated material will be placed over the cap layer of the permeable barrier wall. It is not specifically stated here that this material will be contaminant-free. Only clean back fill should be used to cover the cap layer.

Page 3-29, Section 3.4.2, Alternative 2, No Active Remediation with Monitoring, Sub Section 3.4.2.1, Effectiveness, Paragraph 1

95. Alternative 2 is not protective to human health and the environment because it provides for monitoring only of the migration of the contaminants of concern and does not mitigate the concentrations of the contaminants of concern to levels which are protective to human health and the environment. What is the point of compliance for this alternative?

Page 3-29, Section 3.4.2, Alternative 2, No Active Remediation with Monitoring, Sub Section 3.4.2.1, Effectiveness Paragraph 1

96. Why would a technical impracticability wavier be necessary?

97. How does this relate to this alternative meeting the ARARS? Again, Alternative 2 is not protective to human health and the environment.

Page 3-30, Section 3.4.2, Alternative 2, No Active Remediation with Monitoring, Sub Section 3.4.2.1, Effectiveness, Paragraph 2

98. It is stated here Alternative 2 would not satisfy the statutory preference for treatment and would not reduce the toxicity, mobility, or volume of the contaminated groundwater, by mitigation of the contaminants of concern to levels which would be protective to human health and the environment. Why is this alternative being considered instead of an active remediation technology?

Cost appears to be the major criterion for selection of this alternative. This alternative fails the criteria stated in the NCP for reduction of toxicity and mobility and volume of the contaminants. Again, no point of compliance is specified for alternative two.

Page 3-33, Section 3.4.3.2, Alternative 3, Groundwater, Removal with On-Site Treatment, Implementability

99. The useful life of unit process equipment should not be considered as a factor in the technical feasibility of the remediation process.

Section 3.4.3.2, Pg. 3-33

100. "Flow channeling" would not be a concern if pumping rates were adequate. Also, obstructions which block excavation to the base of the alluvium could be accommodated by breaking the trench into sections. Drawdown should be adequate to control flow if the distance between trench sections is short.

Section 3.4.3.3, Cost (Alternative 3-Groundwater Removal with On-Site Treatment), page 3-34

101. One of the primary expenses for this alternative is the replacement cost of the Quarry Water Treatment Plant (QWTP), which has less than 10 years of life expectancy. An alternative that may not have been considered is the transportation of extracted groundwater (by pipeline or truck via the existing haul road) to the Chemical Plant Water Treatment Plant (CPWTP), which will remain on-line for many years to treat the disposal cell leachate. Some modifications to the CPWTP may be required.

Page 3-35, Section 3.4.4.1, Alternative 4, Containment Effectiveness, Paragraph 1

102. Alternative 4 provides for reduction of the migration of the contaminants of concern towards the St. Charles well field. How will alternative four be protective of human health and the environment if this technology utilizes containment only and does not provide for a reduction in the mass quantities of the contaminants of concern in the groundwater? What would be the point of compliance for alternative four?

Page 3-36, Section 3.4.4.1, Alternative 4, Containment Effectiveness, Paragraph 4

103. It is stated here Alternative 4 would not satisfy the statutory preference for treatment and would not reduce the toxicity, mobility, or volume of the contaminated groundwater, by mitigation of the contaminants of concern to levels which would be protective to human health and the environment. Why is this alternative being considered instead of another remediation technology which would meet this requirement?

Page 3-36, Section 3.4.5, Alternative 5, In-Situ Treatment Using Permeable Barriers, Sect. 3.4.5.1, Effectiveness, Paragraph 4

104. Has this technology been demonstrated on a full scale basis at other sites? Has the data obtained from the use of this technology at other sites for remediation of contaminants, particularly metals demonstrated that this technology is protective to human health?

Section 3.5, Pg. 3-41 and 3-42

105. The time required to remediate the groundwater is very difficult to estimate with the information available. Low permeability does not limit fluid migration from the quarry to the slough area, since this migration occurs in secondary porosity until the alluvium is reached. The replacement of the treatment plant with multiple plants of a ten year design life is questionable. Any subsequent replacements should be designed to function for the remaining expected treatment term. Operation with the existing plant would enable better determination of remediation time frames and might form an adequate basis for Technical Impracticability if the difficulty is as great as is projected in this document. However, we do not agree with TI decisions prior to an attempt to remediate.

The issue of a failure of the slurry wall and mobilization of contaminants due to the "electrical double layer of bentonite" is raised for the first time here. We are unaware of the referenced phenomena. We are also unaware of the types of contaminants present at the quarry causing slurry wall failure. We would like to see more information on these issues.

Page 4-2, Section 4.1.1, Overall Protection of Human Health and the Environment

106. It is recognized that the "no action" alternative has been reviewed. However, the "no action" alternative presents a risk to human health and the environment for receptors to the contaminants of concern in the groundwater south of the slough. Based upon the detection of the contaminant Uranium in monitoring well RMW-2, Uranium is migrating towards the St. Charles well field and presents a risk to human health and the environment.

Page 4-3, Section 4.2, Alternative 2, No Active Remediation with Monitoring, Paragraph 1

107. Uranium has been detected in monitoring well RMW-2. The detection of Uranium in this monitoring well indicates that Uranium is migrating towards the St. Charles county well field. The migration of Uranium in this manner is a risk to human health and the environment.

Page 4-6, Section 4.2, Alternative 2, No Active Remediation with Monitoring, Paragraph 1

108. 40 CFR Sub Part G Section 264.112(b)(5) requires quarterly monitoring of the groundwater as part of a long term monitoring program.

Page 4-6, Section 4.2.1, Overall Protection of Human Health and the Environment, Paragraph 1

109. This alternative is not protective to human health and the environment. Please refer to previous comments regarding this issue.

