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NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

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OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

Before Administrative Judges:

Alan S. Rosenthal, Chair
Dr. Paul B. Abramson
Dr. Richard F. Cole

In the Matter of	)	Docket No. 40-8838-MLA
	)	
U.S. ARMY	)	ASLBP No. 00-776-04-MLA
	)	
(Jefferson Proving Ground Site)	)	August 17, 2007
	)	

ARMY'S INITIAL STATEMENT OF POSITION ON SAVE THE VALLEY CONTENTION B-1

Pursuant to 10 C.F.R. § 2.1207 (a) (1) and the Atomic Safety and Licensing Board's ("Board") Scheduling Order dated May 15, 2007 ("Scheduling Order"), Applicant the United States Army ("Army") hereby submits its Initial Statement of Position ("Statement") on Save The Valley Contention B-1 ("STV Contention B-1"). This Statement is supported by the Testimonies of Harold W. Anagnostopoulos, Michael L. Barta, Todd D. Eaby, Joseph N. Skibinski, Stephen M. Snyder and Paul Cloud, respectively, as to STV Contention B-1 – FSP Contentions ("Army Direct") and exhibits thereto, being filed simultaneously herewith.

I. INTRODUCTION

On April 27, 2006, the NRC Staff issued License Amendment Number 13 to Materials License SUB-1435. The License Amendment permits the Army to implement an alternate schedule for the submission of a decommissioning plan for Jefferson Proving Ground, Madison, Indiana. Pursuant to 10 CFR §2.309,

TEMPLATE= SECY-055 SECY-02

Save The Valley ("STV") intervened, requesting a hearing on several contentions.

One of the amended "final" contentions proposed by STV was Contention B-1,[1] which asserts that, as filed, the Field Sampling Plan ("FSP") is not properly designed to obtain all of the verifiable data required for reliable dose modeling and for accurate assessment of the effects on exposure pathways specific to the JPG site and its surrounding area.

The Board, in its Memorandum and Order dated December 20, 2006, ruled that Contention B-1 satisfied the admissibility requirements imposed by 10 C.F.R. § 2.309(f)(1). STV's remaining contentions were not admitted. In that order, the scope of STV Contention B-1 was clarified by the Board as follows:

> ". . . this proceeding is limited to whether the Licensee's proposal for characterizing the JPG site during the alternate schedule period – i.e. the next five years – is: (1)'necessary to the effective conduct of decommissioning operations'; (2) will 'present no undue risk from radiation to the public health and safety'; and (3) 'is otherwise in the public interest.' 10 C.F.R. § 40.42(g)(2). In order for a contention to be considered 'within the scope of th[is] proceeding' (10 C.F.R. § 2.309(f)(1)(iii)), it must challenge one of these three criteria. Intervenor's Contention B-1 was admitted by the Board because it challenged the adequacy of the Licensee's FSP, by which the Licensee will ultimately characterize the site and eventually produce an effective decommissioning plan." Id, at pg. 17.

II. FSP CONTENTIONS

STV's Contention B-1 alleges that: "As filed, the FSP is not properly designed to obtain all of the verifiable data required for reliable dose modeling and accurate assessment of the effects on exposure pathways of meteorological, geological, hydrological, animal, and human features specific to the JPG site and its surrounding area."

It is STV's conclusion that, if the site characterization is inaccurate or invalid, the calculations and determinations required to predict future effects on public health and safety will be correspondingly erroneous, and the conceptual site model will be invalid.

STV's Contention B-1 was originally supported by Basis Items "a" through "r" and by Basis Item "d" which was submitted in support of its disallowed Contention A-1 in so far as that basis is applicable to Contention B-1. STV has subsequently withdrawn its Basis Items "l", "p" and that part of "q" pertaining to calculation of DU dissolution rates in multiple soil samples.

In addition, STV has presented no testimony or other evidence in support of its Basis Item "j" to Contention B-1 (K_d as an input parameter in exposure calculations), Basis Item "k" to Contention B-1 (analysis of DU penetrators for transuranics) or Basis Item "r" to Contention B-1 (objection to dual role of project manger and independent technical review team leader). In the absence of STV evidence supporting these three bases, the Army is assuming that these Basis Items have been withdrawn also and presents no rebuttal evidence.

Broadly, STV has identified two primary concerns regarding JPG site characterization. First, STV claims that without adequate site characterization, the Army cannot properly estimate the immediate and long-term risks to public health and safety from radiation resulting from an indefinite delay in decommissioning and decontamination. Second, STV claims that without expanded and improved groundwater and surface water monitoring, the Army will not be able to assess the current level of risk and whether that risk is increasing over time as decommissioning and decontamination are delayed.

III. APPLICABLE LEGAL STANDARDS AND ARMY'S POSITION ON LEGAL ISSUES

The criteria for granting an alternate decommissioning schedule, as found in 10 CFR § 40.42(g)(2), are recited in the Board's order of December 20, 2006, as quoted above. As the Board has recognized, implicit in one criterion (i.e.

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[1] Final Contentions of Save The Valley, dated May 31, 2006.

"necessary to the *effective conduct* of decommissioning operations" (emphasis added)) is the issue of whether the site characterization work undertaken as part of the alternate scheduling will produce sufficient data to support a viable decommissioning plan.

The requirements for such a viable decommissioning plan are set forth at 10 CFR § 40.42(g)(4)(i). The plan must include a description of the conditions of the site or outdoor area "sufficient to evaluate the acceptability of the plan". The sufficiency of a plan for license termination under restricted conditions is, in turn, governed by 10 CFR §20.1403(b), which requires that the licensee "provide reasonable assurance that the TEDE (Total Effective Dose Equivalent) from residual radioactivity distinguishable from background to the average member of the critical group (the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances) will not exceed 25 mrem (0.25 mSv) per year."

