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From:	Lemont, Stephen
Sent:	Monday, November 30, 2015 9:39 AM
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Cc:	skibinskij@leidos.com; James Prikryl; aminor@swri.org; Pat LaPlante (plaplante@swri.org); gwalter@swri.org
Subject:	NRC Questions and Clarification Requests on Army's 10-1-15 JPG EIS RAI Responses and Related Matters
Attachments:	NRC QUESTIONS AND CLARIFICATION REQUESTS ON ARMY'S RAI RESPONSES FOR JPG DU IMPACT AREA EIS, NOV. 30, 2015.pdf
Follow Up Flag:	Follow up
Flag Status:	Flagged
Categories:	Yellow Category, Green Category, Purple Category, Blue Category, Orange Category, Red Category

Bob,

The U.S. Nuclear Regulatory Commission (NRC) thanks the Army for submitting the October 1, 2015, *"Additional Responses to Nuclear Regulatory Commission May 8, 2015, Request for Additional Information for Environmental Review of License Amendment Request for Jefferson Proving Ground Depleted Uranium Impact Area License Termination, Materials License SUB-1435."* NRC staff and our contractor's staff have completed review of this submittal, and our evaluation found that follow-up information or clarifications are needed from the Army for the responses to NRC Requests for Additional Information (RAIs) WR-1, WR-4, WR-7, POH-5, CI-1, and CI-2. The NRC's questions and clarification requests are presented in the attachment to this email.

In addition, based on our ongoing assessment of the Army's Environmental Report (ER), the attachment also includes a small number of requests for other information needed by NRC staff to complete the NRC's Draft Environmental Impact Statement (EIS). These include the need for follow-up information on one aspect of the Army's earlier RAI WR-3 response and on ER Figures 1-2 and 6-2.

Please review the attachment and then let me know the date by which the Army will be able to submit its written responses to the attached NRC requests. The NRC appreciates the Army's cooperation in responding to our present requests and in working with the NRC in general on the resolution of our RAIs, thus assisting NRC staff in the completion of our Draft EIS. For your convenience, I have copied Joe Skibinski of Leidos, Inc. on this email.

Please do not hesitate to contact me with any questions the Army or its contractors may have. In addition, NRC staff encourages, and will gladly participate in, one or more conference calls with the Army and its contractors, as needed, to discuss our present questions and clarification requests or any other project-related issues.

Thanks,
Steve

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NRC QUESTIONS AND CLARIFICATION REQUESTS ON U.S. ARMY'S REQUEST FOR ADDITIONAL INFORMATION RESPONSES FOR JEFFERSON PROVING GROUND DEPLETED URANIUM IMPACT AREA ENVIRONMENTAL IMPACT STATEMENT NOVEMBER 30, 2015

INTRODUCTION

The U.S. Department of the Army (Army) submitted additional responses to the U.S. Nuclear Regulatory Commission (NRC), dated October 1, 2015, to the NRC's May 8, 2015, Requests for Additional Information (RAIs) for the Environmental Impact Statement (EIS) for the proposed termination of NRC Materials License SUB-1435 for the Jefferson Proving Ground (JPG) Depleted Uranium Impact Area (DU Impact Area). These additional responses were for the following RAIs: RR-1, WR-1, WR-2, WR-4, WR-7, WR-8, CC-1, POH-2, POH-4, POH-5, CI-1, CI-2, CI-3, CI-4, CI-5, MM-1, and MM-2. NRC staff's evaluation of the Army's responses found that follow-up information or clarifications are needed for the responses to RAIs WR-1, WR-4, WR-7, POH-5, CI-1, and CI-2.

Also, the Army submitted RAI responses to the NRC, dated July 6, 2015, for the following RAIs: GEN-1, PN-1, ALT-1, ALT-2, LU/GEO-1, WR-3, WR-5, WR-6, WR-9, AQ-1, AQ-2, POH-1, POH-3, CB-1, CB-2, CB-3, CB-4, and CB-5. By email dated July 29, 2015, the NRC requested clarifications to the Army's responses to RAIs AQ-2, POH-1, POH-3, and CB-5. By email dated October 7, 2015, the Army provided responses to the NRC's request for clarifications. NRC staff's evaluation of the Army's responses found that clarification is needed regarding one aspect of the RAI WR-3 response.

Finally, based on NRC staff's ongoing review of the Army's Environmental Report (ER) (U.S. Army, 2013), staff has also included herein information and clarification requests on ER Figures 1-2 and 6-2.

Questions on and clarification requests for the specific RAI responses and ER figures identified above are presented below. The specific questions and clarification requests are shown in **boldface type**. Please provide annotated input and output files for the additional simulations requested below, as appropriate, as was done for the Army's October 1, 2015, RAI responses. This document also includes a list of references and four attachments at the end.

QUESTIONS AND CLARIFICATION REQUESTS FOR ARMY'S RAI RESPONSES DATED OCTOBER 1, 2015

RAI WR-1

1. In RAI WR-1, the NRC requested that the Army perform and provide the results of sensitivity analyses/tests to determine the effect of the uranium distribution coefficient (K_d) on the time to peak concentration using the full range of K_ds, based on rainwater sorption and desorption (R_d) values. **Provide sensitivity analysis/test results for the Cincinnati/Rossmoyne soil, which were not included in the Army's RAI response.**

2. The NRC also requested that the Army include simulations in the sensitivity analyses in which the upper 7.5 feet (ft) of the soil column consists of Cincinnati/Rossmoyne soil. Although the Army provided the results of simulations with the upper 7.5 ft as being identified as Cincinnati/Rossmoyne soil, the lowest value of K_d used in those simulations for the upper 3.5 feet was 189 milliliters/gram (ml/g) (for Avonburg/Cobbsfork soil). The lowest value of K_d for Cincinnati/Rossmoyne soil reported in the ER (U.S. Army, 2013) is 57 ml/g. **Provide the results of soil column simulations in which the upper 7.5 ft is Cincinnati/Rossmoyne soil with a K_d of 57 ml/g.**