Page 4-7, Section 4.2.2, Compliance with Potential ARARs

110. This remediation alternative does not comply with 40 CFR 192 Subparts A,B, and C and Section 192.21, Groundwater Standards for Remedial Action at Inactive Uranium Processing Sites.

Page 4-8, Section 4.2.3.2, Protection of the Public

111. This alternative provides no protection to the public who would use the groundwater as a drinking water source. The migration of the contaminants of concern particularly Uranium which has been detected in monitoring well RMW-2 is a concern because the contaminants could migrate into the St. Charles well field which is a major source of drinking water for a major metropolitan area.

Section 4.2.4, Reduction of Toxicity, Mobility and Volume through Treatment

112. Alternative 2 fails to meet this evaluation criteria, which is one of the nine criteria specified in the NCP. It seems that this criteria should be "applicable," regardless of the remedial alternative selected.

Page 5-1, Section 5, Comparison of Alternatives and Appendix A

113. Refer to the general comment section on ARARs.

114. Cost should not be the major driver in the decision making process regarding whether a technology is technically feasible. A waiver for "technical impracticability" should be a last resort alternative and cost should be subordinate to technical feasibility of the remedial action proposed.

Page 5-7, Section 5.2.2, Reduction, of Toxicity, Mobility, or Volume Through Treatment

115. Alternative 1 and Alternative 2 proposed by the Department of Energy do not reduce the toxicity, mobility, or volume of the contaminants of concern in the groundwater.

Table 5.1, Comparative Analysis of Alternatives, Compliance with ARARs, Alternative 2: No Active Remediation with Monitoring.

116. It is not clear if the proposed waiver of 30 pCi/l would apply to treatment of quarry groundwater north of the slough or groundwater in the well field to be used as a drinking water source. Please clarify.

Page 5-9, Section 5.3, Summary

117. Refer to the section previously on General Comments.

Appendix B, B.2 - Determination of Required Operational Period of the Interceptor Trench and Permeable Barrier Concepts, page B-6

118. The average figure for porosity, 0.27 and the range of porosity, 0.21 to 0.32, listed on this page, seem low for the fine-grained soils north of the slough. Is this data site-specific or from another source?

Appendix B, Pg. B-6

119. Porosity used in these equations should be effective porosity, not total porosity. Effective porosity in fine-grained materials may be one-tenth the total porosity or less. Hence, these calculations would be significantly altered.

The following comments are from a letter dated June 13, 1997, from Mr. Tom Lorenz, Remedial Project Manager of U.S. EPA, Region VII, to the U.S. Army Corps of Engineers and the Department of Energy, regarding the remediation of the Groundwater Operable Units at the Chemical Plant Area, Ordnance Work Area, Weldon Spring, Missouri, and these are applicable to the Quarry Residuals groundwater remediation:

120. EPA expressed concern regarding whether sufficient information has been or will be, collected to establish the feasibility of natural attenuation. The RI has not been reviewed in response to this comment because this matter is apparently still under review by the Corps of Engineers.

The response to this comment (General Comment 6 regarding the RI) has not adequately addressed the concern regarding the appropriate reasonable maximum exposure scenario, which should involve groundwater consumption. As previously commented, existing institutional constraints on groundwater usage cannot appropriately be used as a basis for eliminating this exposure pathway in the baseline risk assessment. The response to comments maintains that groundwater usage is unlikely; however, barring formal institutional controls for the use of this groundwater, elimination of this exposure pathway is inappropriate.

121. The RI indicates it is unlikely that the shallow bedrock aquifer would be used as a water source because low yields and the casing requirements associated with wells screened in this unit. Yields in fractured bedrock aquifers are not universally low as evidenced by the 10^{-2} centimeters per second (cm/s) hydraulic conductivity referenced in Section 3.2.2.1. The

RI indicates that a well with 80 feet of casing would be open to both the weathered and unweathered portions of the Burlington-Keokuk Limestone as opposed to only the upper weathered portion. Both hydro stratigraphic units are part of the shallow bedrock aquifer, consequently, a well screened in either the lower or the upper and lower units would not be isolated from contamination by an intervening confining unit. The RI should address these issues as well as the possibility of the shallow aquifer potentially being used as a water source.

The RI indicates the shallow aquifer is inadequate for use as a future water resource, based in part on a 1989 pumping test with a maximum sustainable pumping rate of 0.3 gallon per minute (gpm). The variable hydraulic conductivity results reported in Section 3.2.2.1 suggest wells located elsewhere in the aquifer might be considerably more productive than those tested in the Chemical Plant Area. The use of groundwater from the shallow aquifer should not be categorically ruled out unless formal institutional controls prohibiting such use are in place.

We believe the intent of the response was to convey that 0.3 gallons per minute was not a large enough recharge rate to sustain a typical residence with four occupants. That scenario is only valid if the residence relies on groundwater for immediate use. In fact a simple solution to low yield wells is to install a cistern and replenish the cistern from the groundwater. Using that approach there would be in excess of 12,000 gallons of water per month available to the household (0.3 gallons per minute x 60 min/hr; 18 gal/hr x 24 hr/d = 432 gal/day; 432 gal/day x 30 day/month = 12,960 gallon per month). A typical household of four would be expected to average 5,000 to 6,000 gallons per month. Therefore the low yield rate of the area does not preclude the possibility of using shallow groundwater for a water supply.

The RI does not address whether there are geochemical differences between the hydro stratigraphic units identified in the upper rock aquifer. The RI should address whether the distinction between the two units is based strictly on physical properties or on geochemical evidence as well. It does not appear that the RI has been revised to incorporate DOE's response to the comment.