As set out in §20.1403(b), the focus of the decommissioning process is the protection of human health. The object of site characterization activity is to collect data associated with the potential for human radiological exposure.

As will be more specifically demonstrated by Army's witnesses, the data currently being collected, together with the logical progressions to additional characterization efforts based on the results of the data obtained, is sufficient to insure that an effective decommissioning plan will be produced.

III. ARMY'S STATEMENT OF POSITION ON FACTUAL ISSUES

Army's testimony on STV Contention B-1 will be presented by a panel of six experts, each with extensive experience in their respective fields. All have participated in the ongoing site characterization activities at JPG.

Witnesses Todd D. Eaby and Stephen M. Snyder have been providing technical support to the Army's JPG decommissioning since early 2004. Both have participated in field work and provided oversight and technical direction of field personnel in connection with hydrogeological activities.

Witness Harold W. Anagnostopoulos is a certified health physicist and has acted as the Army's radiological technical consultant relating to the planned decommissioning of JPG.

Joseph N. Skibinski is an environmental chemist and human health risk assessor with SAIC. He has been providing technical support to the Army's JPG facility since early 2004 and has been project manager for SAIC at JPG since February 2006. Michael L. Barta leads the biota sampling efforts and serves as deputy project manager for SAIC on the planned decommissioning of JPG's NRC materials license.

The evidence provided by the Army's witnesses demonstrates that there is no support for the claims made in STV's Contention B-1 that the data necessary for proper decommissioning will not be obtained from the Army's site characterization activities. The site characterization activities being carried out by the Army and the SAIC team pursuant to its FSP can and will ultimately provide reasonable assurance and confidence to the NRC Staff that the TEDE from residual radioactivity, distinguishable from background, will or will not exceed 25 mrem (0.25 mSv) per year. The potential additional information to be gained by extending JPG characterization activities to include the more general ecological and environmental investigations advocated by STV's witnesses is not relevant to NRC decommissioning concerns and is significantly outweighed by the increased time, expense and danger (in terms of UXO) involved. In those instances where STV does confine itself to matters concerning radiological exposure, it fails to clearly demonstrate that additional data is necessary to satisfy the concerns of 10 CFR § 40.42(g)(4)(i) and 10 CFR §20.1403(b).

A. Understanding of Site Hydrogeology

In response to Basis Item "d" subsumed into Contention B-1 from disallowed Contention A-1, the Army and the SAIC Team have acknowledged in the past that the understanding of the site hydrogeology and fate and transport of contaminants in the environment were then insufficient to prepare an adequate

Decommissioning Plan. The Army has documented its plans to fill critical data gaps and to ensure site understanding is sufficient to document the conceptual site model of DU-related contamination in the environment to current and future receptors. These plans are discussed more fully in the testimony specifically addressing the other basis items raised by STV.

B. Electrical Imaging; Selection of Conduit Well Sites

With respect to Basis Item "a" to Contention B-1, it is Army's position that STV has misunderstood the goal of and purpose for the Electrical Imaging (EI) survey. The purpose of the investigation is not to locate all significant Karst features, but rather to identify locations where conduit wells can be drilled that will intersect Karst features. Similarly, locating the water table with the EI study is not a primary goal of the study, and is not necessary because field observations during well drilling will be used to determine the location of the water table. The use of stream gauging, as proposed by STV, will not provide significant additional information to assist in positioning wells. The stream gauging proposed by STV is a one time snapshot. The Army's evidence will show that Army's recording stream gauges and cave stream gauges will continue to measure flow after the completion of the well installation and will provide similar and more substantial information.

C. Lack of Specificity in Describing FSP Laboratory Analysis

The suggestion by STV, in its Basis "b" to Contention B-1, that a detailed program of laboratory analysis should be set out from the beginning, would not result in a plan based on actual site conditions. The Army's plan of a tiered approach based on the results of previous studies and actually determined site conditions and data will result in a more complete, accurate, and representative site characterization. The future development of the FSP and addenda will be monitored by the NRC.

D. Conduit Well Sites

In its Basis Item "d", STV seeks greater specificity at the outset in regard to rationale, placement and depth of the conduit wells. FSP Addendum 4 and the Well Location Selection Report, submitted after STV filed its Contention B-1, include details of the anticipated well depths and states that they will be based on actual subsurface site conditions observed during the drilling and installation. This flexibility to modify and design the well screen intervals based on the actual site conditions is crucial to the appropriate and successful installation of monitoring wells due to the highly variable nature of fractured and Karst aquifers.

E. Purpose of Conduit Well Installation

In its Basis Item "e", STV asserts that boreholes for the conduit wells be maintained for an unspecified time above the water table before the Army makes a decision to abandon the site. Army's evidence will show that the intent of the conduit well installation is to provide a monitoring well network at depths below the water table to be used in the characterization of groundwater and groundwater flow, not to take above water table measurements where the flow will vary greatly at any given time. Thus, the decision to abandon boreholes would be based on whether or not adequate permeability is encountered below the water table. The purpose of the well construction is to monitor and characterize groundwater. The FSP (SAIC 2005) and Addenda (SAIC 2006a, 2006b, 2007) allow the flexibility to make determinations and appropriate selections of well screen intervals based on actual observed site conditions.