3. The NRC additionally requested that the Army provide a written report detailing the parameters and boundary conditions used in the requested simulations and sensitivity analyses, as well as graphs or tables showing the time histories of relative concentrations in the effluent from the column models and uranium concentrations in the soil. **Clarify the following statement on page 29 of the Army's October 1, 2015, RAI responses: "Source depth also was varied from the column model surface to 3 feet below the surface of the soil column in 1-foot increments for Avonburg/Cobbsfork and Cincinnati/Rossmoyne soil type groupings." In addition, explain the rationale for placing the source below the surface, and provide source depth for each of the simulations reported in Table WR-1-1.**

4. In reviewing the input and output files for the Finite Element Heat and Mass Transfer (FEHM) Code simulations provided by the Army, NRC staff noted that the simulations were performed with FEHM Version 3.00. NRC staff performed independent simulations using FEHM Version 3.2.0. According to the Users Manual for FEHM Version 3.2.0 (Zyvoloski, et al., 2013), the aqueous molecular diffusion coefficient of 1×10^{-9} meters^2/second (m^2/s) specified in the input can be modified in the simulations based on various models for converting the aqueous diffusion coefficient into an effective diffusion coefficient in a porous medium based on porosity and liquid saturation. NRC staff's calculations, comparing simplified versions of the Army's FEHM input files with constant sources and uniform soil column properties with analytical solutions, indicate that the FEHM calculations reported in the Army's response to RAI WR-1 used the diffusion coefficient of 1×10^{-9} m^2/s without adjustment for saturation or porosity. The manner in which FEHM adjusts the free aqueous diffusion coefficient specified in the input file has an effect on the resulting relative concentrations. **Provide an explanation as to whether or not the column simulations reported in the response to RAI WR-1 were based on an effective diffusion coefficient adjusted for porosity and saturation and, if they were, identify the model that was used to compute the effective diffusion coefficients. If the diffusion coefficients in the simulations were not adjusted for porosity and saturation, provide an assessment of the effect of such adjustments on the peak concentrations for the scenarios simulated in response to RAI WR-1.**

RAI WR-4

1. In RAI WR-4, the NRC requested that the Army provide calculations of the average annual mass of uranium transported as uranium adsorbed onto suspended sediment and uranium mass transported as uranium adsorbed onto bed load sediment at the downstream boundaries of (i) subbasins 15 and 16 on Middle Fork Creek, (ii) subbasin 122 on Big Creek, and (iii) subbasin 129 at the confluence of Big Creek and Middle Fork Creek. The NRC further requested for each of the subbasin boundaries that the Army provide the calculations of suspended and bed load sediment transport for the base

case composite K_d value of 2,200 ml/g [Appendix E, page 6-9 of the ER (U.S. Army, 2013)], for the desorption test composite K_d value of 429 ml/g, and for the sorption test composite K_d value of 7,004 ml/g [Appendix E, page 6-15 of the ER (U.S. Army, 2013)].

The rate of uranium mass release was based on calibration of the model by the Army using existing data on uranium concentrations in surface water and stream sediment, and resulted in slightly higher average dissolved uranium concentrations than have been observed. In essence, the annual uranium transport from the DU Impact Area is fixed in the model and is based on the mass of depleted uranium (DU) that has been released to the soil. However, based on the estimated rate of DU penetrator corrosion, only about 25 percent of the DU would have been released to the soil in the form of uranium salts and sorbed uranium over the approximately 20 years since the DU penetrator testing ceased and surface water and sediment sampling analysis data became available. Thus, the total mass of uranium in the form of soluble uranium salts and sorbed uranium available for release to the streams by surface water runoff and soil erosion is less for the calibration period than it would be for the future when all of the DU penetrators have corroded. In other words, the total uranium in the soil may be approximately five times greater after all of the penetrators have corroded than it was during the sampling period used by the Army for model calibration. Following this line of reasoning, the calibrated surface water model used by the Army to develop its RAI response may therefore underestimate the rate of uranium mass release to the stream in the future.

Consequently, *to* better evaluate potential future concentrations of uranium in surface water and stream sediment and to compare the results of the simulations using the Hydrologic Simulation Program - FORTRAN (HSPF) model with the calculations using the Representative Unit Volume (RUV) approach presented in the response to RAI WR-7, as was the intention of the NRC's RAI WR-7, perform additional simulations for current and future climate conditions assuming that the uranium source term to surface water in the streams is linearly scaled by the ratio of the total DU mass [(73,500 kilograms (kg)] to the mass that would have been released by penetrator corrosion during the time period of surface water and sediment monitoring. Alternatively, provide an explanation as to why the results for past surface water and sediment uranium analyses would be representative of future climate conditions.

In addition, to compare the results of the HSPF simulation with the RUV calculations in the response to RAI WR-7, provide a table of simulated average annual surface runoff and interflow rates per unit area for the subbasins containing DU.

2. The NRC also requested that the Army provide the results of surface water and sediment transport simulations that consider the effects of future climate conditions over the timeframes estimated in Section 6.4 of Appendix E (Surface Water Flow, Sediment, and Depleted Uranium Fate and Transport Model) of the ER (U.S. Army, 2013) over which uranium would be released into the surface water from corrosion of DU penetrators (1,000 to 10,000 years). The NRC noted that the requested surface water and sediment transport simulations should consider the following climate change influences: (i) the frequency and intensity of precipitation events, (ii) the frequency and intensity of floods, (iii) the ambient air temperature, and (iv) the ecosystem.

As noted in item 1 above, the DU source term used in the surface water model was fixed, such that the uranium mass loading to the streams is not sensitive to changes in future climate. If the Army changes the way it handles the DU source term in the surface water model, the uranium mass loading could become sensitive to future climate changes. If additional simulations are conducted in response to item 1 above, NRC staff expects the Army to address climate change influences to the future climate conditions used in these simulations and NRC staff will revisit the assumptions used to construct future climate conditions.