F. Installation of Shallow Wells

The Army disagrees with STV's assertion, found in Basis Item "f", that all wells to be completed will be in "conduit" settings in bedrock. The Army intends to install wells, as appropriate, in unconsolidated materials, and other parts of the aquifer that would reasonably be expected to transmit groundwater. Once again, the purpose of the well construction is to monitor and characterize groundwater. The FSP (SAIC 2005) and Addenda (SAIC 2006a, 2006b, 2007) allow the flexibility to make determinations and appropriate selections of well screen intervals based on actual observed site conditions.

G. Permeability Testing

STV asserts, in its Basis Item "g", that permeability testing should be mandatory as part of a proper site characterization. It is Army's position that aquifer testing in well bores during construction provides useful information in the environment expected at JPG. Planning other types of aquifer testing is inappropriate at this point in the site characterization. The phased approach of basic data collection followed by consideration and design of aquifer testing would more likely result in appropriate aquifer testing and aquifer specific data.

H. Borehole Geophysical Testing

In its Basis Item "h", STV requests geophysical and video borehole logging. The Army's evidence will show that the present method utilized or to be utilized by the Army will provide actual soil and rock cores for examination and logging, eliminating the need for the requested borehole logging.

I. Surface Water Sampling and Stream Gauging

In a reverse of STV's recurring criticism of "not-enough-detail-in–the-FSP", Basis Item "i" asserts that specifying the number and locations of surface water sampling and gauging locations at the outset of the FSP (SAIC 2005a) implementation *"...is not acceptable practice."* The 14 specific sample locations referenced by STV in this basis and presented in the FSP are not the final surface water and sediment sampling locations. Rather, they are only used for purposes of program planning, scheduling and budgeting.

The Army actually initiated such a characterization approach in September of 2006 by installing surface water gauging stations at 10 locations including seven automatic recording stream gauge stations, two automatic recording cave stream gauging locations, and one manual/visual staff gauge monitoring location. This is in excess of the five locations originally stated in the FSP. As a result of subsequent evaluation / site observations, followed by discussions with the NRC, it was determined that the actual number of surface water gauging stations to be installed should be increased from the original plan.

Additional detail for surface water and sediment sampling will be provided in a subsequent addendum; and these further refinements to the site characterization will be monitored and evaluated by the NRC.

J. Air Sampling

Basis Item "m" asserts that the air pathway is a significant exposure pathway and the Army should be required to conduct air sampling and analysis specifically relating to controlled burns at JPG. The evidence will show that the Los Alamos National Laboratory study ("Dust to Dose") does not support STV's position. The calculated increase in dose at Los Alamos from the severely burned areas, upon which STV pins its position, is insignificant in terms of radiation exposure.

K. Environmental and Ecological Risk

STV's Basis Item "n" asserts a need for a more comprehensive research to characterize the general ecological risk attendant to the DU at JPG. It is the Army's position that there is no regulatory requirement nor any need to conduct such an extensive sampling program to collect the data necessary for decommissioning at JPG. NUREG 1757 (NRC 2006) specifies that Group 6 sites (Restricted Use) need to evaluate residual radiation doses to humans based on the use restriction and if the restrictions fail. There are no requirements in NUREG 1757 (NRC 2006) to collect biological data as model inputs or to evaluate risks to the biota themselves.

L. Ecological (Additional Biota) Sampling

STV's Basis Item "o" asserts that additional biota sampling is required in accordance with ecological risk assessment recommendations found in *Suter* (2000). As stated above, decommissioning activities focus on potential radiological risks to humans. Entrance into the DU Impact Area is restricted and fishing/clamming activities are prohibited. Since deer, turkeys, and squirrels are the only complete pathways to human receptors, there is no benefit to collecting other biota samples. Also, Army's witness Michael L. Barta, will testify that there is no data to support STV's assertion that DU levels in deer are increasing because DU was not detected in any of the 30 deer collected. The abiotic data collected according to the FSP (SAIC 2005a) and FSP addenda will be technically sufficient to revise the RESRAD model to determine if DU is a potential concern to public health.

IV. CONCLUSION.

Under 10 CFR § 40.42(g)(4)(i), a viable decommissioning plan must include a description of the conditions of the site "sufficient to evaluate the acceptability of the plan". The acceptability of a plan for restricted release license termination is measured with reference to 10 CFR §20.1403(b), which requires that the licensee provide reasonable assurance that the Total Effective Dose Equivalent from residual radioactivity distinguishable from background will not exceed 25 mrem (0.25 mSv) per year to the group of individuals reasonably expected to receive the greatest exposure.

STV and its experts misinterpret and misunderstand the locus of concern in the FSP and this decommissioning proceeding which is created by the intersection of 10 CFR § 40.42(g)(4)(i) with 10 CFR §20.1403(b).

Much of STV's analysis overstates the objectives of the site characterization proceedings. Being perhaps more familiar with risk assessment under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and similar legislation, STV and its experts often divert the discussion to inappropriately applied environmental, ecological and scholarly paradigms, instead of focusing on the need to evaluate residual radiation doses to humans. As a result, STV criticizes the Army in many instances for not providing data which it is not required to provide as part of the decommissioning process.

The objective of the FSP and site characterization activities is not to complete an ecological risk assessment or to gather the type of comprehensive data required by a remedial investigation/feasibility study paradigm to be implemented under the CERCLA. There is no regulatory requirement nor any need to conduct such an extensive sampling program to collect the data for decommissioning at JPG.

Nor is it an objective of the FSP to support a fate and transport model. The decommissioning plan will include a conceptual site model, but numerical fate and transport modeling and estimates of future off-site concentrations are not required.

In addition, when STV and its experts maintain their focus on decommissioning concerns, their analysis often contains errors in data use and interpretation. One example is their undue reliance on the Los Alamos National Laboratory's airborne DU study entitled "Dust to Dose". As demonstrated by Army witness Harry W. Anagnostopoulos, the conditions/variables studied are clearly distinguishable from those present at JPG and the ultimate findings of the study provide additional assurance that airborne exposure to DU at JPG following burns would be insignificant.

As shown by the testimony and evidence accompanying this statement, the additional information that STV would have the Army develop is either not necessary or not germane to the development of a site characterization model for decommissioning purposes.

Dated this 17th day of August, 2007.

Respectfully submitted,

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(Jefferson Proving Ground Site)	)	**August 15, 2007**
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TESTIMONY OF STEPHEN M. SNYDER ON STV CONTENTION B-1 BASIS ITEMS "a," "d," "e," AND "f"

SUBJECTS: Electrical Imaging; Selection, Installation, and Purpose of Conduit Well Sites; Installation of Shallow Wells

I. WITNESS BACKGROUND

Stephen M. Snyder ("SMS")

Q1. Please state your full name.

A1. (SMS) My name is Stephen M. Snyder.

Q2. By whom are you employed and what is your position?

A2. (SMS) I work as a Senior Hydrogeologist and Program Manager with Science Applications International Corporation (SAIC) in their Harrisburg, Pennsylvania office. SAIC acts as the Army's technical consultant and expert on selected tasks related to the planned decommissioning of the U.S. Nuclear Regulatory Commission (NRC) materials license at the Jefferson Proving Ground (JPG).

Q3. Please summarize your professional and educational qualifications.

A3. (SMS) My professional and educational experience is summarized in the résumé attached to this testimony as "Exhibit SMS #1." Briefly summarized, I am a Licensed Professional Geologist in Pennsylvania, Alabama, Mississippi, Virginia, Wisconsin, and Tennessee. I have been actively employed as an environmental consultant for 34 years.

I have experience with groundwater characterization for numerous purposes, including water supply development, landfill design and permitting, contaminant transport, and remedial investigation and remedial action. I have worked in most types of geologic environments in the continental United States, but have developed a specialty in fractured rock and Karst aquifers, which underlies the JPG site. Karst aquifers develop in soluble carbonate rocks (limestone and dolomite) and are unique in that groundwater flow pathways are dominated by solution-enhanced pathways along fractures, bedding planes, and other discontinuities in the rock, while blocks of rock between discontinuities may be nearly impermeable, transmitting little or no groundwater.

I have developed a specialty of characterizing fractured and Karst aquifers along preferential flow pathways, using a combination of aerial photo analysis and geophysical surveys. Combined with other tools, such as pumping tests, dye studies, thermal studies, analysis of stream flows, groundwater chemistry, and monitoring of water levels in wells and streams, I have characterized or assisted in the characterization of four large facilities (200 acres or more) with Karst geology in Pennsylvania, Alabama, and Tennessee. In addition, I sited numerous production wells in fractured rock aquifers for water supply purveyors, and sited or developed extraction wells and groundwater remediation systems for six projects.

I received a B.S. in Geology in 1973, from the College of William and Mary and I have completed Continuing Education in Hydrogeology at Pennsylvania State University.

Q4. Please summarize the nature of your professional involvement with JPG.

A4. (SMS) My technical support activities on the Army's JPG facility started in early 2004. I have visited JPG on two occasions and have conceptualized and guided the development of the groundwater characterization studies at JPG. I personally conducted an aerial photo fracture trace analysis of 22 square miles ,including and surrounding the Depleted Uranium (DU) Impact Area, and designed an Electrical Imaging (EI) survey for the purpose of locating monitoring wells on preferential flow pathways, which are the most likely avenues for migration of groundwater and potential migration of DU constituents with groundwater on-site and off-site. Along with the placement of stream gauging stations. I planned studies of DU penetrator corrosion and DU component migration through soils, and shallow/soil/bedrock interface zones. I am the primary author for sections in the Field Sampling Plan (FSP) that deal with DU migration pathways in groundwater and surface water.

Q5. What is the purpose of your testimony?

A5. (SMS) The purpose of my testimony is to address, on behalf of the Army, hydrological and geological issues at JPG as raised by Save The Valley (STV) as part of its Contention B-1 in these proceedings.

STV has asserted in Contention B-1 in a May 31, 2006 filing with the NRC that:

"As filed, the FSP is not properly designed to obtain all of the verifiable data required for reliable dose modeling and accurate assessment of the effects on exposure pathways of meteorological, geological, hydrological, animal, and human features specific to the JPG site and its surrounding area."

In that filing, STV provided 18 supporting bases for their contention, lettered "a" through "r" (basis "p" was withdrawn with this filing of the Final Contentions of STV.

The purpose of my testimony is to provide evidence and expert opinion that refutes the assertions and/or provides clarification to the statements made in Basis Items "a,: "d," "e," and "f".

II. OVERVIEW

Issues Raised By Basis Item "a" to STV Contention B-1

Q6. What is your understanding of the technical issues raised by Basis Item "a" of STV's Contention B-1?

A6. (SMS) STV's Basis Item "a" states:

"The EI geophysical study which will follow the fracture analysis study, as described in section 6.1 of the FSP, is supposed to find all significant karst features and location of the water table. From these studies, 10 to 20 pairs of monitoring wells are proposed to attempt to tie into 'conduits' of ground water flow. This study may help to site monitoring wells, but stream gauging studies should be an early and integral part of the search for likely conduits. The stream reaches of strong gain would be a very strong direct indicator of the discharge points of ground water 'conduits.' EI is an indirect technique and can miss conduits or identify features that are not conduits. The FSP alludes to doing stream gauging in its discussion of well location criteria, but the time table shown indicates stream studies will follow the ground water studies by a year."