Also, although evaluation of climate change effects by the Army did not explicitly consider changes to the ecosystem, primarily changes to vegetation, these possible changes were discussed and discounted by the Army based on the assumptions that basic ecology is not expected to change unless the land use changes significantly and access to the DU Impact Area will be restricted in perpetuity. However, Section 1.2 of the ER (U.S. Army, 2013) states that for the proposed action, the institutional controls are only reliable and sustainable for the first 1,000 years after license termination. Therefore, a remaining question is whether or not land use in the DU Impact Area can be assumed to be unchanged after the first 1,000 years. Another ecological issue affecting vegetation cover that requires consideration is the increased risk and frequency of forest and grass fires that might result in increased surface runoff and erosion. **Considering the above information, provide additional simulation results based on consideration of the effects of changes in land use and vegetation patterns on the results of surface water and sediment transport simulations both before and after the first 1,000 years.**

RAI WR-7

1. In RAI WR-7, the NRC requested that the Army provide calculations of the range of possible concentrations of total dissolved uranium in soil pore waters that would result from an average uranium soil concentration in the Primary Contamination Zone (PCZ) and the Secondary Contamination Zone (SCZ). The NRC further requested that these calculations consider the mass of DU penetrators and corrosion products in each zone, the spatial area of each zone, and the range of possible uranium distribution coefficient (K_d) values in the surficial soil. Alternatively, the NRC indicated that the calculations of the dissolved uranium concentration be based on geochemical modeling, such as those reported in Table 6-7 of Appendix C of the ER (U.S. Army, 2013), and that these calculations could be used as a source in the Vadose Zone Soil Column Model.

   The NRC further indicated that if the calculations reported in Table 6-7 of ER Appendix C are used, the Army should provide an explanation of the difference between the total dissolved uranium concentration based on Table 6-7 and the concentration of dissolved uranium based on the mass of schoepite added to the soil in the geochemical model calculations and the mass of water in the soil assumed in the calculations as stated in Section 6.1.3 of ER Appendix C, and reconcile that with the statement in Section 6.3.2 of ER Appendix C that, “In all of the [pH-Redox-Equilibrium] PHREEQC calculations, the schoepite dissolves completely and, as in the K_d tests, all of the uranium goes into solution.” The NRC noted that the explanation should clearly state the mass of uranium added to the soil to perform the calculations and which, if any, processes resulted in uranium being removed from the pore water solution.

The Army addressed this part of the RAI in Sections WR-7.1 and WR-7.2 of its RAI response, based on new geochemical modeling and calculations using the RUV concept. With respect to the geochemical calculations of uranium solubility, the revised calculations for the case of enhanced CO_2 levels in the soil reported in Tables 6-9 and 6-10 of the RAI response are significantly different from those reported in Tables 6-9 and 6-10 in Appendix C of the ER (U.S. Army, 2013). Specifically, the total U(VI) molalities reported in the RAI response tables equate to 1,312 milligrams/Liter (mg/L) and 164 mg/L for the before soddyite and after soddyite precipitation, respectively. The corresponding values reported in the ER are 2.4 and 0.06 mg/L. The partial pressure of carbon dioxide (CO_2) assumed in the enhanced CO_2 calculations appears to be 10^{-2} atmospheres based on the PHREEQC model files provided by the Army. **Based on the much higher U(VI) solubility calculated for the enhanced CO_2 condition, provide an evaluation of the conditions in the DU Impact Area under which the enhanced CO_2 condition would or would not apply when estimating the potential soil pore water concentration of uranium. Also, the response using the RUV concept requires further clarification as detailed in the items that follow.**

2. The NRC also requested that the Army provide calculations of the concentration of dissolved uranium that will reach the water table at the time of peak concentration (even if greater than 1,000 years), using the calculated range of potential concentrations of dissolved uranium in the soil pore water as a source and using the Vadose Zone Soil Column Model described in Section 4 of Appendix B (Groundwater Modeling) of the ER (U.S. Army, 2013). The Army addressed this part of the RAI in Section WR-7.2 of its RAI response. **Provide the following information and clarifications related to the calculations using the RUV concept:**

    - **Regarding Section WR-7.2.2 of the response, provide an explanation as to why the pore water concentration is based on the dissolved mass of uranium divided by the total pore water volume in the RUV when the pore water mass was based on the pore water concentration as calculated by the geochemical modeling, as stated in Section WR-7.2.2.a of the RAI response.**
    - **Provide the GIS coordinates used to define the PCZ and SCZ.**
    - **Clarify the sorbed uranium surface water pathway calculations listed in the bullets on the bottom of page 91, Section WR-7.2.3, of the RAI response by providing an example calculation.**
    - **Provide justification for using the uranium concentration in the entire RUV to calculate the aqueous uranium removal rate in Table WR-7-2 when only the aqueous concentration in the upper inch of soil was assumed to be removed. Also, clarify the calculation of DU mass lost through the surface water runoff pathway listed in Table WR-7-2 by providing an example calculation.**
    - **Clarify the annual DU mass releases and times for complete DU penetrator release listed in Table WR-7-4 by providing an example calculation.**
    - **Clarify the aqueous DU mass in the RUV listed in Table WR-7-5 by providing an example calculation.**
    - **Provide justification for calculating the leachate concentrations listed in Table WR-7-6 based on the mass of dissolved uranium in the RUV divided by the recharge rate. Under equilibrium conditions, the pore**

water concentration would be determined by the solubility of uranium salts and the distribution coefficient. Thus, the concentration in the pore water would be fixed and independent of the recharge rate until the soluble uranium salts in the RUV are depleted.

- **Clarify the rationale for applying the Dilution Attenuation Factors (DAFs) determined from the column modeling reported in the Army's response to RAI WR-1 to the leachate concentrations listed in Table WR-7-6 in order to calculate the uranium concentrations at the water table listed in Tables WR-7-9 and WR-7-10. NRC staff understands that most of the column model simulations reported in the response to RAI WR-1 were performed by specifying a relative concentration of 100 for a specified time period to the surface of the soil column (as noted in the comment above on the WR-1 response, some simulations appear to have the source below the surface). For those column simulations with the source at the surface, the DAF already accounts for dilution of the source pore water concentration and the DAF should be applied only to the source pore water concentration in the RUV and not to the already diluted leachate concentration from the RUV listed in Table WR-6.**
- **Clarify the content of Table WR-7-8. The column titles seem to indicate that all of the DAFs are for the Avonburg/Cobbstock soil, but the note implies that they may be for other soil types.**

3. The NRC further requested that the Army provide calculations of the areal extent of any resulting dissolved uranium plume in the groundwater with concentrations of dissolved uranium above background levels due to the calculated groundwater uranium concentrations beneath the DU Impact Area. The NRC had requested that the calculations for the extent of the plume should be performed for a time period long enough to delineate the full extent of the area containing dissolved uranium concentrations above background concentration, even if greater than 1,000 years. For example, the NRC indicated that the calculations of the extent of the uranium plume could be performed based on simulated groundwater flow paths from the DU Impact Area or with concentrations computed using a groundwater transport model.