STV's Basis Item "a" raises issues relating to the goal and purpose of the EI survey performed by the Army at JPG. By implication, STV asserts that the license amendment should not be approved unless the Army provides significant additional information to assist in positioning wells.

Q7. Do you agree with the assertions contained in Basis Item "a" of STV Contention B-1?

A7. (SMS) No.

III. Discussion

Electrical Imaging; Selection of Conduit Well Sites

Q8. Describe what Electrical Imaging is?

A8. (SMS) EI is a geophysical technique that measures differences in subsurface electrical resistivity at depth. Direct Current (DC) is introduced into the ground, and the resistance of the subsurface material to conducting the electricity is measured. Subsurface materials with low moisture content, like solid rock and dry sand, have high resistivity; weathered rock and silt-sized material have moderate resistivity; and clayey or saturated materials have low resistivity. A profile or cross-section is constructed from the data, showing the distribution of electrically resistant materials and electrically conductive materials. Zones of fracture-induced weathered rock are easily identifiable with EI, since they are usually saturated vertical or sub-vertical zones filled with sand, silt, and clay between blocks of solid rock. Where such features correlate with fracture traces mapped on aerial photographs, the chances are good that a well drilled on that location will intersect the network of conduits that conduct most of the groundwater through the site. The degree to which conduits develop may vary from site to site, but the procedure will locate the most likely conduit features for exploration and sampling.

Q9. Please describe the technical or analytical bases for your disagreement with STV's Basis Item "a".

A9. (SMS) There are two points made by STV in the first sentence of this Basis Item "a" that are inconsistent with the FSP and what is expected to occur as a result of the fracture trace analysis and the EI geophysical study:

- STV states that the EI geophysical study is supposed to find "*all significant karst features and location of the water table*." The purpose of the investigation is not to locate all significant Karst features, but rather to identify locations where wells can be drilled that will intersect Karst features. These features are the most likely pathways for groundwater migration through and from the site, and by installing wells into these features the groundwater flow network can be monitored and characterized. Therefore, there is no need to identify all significant Karst features in order to adequately characterize the site.

- With respect to locating the water table, it was stated in the FSP (SAIC 2005a), Section 6.1.2.7 Potential Interpretation Techniques, page 6-4, that "The resistivity difference between dry and wet material, if indicated in the observed electrostratigraphy, can represent water table depths." This does not state that the water table will be located, only that, depending on the site conditions, it may be possible, at times, to estimate the location of the water table from the results of the EI testing. Locating the water table with the EI study is not a primary goal of the study, and would not be that significant, since the location of the water table fluctuates in response to recharge. The primary goal is to locate the most likely areas that may have increased potential for preferential groundwater flow pathways so that monitoring wells may be located in zones where groundwater is migrating, and not in Karst blocks (solid blocks of unfractured bedrock with low permeability [capacity of a rock or aquifer to transmit groundwater]) and, therefore, where groundwater migration is minimal.

STV and its consultants contend that surface water gauging along the entire stream reaches of Big Creek and Middle Fork Creek in the vicinity of the DU Impact Area are necessary for the selection of drilling locations for monitoring wells intersecting groundwater conduits with the Karst aquifer. I do not believe that this type of study is necessary for appropriately selecting conduit well locations and that the results achieved from those types of investigations (i.e., gaining, losing stream reaches) may indicate broad areas where groundwater conduits intersect streams, but does not provide accurate enough resolution of the locations or any indication of the orientation of the possible groundwater conduit intersections to appropriately locate conduit well drilling locations.

Furthermore, the surface water gauging study that STV refers to would provide limited information for areas immediately along the streams and provide no useful information as to groundwater flow pathway locations in locations surrounding and inside the DU Impact Area that are not in close proximity to the streams. Fracture trace analysis and EI are certainly a more direct method for designing a groundwater monitoring network in a conduit controlled aquifer. Nine recording stream and cave stream gauges, which are measuring surface water flow continuously for 1 year, and then will continue to measure flow after wells are installed for comparison of groundwater levels to surface water flow, will provide similar and much more substantial information, rather than a one-time snap shot of stream flow, as is proposed by STV.

IV. SUMMARY AND CONCLUSION

As to Basis Item "a"

Q10. Please summarize your testimony with regard to Basis Item "a".

A10. (SMS) My testimony can be summarized as follows:

STV misunderstood the goal of and purpose for the EI survey. The use of stream gauging will not provide significant additional information to assist in positioning wells. The project should continue as presented in the FSP (SAIC 2005a) and FSP Addendum 4 (SAIC 2007a) with the selection of well locations based on the results of the fracture trace analysis and the EI survey. Following the drilling and installation of the monitoring wells, site-specific information will be obtained as to the success of locating preferential flow pathways and the extent of Karst aquifer development at the site in the vicinity of the DU Impact Area.

V. OVERVIEW

Issues Raised By Basis Item "d " to STV Contention B-1

Q11. What is your understanding of the technical issues raised by Basis Item "d" of STV's Contention B-1?

A11. (SMS) In Basis Item "d" STV stated that:

"The FSP specifies in section 6.2.4 that the 'conduit' wells will be paired, but does not describe or explain the reason(s) for the relative positions of the two wells at each well site. Presumably, the objective is to provide a means of measuring vertical gradients at each site, but that is not explained or discussed. Nor is there an indication of whether the 'paired' well will be above or below the 'conduit' well or whether that relative position would change depending upon unspecified geologic or hydrogeologic conditions."