   The Army addressed this part of the RAI in Section WR-7.2.9 of its RAI response. The Army provided particle pathlines from the SCZ in Figure WR-7-1. However, the response in WR-7.2.9 states, "The adoption of the PCZ and SCZ introduces fundamental uncertainty into the analysis because, in reality, DU penetrators are known to cover a larger area than the PCZ and SCZ." Providing flow paths only from the boundary of the SCZ is inconsistent with this statement. For NRC staff to complete its evaluation of the area over which groundwater could potentially be contaminated by uranium from the DU Impact Area, the NRC must have a basis for the area potentially affected by uranium released from the DU Impact Area. **Provide the NRC with a figure showing groundwater flow pathlines for particles originating from the <u>boundary</u> of the DU Impact Area. This figure should show the extent of the groundwater flow model domain in relation to the boundary of JPG and internal boundary conditions in the model. The illustration of pathlines should be in a form that is legible when reproduced in gray scale.**

RAI POH-5

1. RESRAD-OFFSITE output files provided by the Army with its RAI POH-5 response appear incomplete and do not consistently provide the same output information for each set of runs. **Review all the files and provide any missing files, or better describe the existing file structure relative to the analysis runs to make the suite of output files provided for each set of runs more consistent and transparent to the analysis. Some examples follow:**

   - **Only two output files \RAI POH-5\POH-5 Onsite Farmer (PCZ).zip\POH-5 Onsite Farmer (PCZ)\Sensitivity Extended Time. The code generates several output files; therefore, this directory appears incomplete.**
   - **Probabilistic output files labeled MCSUMMARY were not provided for all sets of runs such as in \RAI POH-5\POH-5 Onsite Farmer (PCZ).zip\POH-5 Onsite Farmer (PCZ)\Base Case Extended Time.**

2. **Clarify the Figure POH-5-8 caption on page 146 of the RAI response. The caption indicates that the figure is showing dose, but the Y axis is labeled in concentration units and the text that cites the figure describes the figure as presenting concentration results.**

RAI CI-1

1. On page 150 of the Army's RAI CI-1 response, the description of U.S. Department of Defense (DoD) programs for addressing unexploded ordnance (UXO) and munitions constituents (MCs) on Non-Operational Ranges states:

   > *"[Military Munitions Response Program] MMRP eligible sites include other than operational ranges where UXO, [Discarded Military Munitions] DMM, or MCs are known or suspected and the release occurred prior to 30 September 2002."*

   Clarify the meaning of "*the release*" in the above quoted sentence because it is not otherwise defined or described in the Army's response. Additionally, clarify whether the above statement about MMRP eligibility would limit the future eligibility of the JPG areas north of the firing line as an MMRP site [e.g., DoD Environment, Safety, and Occupational Health Network and Information Exchange (DENIX) site JPG-001-R-01 described in Section CI-1.2 on page 163 of the Army's response] if and when the site status becomes non-operational. For example, with regard to UXO, do munitions constituents need to be released into environmental media (e.g., soil, surface water, groundwater) for the MMRP program to apply? Additionally, would the applicable MMRP investigations and response actions only address the environmental media concentrations of those constituents, or would MMRP address the potential for releases from the broader inventory of munitions constituents in UXO that have intact shell casings but could corrode and release constituents into the environment? Further, if the MMRP program is limited to already released constituents, then clarify whether or not MMRP or any other Army programs require the Army to evaluate and address, as necessary, the potential for any future releases of munitions constituents from the existing UXO inventory within and surrounding the DU Impact Area.

This information is needed because, for NRC staff to evaluate the potential for cumulative impacts in the EIS, the staff needs an explicit understanding of the applicability of the Army's existing programs, plans, and actions with regard to UXO. This understanding will help NRC staff to understand whether there is a potential for other actions to generate impacts that could overlap and accumulate with impacts from the proposed action or whether a reasonable likelihood exists that any potential impacts would be mitigated by existing Army programs, plans, or actions. Considering the limited information about the quantities, long-term fates, and potential impacts of the MCs in UXO at JPG (RAI CI-2), and the present absence of Army plans for long-term monitoring, information about any applicable programs and requirements that would address potential future hazards is needed to support NRC staff assumptions about the likelihood the Army would assess, detect, and mitigate potential future impacts.

2. Page 151 of the Army's RAI response contains the following passage:

> *"U.S. Department of Defense Manual (DoD-M) 4715.20, Defense Environmental Restoration Program (DERP) Management (9 March 2012), states,'…In accordance with the DoD and [Environmental Protection Agency] EPA Memorandum (Reference (ak [DoD/EPA 2000])), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is the DoD-preferred response mechanism for addressing UXO on other than operational ranges.' If JPG was eligible for inclusion on the MMRP inventory of [Munitions Response Sites] MRSs, the CERCLA response process would have been followed to address munitions and explosives of concern (MEC) at JPG. However, since [Indiana Air National Guard's] INANG's Primary Range and the [Precision Guided Munitions] PGM Range, an operational range, covers a large portion of remaining JPG property north of the firing line, including the entire DU Impact Area, the UXO, DMM, and MCs from previous Army activities are ineligible for funding under the MMRP. When the Jefferson Range eventually closes, DERP requires INANG or the Army to add it to the range inventory and prioritize the MRSs using MRSPP."*

The above statement describes that when the INANG *Jefferson Range* closes, DERP requires INANG *or the Army* to add it to the range inventory and prioritize the MRSs using MRSPP; however, it does not provide a clear statement about what DERP requires of the Army regarding JPG UXO, DMM, and MC's separate from the INANG responsibilities for the *Jefferson Range* (which are described in the third paragraph on Page 164 of the RAI response *as "limited to MCs associated with their operations"*). **Clarify what DERP requires the Army to do regarding the UXO, DMM, and MCs from previous Army activities at the JPG areas north of the firing line when the JPG range status changes from "operational" to non-operational. In this clarification, address, as was done for the INANG *Jefferson Range* in the quoted text above, the required actions regarding MMRP and adding MRSs to the range inventory and applying the MRSPP.** This information is needed for NRC staff to fully understand whether the Army MMRP program would be applied in the future to continue addressing the potential hazards and response actions for munitions and explosives of concern at JPG including UXO. Because the MMRP follows the CERCLA process, the application of the program in the future following the cessation of operations at JPG would provide the NRC with a more substantive and factual basis for evaluating the potential impacts of actions at JPG occurring concurrent with the proposed action while taking into account the potential mitigations associated with programs affecting the further evaluation and disposition of the munitions and explosive materials.