By implication, STV asserts that the license amendment should not be approved unless the Army is required to explain in greater detail the installation of paired conduit wells at the JPG site.

Q12. Do you agree with STV's assertions in Basis Item "d"?

A12. (SMS) No.

VI. DISCUSSION

Conduit Well Sites

Q13. Please describe the technical or analytical bases for your disagreement with STV's Basis Item "d".

A13. (SMS) Monitoring well pairs are two wells constructed in close proximity to each other that are used to measure and sample at different discrete depth intervals in the aquifer. The total depth of the target investigation will be drilled and the information will be used to select the most permeable zones, into which well screens will be placed. Different depths may represent different pathways and source areas, and will be useful in determining the vertical gradient within the aquifer.

Some of the information or details that STV requests is present in other sections of the FSP (SAIC 2005a) (Section 6.2 Groundwater [page 6-4] and Section 6.2.4.3 Installation, subpart Borehole Diameter and Depth [page 6-12]).

As stated in the referenced sections of the FSP (SAIC 2005a), the final depths and screen intervals will be determined following review of the actual location subsurface conditions encountered. In addition, FSP Addendum 4, Section 2.1 Well Locations and Proposed Depths (SAIC 2007b), which was submitted after STV filed their contention, also includes details of the anticipated well depths and states that they will be based on actual subsurface site conditions observed during the drilling and installation. This flexibility to modify and design the well screen intervals based on the actual site conditions is crucial to the appropriate and successful installation of monitoring wells due to the highly variable nature of fractured and Karst aquifers.

VI. SUMMARY AND CONCLUSION

As to Basis Item "d"

Q14. Please summarize your testimony with regard to Basis Item "d".

A14. (SMS) My testimony can be summarized as follows:

Sufficient information is presented in the FSP (SAIC 2005a) and Addendum 4 (SAIC 2007a) regarding the purpose of the well pairs. The project should continue in the fashion presented in the FSP and Addendum 4 to allow the flexibility to make determinations and appropriate selections of well screen intervals based on the actual observed site conditions during drilling.

VII. OVERVIEW

Issues Raised By Basis Item "e," to STV Contention B-1

Q15. What is your understanding of the technical issues raised by Basis Item "e" of STV's Contention B-1?

A15. (SMS) In its Basis Item "e," STV states:

"The FSP also specifies in section 6.2.4.3 that a boring that does not produce enough water for a well will be abandoned. If lack of production occurs because the system is 'tight' (i.e., impermeable), that makes some sense. However, the nature of karst terrain is such that conduits may not produce water because the flow is highly transient and, unless there is a new flow event at the time of drilling

and/or testing, a well may be dry even though it has been placed in an appropriate and important location. To ensure the problem is a temporary lack of water, rather than a permanent lack of permeability, it is necessary to monitor the boring for enough time to be sure it never produces before abandoning it."

In this Basis Item STV suggests that a borehole be maintained and monitored for an unspecified amount of time above the water table.

Q16. Do you agree with the position asserted in Basis Item "e" by STV?

A16. (SMS) No.

VIII. DISCUSSION

Purpose of Conduit Well Installation

Q17. What is the basis for your disagreement?

A17. (SMS) The context of the statement from which STV developed this contention is a discussion of the anticipated depth of well pairs, which are to be targeted for 50 and 120 feet, for shallow and deep well screens, respectively. Both of these depths would be below the water table and therefore, not be subject to temporary dryness. The only reasonable cause that a borehole would not have "sufficient water to support a functional monitoring well" (quoted from the FSP [SAIC 2005a]) would be the lack of permeability or connection with the flow pathways through the aquifer, which is mentioned by STV.

What STV is intending or suggesting is that a borehole be maintained and monitored for an unspecified amount of time above the water table. Without building a dry well, this is impractical and unnecessary for the site characterization.

The intent of the conduit well installation is to provide a monitoring well network that will be used for characterizing the groundwater and groundwater flow in and immediately surrounding the DU Impact Area, not to build wells above the water table that may flood for days or minutes during storm events, if ever. Features that could possibly flood or fill with water will either drain into the groundwater conduit pathways (proposed to be monitored by installed wells) or flow through the shallow Karst network and eventually discharge to surface water through a cave stream or spring (proposed to be monitored by surface water sampling of cave streams and streams). In other words, the current monitoring well installation plan (FSP [SAIC 2005a] and Addendum 4 [SAIC 2007b]) plus the inclusion of a planned FSP addendum that will address monitoring surface water, which is likely to include sampling locations at the mouths of caves or the confluence of cave springs with creeks/streams, is sufficient to adequately characterize DU migration at the site to develop a Decommissioning Plan that meets the requirements of 10 Code of Federal Regulation (CFR) et seq.

The decision to abandon boreholes based on well yield is further refined in Section 2.1, Well Locations and Proposed Depths, of FSP Addendum 4 (2007b) as stated "The goal is to target high-permeability zones, such as fractures and solution-enhanced zones, with the screened interval.....If adequate permeability is not encountered, abandonment of the borehole will be considered."

IX. SUMMARY AND CONCLUSION

As to Basis Item "e"

Q18. Please summarize your testimony with regard to Basis Item "e".