RAI CI-2

The second paragraph on page 188 of the Army's RAI CI-2 response contains the following statement:

> *"Despite the reported relatively low degradation rates for [Royal Demolition Explosive] RDX and [Her Majesty's Explosive] HMX, it is likely that most or all of these residual explosives exposed to the environment have fully degraded at JPG."*

Clarify whether the Army has a t**echnical bas**i**s for this statement because no supporting studies or information sources were referenced. If the Army has a technical basis, then provide that information. While Table CI-2-8 in the RAI response quantifies the degradation rate**s **of HMX and RDX from exposure to ultraviolet light (photolysis) as short (on the order of days), this information would appear to be inapplicable to subsurface conditions. Additionally, the biotransformation/biodegradation rates for RDX are characterized in the Army's response (Table CI-2-8) as being limited for aerobic degradation in soils but occurring under anaerobic conditions. Additionally, clarify the intended meaning of "exposed to the environment" in the quoted statement above (i.e., does it mean released to the environment, or exposed to environmental conditions by a breach of a canister, or something else).** The clarification and technical basis for the statement about the degradation of RDX and HMX at JPG is needed to support the NRC staff's evaluation of cumulative impacts in the EIS.

<u>CLARIFICATION REQUEST FOR ARMY'S RAI WR-3 RESPONSE DATED JULY 6, 2015</u>

RAI WR-3

In RAI WR-3, the NRC had requested that the Army provide Microsoft Excel spreadsheets, or a database that can be converted into Microsoft Excel spreadsheets, containing the results of all surface water, groundwater, soil, sediment, and deer tissue data reported in the Data Presentation Tables in Appendix F of the ER (U.S. Army, 2013). The spreadsheet named BORE_1 provided by the Army in its RAI response contains two rows under the row heading "pH." The first row appears to contain the pH measured for the soil sample, but the second row contains N/A. **Clarify whether or not the row labeled pH contains the value of pH determined for the sample.**

<u>QUESTIONS AND CLARIFICATION REQUESTS ON FIGURES PRESENTED IN THE ARMY'S ENVIRONMENTAL REPORT</u>

ER FIGURE 1-2, "SITE LAYOUT"

In the ER (U.S. Army, 2013), the Army describes two trenches created by repeated DU penetrator impacts along the 500-Center and J firing line. As described in Section 6.1.3.3.2 of the ER, these two DU trenches are areas of elevated radioactivity based on gamma radiation measurements. The location of the DU trench along the 500-Center firing line position is depicted in Figure 1-2 of the ER. However, the location of the DU trench along the J firing line is not depicted in any figures presented in the ER. The location of the DU trenches together with the quantity of DU fired from the three DU firing positions provides information to quantify the spatial distribution of residual DU penetrators within the DU Impact Area. **Provide a revised ER Figure 1-2 to depict the location of the DU trench along the J firing line. This figure needs to be legible in gray scale.**

ER FIGURE 6-2, "EXPOSURE RATE OF 14 µR/hr FROM SOIL"

NRC staff could not locate the information presented and described in ER Figure 6-2 in the cited Scientific Ecology Group, Inc. (SEG) reference document, *"Jefferson Proving Ground Depleted Uranium Impact Area: Characterization Survey Report"* (SEG, 1996). **Review the caption and reference for Figure 6-2 in the ER (U.S. Army, 2013) and provide any necessary corrections or clarifications to ensure the data being presented in the figure match the caption and the cited reference.**

Based on NRC staff's review of available Army site characterization information for the DU Impact Area, staff believe that ER Figure 6-2 may be showing the gamma exposure rate measurements within the DU Impact Area which exceed the 95 percent confidence interval about the mean of all gamma exposure rate measurements rather than the areas corresponding to a DU concentration of 35 picocuries/gram (pCi/g) as stated in Section 6.1.1.2 on page 6-6 of the ER (U.S. Army, 2013). NRC staff consider the "95 percent confidence interval" information to be useful for broadly describing the areas within the DU Impact Area that have elevated concentrations of DU, but need a clearer understanding of information that is being presented in ER Figure 6-2 as well as the origin of that figure. The following paragraphs provide additional details.

The Army's cited source for ER Figure 6-2, "Exposure Rate of 14 µR/hr from Soil" (see attached below), is SEG (1996). Section 6.1.1.2 on page 6-6 of the ER text describes what is presented in the figure as follows: "*The exposure rate corresponding to a DU concentration of 35 pCi/g is 14.4 microRoentgens per hour (µR/hr). The contour map showing areas with an exposure rate <u>greater than 14.4 µR/hr</u> is shown in Figure 6-2*." (emphasis added). The closest match that NRC staff located in the cited source document (SEG, 1996) for the above is Figure 5-2 (see also attached below). SEG (1996) Figure 5-2 appears to be conveying the same information according to the figure caption (Figure 5-2, "Affected Area at 35 pCi/gm (14.4 µR/hr"); however, the marked "affected area" contours on Figure 5-2 are noticeably smaller than those depicted in ER Figure 6-2. The text of Section 5.1 on page 5-2 in SEG (1996) states: "*The exposure rate corresponding to a DU concentration of 35 pCi/g is 14.4 µR/hr. This value is programmed into the mapping software, to define a new affected area. The resulting affected area contour map based on the exposure rate is shown in Figure 5-2."* Thus, the captions and descriptions on ER Figure 6-2 and SEG (1996) Figure 5-2 are consistent, but the depicted graphics are different.

Further evaluation by NRC staff resulted in locating Figure 5-1 (see also attached below) in the *"Jefferson Proving Ground Depleted Uranium Impact Area: Scoping Report"* (SEG, 1995). This figure illustrates information that matches the elevated gamma exposure contours shown in ER Figure 6-2 (i.e., the same or very similar data are presented). The caption of Figure 5-1 in SEG (1995) is "*Impact area with dose rates greater than or equal to <u>13.3 µR/hr</u>*" (emphasis added). The text of Section 5.0 on page 5-2 of the SEG (1995) report describes Figure 5-1 as follows: "*…the radiation contour map for the 95% confidence level upper bound is shown in Figure 5-1. The areas shown are considered to be affected areas for the JPG firing range."* The contours presented in SEG (1995), Figure 5-1 are those radiation measurements that were at or beyond the upper bound of the 95% confidence interval about the mean of all 25,098 gamma measurements in the DU Impact Area. Additionally, the SEG (1996) report shows what appear to be the same contours depicted on a clearer graphic, Figure 3-5 (see also attached below); however, Figure 3-5 is used to show soil sampling locations and the text of SEG (1996) does not specifically describe the contour information in that graphic. In summary, the contours of both figures SEG (1995) Figure 5-1 and SEG (1996) Figure 3-5 appear to match the contour data depicted in ER Figure 6-2 but not that figure's caption.

ATTACHMENTS (see below)

Figure 6-2 (U.S. Army, 2013)
Figure 5-2 (SEG, 1996)
Figure 5-1 (SEG, 1995)
Figure 3-5 (SEG, 1996)

REFERENCES

DoD/EPA. Memorandum from Sherri W. Goodman (DoD) and Timothy Fields, Jr. (EPA), March 7, 2000, "Unexploded Ordnance (UXO) Management Principles." Washington DC: Department of Defense, U.S. Environmental Protection Agency. Available at http://www.denix.osd.mil/mmrp/upload/UXO-Management-Principles.pdf.

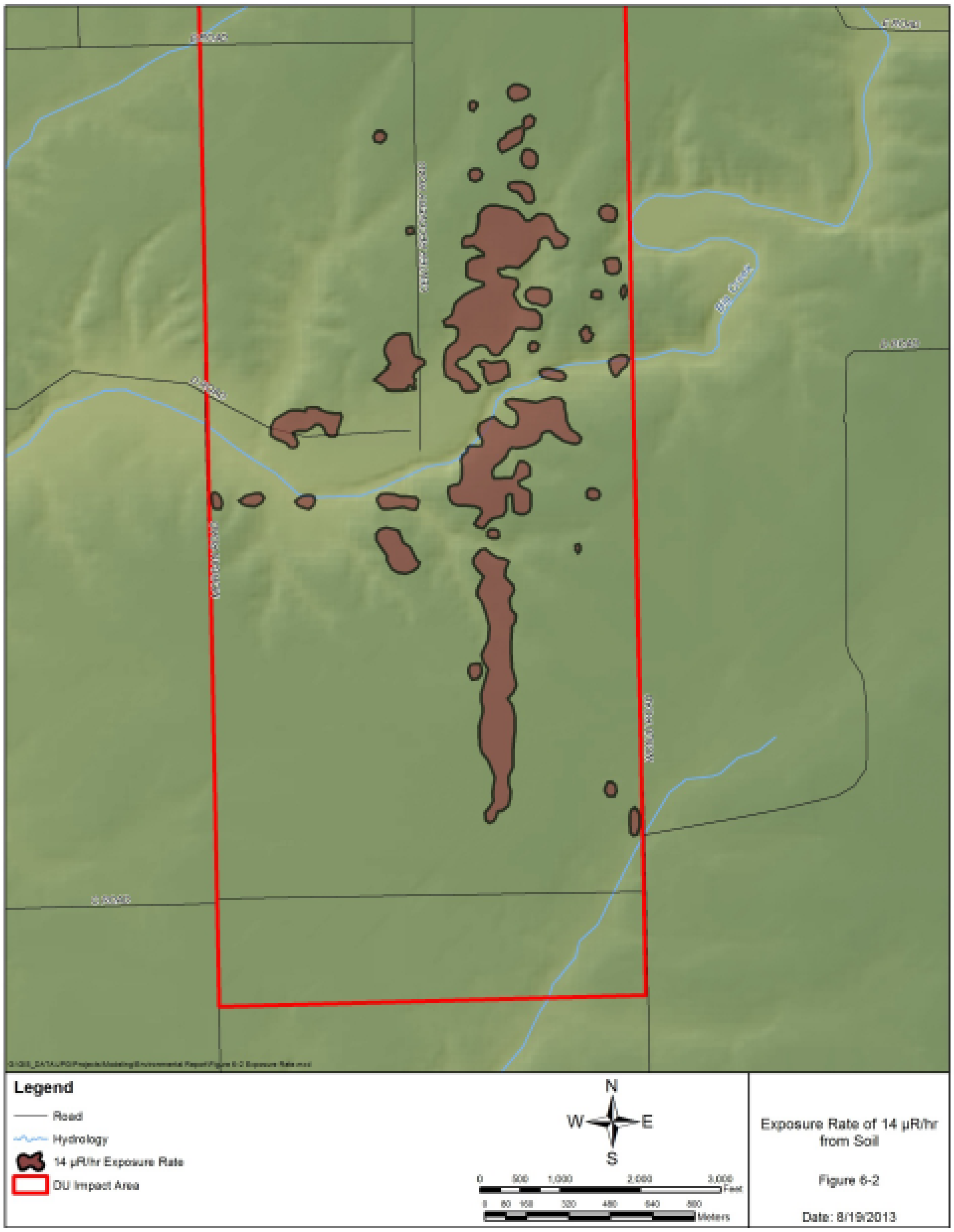
SEG (Scientific Ecology Group, Inc.). "Jefferson Proving Ground Depleted Uranium Impact Area: Scoping Report." Vol. 1, Survey Report. ADAMS Accession No. ML15331A114. Oak Ridge, Tennessee: Scientific Ecology Group, Inc. 1995.

SEG. "Jefferson Proving Ground Depleted Uranium Impact Area: Characterization Survey Report." Vols. 1 and 2, Rev. 0. ADAMS Accession Nos. ML15331A122 and ML15331A124. Oak Ridge, Tennessee: Scientific Ecology Group, Inc. 1996.

U.S. Army. "Army's Environmental Report for NRC Materials License SUB–1435 Depleted Uranium Impact Area Jefferson Proving Ground, Madison, Indiana." ADAMS Accession Nos. ML13247A557–ML13247A563 and ML13247A554. Rock Island, Illinois: U.S. Department of the Army; Louisville, Kentucky: U.S. Army Corps of Engineers. 2013.