A18. (SMS) My testimony can be summarized as follows:

STV's request to construct dry wells above the water table that may contain water during storm events is impractical. The project should continue in the fashion presented in the FSP (SAIC 2005a) and addenda (SAIC 2006a, 2006b, 2007a) to allow the flexibility to make determinations and appropriate selections of well screen intervals based on the actual observed site conditions during drilling for appropriate well construction for the purpose of monitoring and characterizing groundwater and groundwater flow.

X. OVERVIEW

Issues Raised By Basis Item "f," to STV Contention B-1

Q19. What is your understanding of the technical issues raised by Basis Item "f" of STV's Contention B-1?

A19. (SMS) In its Basis Item "f" STV states:

"The FSP states in section 6.2 that all new wells to be completed will be in 'conduit' settings in bedrock. This placement is too limited. Certainly, most off-site transport is likely to occur through bedrock karst features. But, the projectiles and the DU reside in the till and/or the weathered bedrock/colluvium. Simply because good, shallow wells were not completed in the original set of JPG wells does not mean that properly located and completed shallow wells are unnecessary to characterize properly the hydrogeology of the site. Such wells should be included in the FSP."

STV is asserting that the license amendment should not be approved unless the Army is required to install these shallow wells.

Q20. Do you agree with the position asserted in Basis Item "f" of STV Contention B-1?

A20. (SMS) No.

XI. Discussion

Installation of Shallow Wells

Q21. What is the basis for your disagreement?

A21. (SMS) As an expert dealing with Karst aquifers, I recognize and STV acknowledges, as stated in this basis, that the most probable off-site transport by groundwater is most likely to occur through fracture zones in bedrock in which Karst features may develop, but the Army and SAIC have never presented or stated that *"...shallow wells are unnecessary to characterize properly the hydrogeology of the site."*

The Army intends to consider the installation of shallow wells completed in the unconsolidated materials if sufficient, saturated permeable materials are encountered and has presented this in both FSP Addendum 4 (SAIC 2007a) and the January 2007 Well Selection Report (SAIC 2007b) completed by SAIC. Section 6.2.1.2, Deep Overburden Well Pair Location (SAIC 2007b) presents the evaluation of overburden materials and the soil/bedrock interface for the presence of permeable materials and potential for groundwater flow and plans to installing at least one well in the unconsolidated materials at this location based on the actual observed site conditions.

The inclusion of this evaluation of the potential for deep soils and permeable unconsolidated materials at this location based on the results of the EI survey. demonstrates the intention of the Army to appropriately modify and design successive studies based on the results of the preceding studies and the acquisition of site-specific data. Once again, this is crucial to appropriately and accurately design and install a representative monitoring network.

Section 2.1, Well Locations and Proposed Depths of FSP Addendum 4 (SAIC 2007a) also describes the evaluation for permeable materials at the deep soil location identified with the EI survey and also states "At all sites, if sufficiently permeable saturated materials are identified in the unconsolidated deposits, the installation of a well with a screened interval in the permeable zone will be considered."

Further, it is the intent of this characterization to evaluate the potential for migration of DU penetrator material through the unconsolidated materials (soil, till, loess) as described in Sections 6.7 and 6.8 of the FSP (SAIC 2005a) by sampling soils and analyzing for DU components near deposits of DU penetrators, measuring the rate of corrosion, and conducting leachability tests. If these tests indicate that the DU components are mobile in the unsaturated unconsolidated material, that information might lead to a recommendation for a more rigorous examination of the extent of migration in the shallow saturated unconsolidated materials, where they exist.

Thus, the characterization will evaluate migration near the source in the shallow soils around the DU penetrators; in saturated unconsolidated material above bedrock, if encountered; in cave streams and surface streams; and in solution enhanced groundwater pathways that would be the most likely migration pathway for DU in groundwater leaving the site.

XII. SUMMARY AND CONCLUSION

As to Basis Item "f"

Q22. Please summarize your testimony with regard to Basis Item "f".

A22. (SMS) My testimony can be summarized as follows:

Most probable offsite groundwater migration is through fracture zones, which may develop into Karst features, and thus the greatest emphasis is placed on successful construction of wells in the Karst network. However, wells will be installed, as appropriate, in unconsolidated materials, and other parts of the aquifer that would reasonably be expected to transmit groundwater. The project should continue in the fashion presented in the FSP (SAIC 2005a) and addenda (SAIC 2006a, 2006b, 2007a) to allow the flexibility to make determinations and appropriate selections of well screen intervals based on the actual observed site conditions during drilling for appropriate well construction for the purpose of monitoring and characterizing groundwater and groundwater flow.

XIII. OVERVIEW

Comments and Rebuttal Pertaining to Testimony of Chuck Norris

Q23. Are you familiar with the testimony offered by Charles Norris in this hearing?

A23. (SMS) Yes. I have reviewed his written testimony dated July 13, 2007.

Q24. Do you agree with his opinions and conclusions concerning the adequacy of the hydrogeological characterization program?

A24. (SMS) No, I disagree in a number of respects.

Q25. Please state the general basis for your disagreement.