Zyvoloski, G.A., B.A. Robinson, Z.V. Dash, S. Kelkar, H.S. Viswanathan, R.J. Pawar, P.H. Stauffer. "FEHM UM V3 Appendix for Software Release FEHM Version 3.2.0; Addendum to Software Users Manual (UM) for the FEHM Application Version 3.1.0, LA-UR-12-24493." Los Alamos, New Mexico: Los Alamos National Laboratory. July 2013. Available at https://fehm.lanl.gov/docs/FEHM_UM_V3_Appendix_V3.2.pdf.

ATTACHMENTS:



Source: SEG 1996

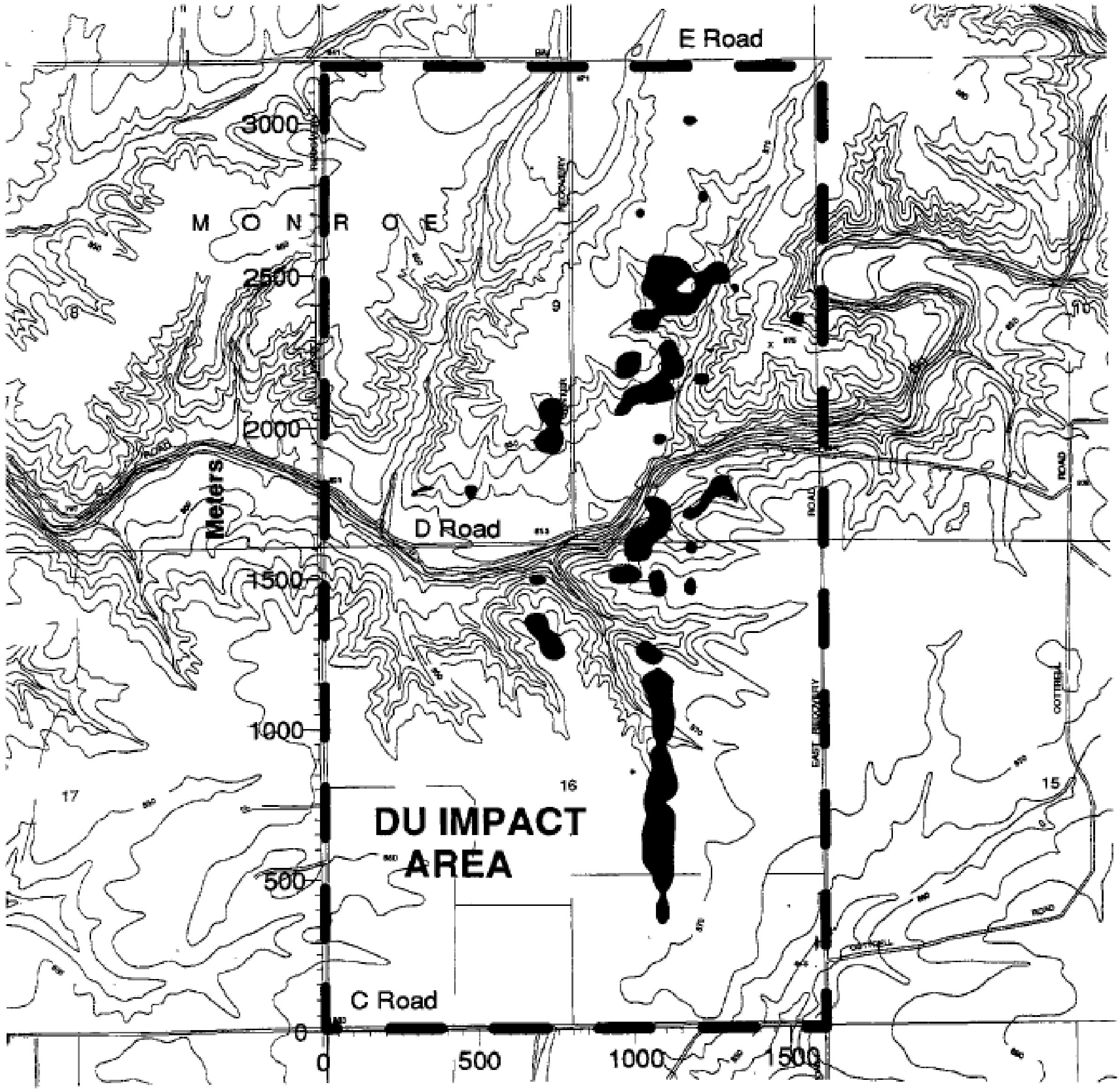
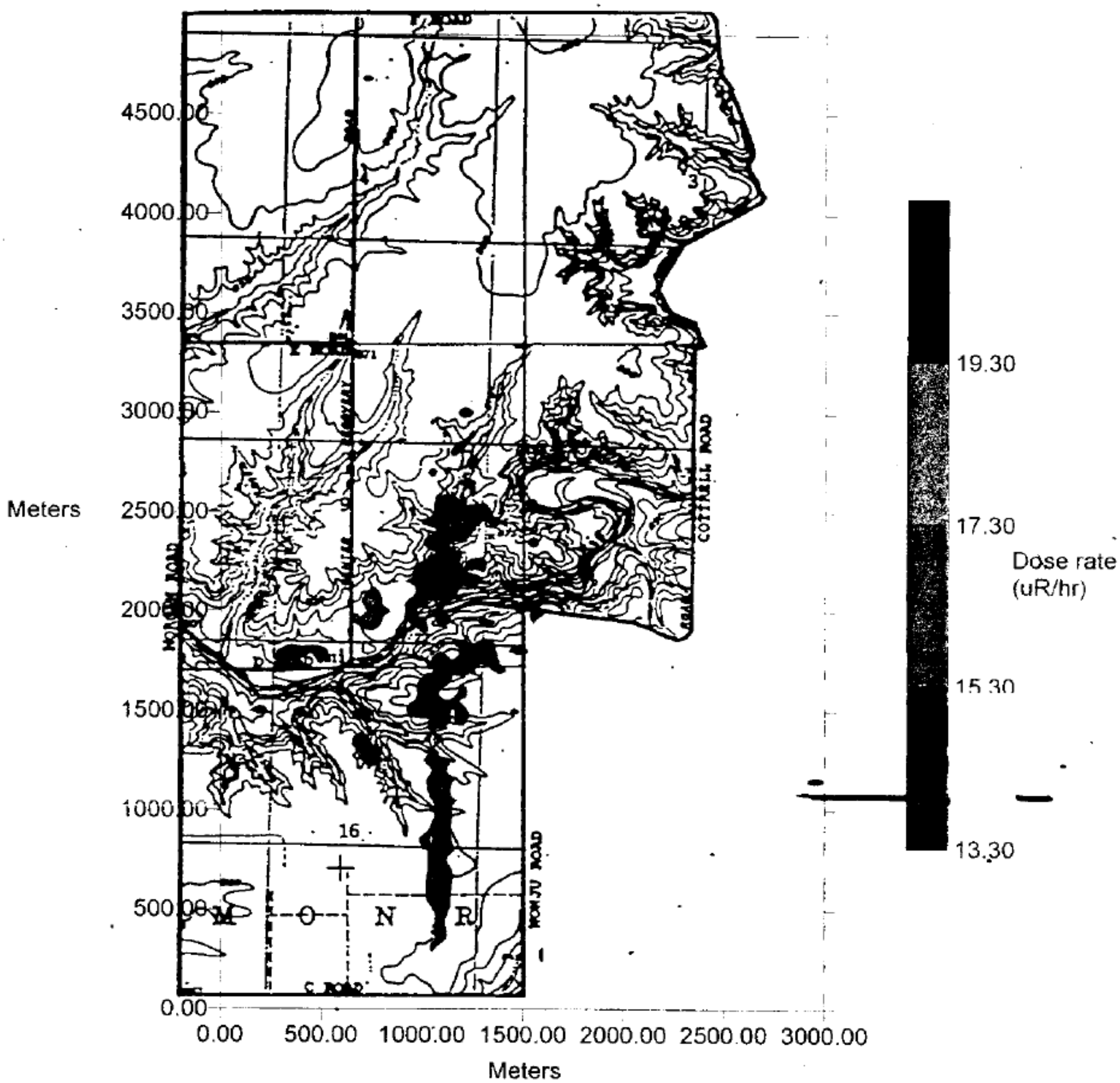


Figure 5-2
Affected Area at 35 pCi/gm (14.4 μR/hr)

Jefferson Proving Ground

Affected Portions of the DU Impact Area at the 95% Confidence Level



Impact area with dose rates greater than or equal to 13.3 uR/hr

Figure 5-1

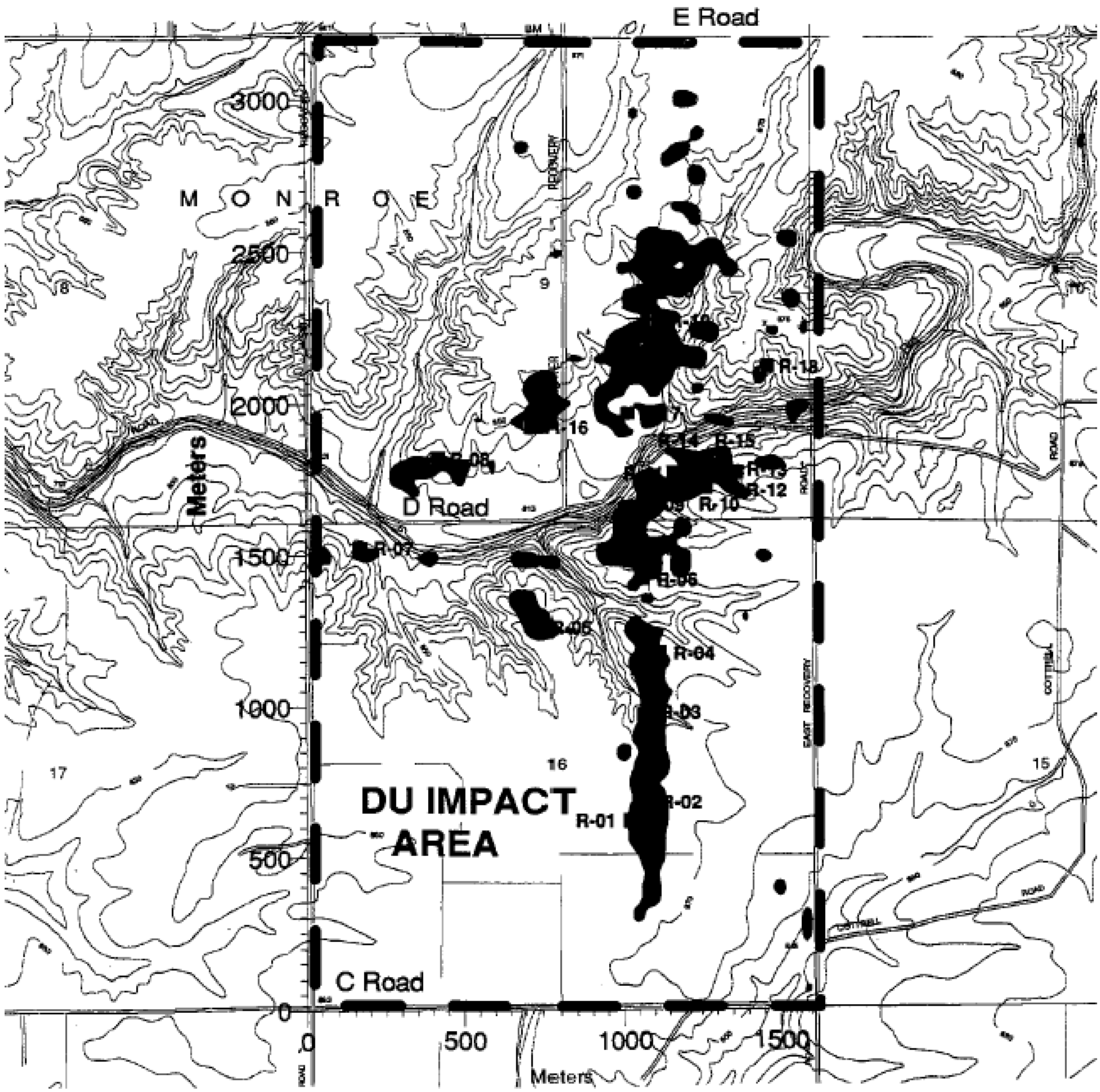


Figure 3-5
Random Soil Sample Locations
(Sample taken at center of 50 meter Square Grid)