A25. (SMS) My testimony and my rebuttal of testimony by Charles H. Norris focuses on the processes and conditions that control the potential migration of DU in water. That portion of the Conceptual Site Model (CSM) is being studied at significant points along those pathways:

- DU in its original form is a smooth solid metal rod, not unlike a heavy reinforcing bar. DU is immobile in that form. Once it corrodes, as a result of exposure to the elements, it can be dissolved in water or be transported by water as particles or attached to particles of soil. Thus, the rate of corrosion is important. That process is being characterized in two ways: by exposing a DU rod to a weathering chamber and by exhuming and examining DU projectiles that were test-fired as part of the JPG operation.
- On its way to the groundwater table, DU must migrate through the soils. The rate and extent of migration of DU through the soil will be calculated/measured by collecting soil samples near and beneath the DU projectiles at a number of locations. Different soil types found at JPG may transmit DU at different rates, so those soil properties have been characterized and this testing will be conducted in areas representing those different conditions.
- Most of the unconsolidated materials overlying bedrock are tight glacial tills and residual limestone clay and silt, which do not allow water (or DU) to pass through readily. Where more permeable unconsolidated materials are found, wells will be constructed to sample groundwater for DU. These wells will be located near areas high in DU deposits, as well as up-gradient, in order to examine natural uranium content.
- Once through the unconsolidated mantle of materials, the water pathway migrates to the bedrock. Bedrock underlying JPG is composed of horizontally bedded siliceous limestone and dolomite. Migration of groundwater through this rock is almost exclusively along joints, fractures, and bedding planes in the rock. To some degree, over time, water percolating through these discontinuities may have dissolved portions of the rock and enlarged the pathways. This created a network of relatively higher zones of permeability, which act as avenues for the

majority of groundwater migrating through the site. The FSP (SAIC 2005a) calls for wells to be placed on concentrated zones of fractures upgradient of the DU Impact Area (to measure natural U) and downgradient of the DU Impact Area, to measure the current impact of DU deposits. Great care has been taken to place wells in the most likely areas of high permeability and in all likely directions of groundwater migration from the DU deposit.

- DU may potentially be transported by surface water, either in solution or as particles, along with sediment. Numerous surface streams cross the DU Impact Area. Recent sediment deposits and stream samples, collected at different times of the year, will characterize this pathway.
- Lying somewhere in between surface water and groundwater is a network of sinkholes and shallow caves. Sinkholes can receive surface water runoff and sediment and transport it to caves or to the groundwater table. Groundwater also may discharge to cave channels. Some caves carry streams, either intermittently or perennially. This potential pathway is being characterized by sampling cave streams at the mouths of caves.
- Numerous stream gauging stations have been set up to measure stream flow across the site. The stream flow hydrographs will be analyzed to determine what portion of precipitation that falls on-site goes to direct surface runoff, through the sink holes and caves, and to the water table. That information will allow us to order the most likely potential pathways for DU carried by water.
- All sample points are in close proximity to or within the boundaries of the DU Impact Area. The concentration of DU, if migrating, will be highest and most detectable close to the DU deposits. The pathways are also most predictable closest to the source. By determining the degree to which migration is occurring close to the site, the DU migration processes can be understood. From that point, conservative dose modeling scenarios can be developed and tested.

Throughout the development of the FSP (SAIC 2005a), the physical conditions of the site had to be considered. The DU area contains incised stream channels and a high concentration of unexploded ordnance (UXO), making access to many areas difficult, and in some cases, nearly impossible.

Respecting those access limitations, a characterization plan was developed that will provide sufficient information to satisfy NRC requirements needed to consider license closure.

Throughout his testimony, Mr. Norris repeatedly refers to fate and transport modeling. As modified in his Answer 10 by the phrase *"required for purposes of the ultimate decommissioning of the site in accordance with NRC regulations,"* I have no problem with this reference. I would like to make it clear that, at this time, there is no plan for or indication that a numerical fate and transport groundwater model will be conducted for this site. The type of data required for a numerical groundwater model is somewhat different than that required for Residual RADioactivity (RESRAD) modeling. Therein may be the source of many of Mr. Norris's concerns regarding the FSP (SAIC 2005a) and its addenda (2006a, 2006b, and 2007a).

Although all of the components mentioned by Mr. Norris in his Answer 11 will be evaluated sufficient to provide input data for the implementation of the RESRAD model, the use of the words *"site-specific input data to the site modeling"* further raises the concern that Mr. Norris is mistakenly expecting a numerical groundwater fate and transport model.

Q26. Do you agree or disagree with Mr. Norris's explanation of karst features and their formation found in his Answers 13 and 14?

A26. (SMS) I disagree.

Q27. Please state the basis for your disagreement.

A27. (SMS) Although all levels of complication and intricate flow patterns have been found in karst aquifers throughout the world, most karst aquifer systems fall into one of a few patterns (Fetter, "Applied Hydrogeology" 2nd edition, 1988, p. 288), and can be effectively characterized. The depth of the karstified portion of the aquifer may be extremely limited, as suggested by local geologic literature (Greeman, "Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana", 1981, p. 12 and 13) and the preferential flow pathways are often very well-connected, particularly in bedrock with well-defined horizontal bedding, as occurs at JPG. One type of carbonate aquifer, called diffuse-flow aquifers, *"have little solutional activity directed toward opening large channels." "Diffuse-flow aquifers, are typically found in dolomitic rocks or shaley limestones,"* such as those that are present underlying and surrounding the DU Impact Area at JPG. *"Water movement is along joints and bedding planes that have been only modestly affected by solution. Moving groundwater is not concentrated in certain zones in the aquifer and, if caves are present, they are small and not interconnected. Discharge is likely through a number of small springs and seeps."* All quotes are from Fetter, 1988, p. 289-290. All of these conditions are consistent with the current observations at the JPG site.

Mr. Norris provides no documentation that a complex condition could or is likely to exist at JPG and, only talks in general about nightmarish conditions that occur in karst aquifers somewhere in the world. Little site-specific investigative work has been completed to date. As the work is completed, the process of characterizing the degree and depth of karstification, the interconnectivity of the karst network, and the potential for accurately characterizing groundwater migration from and through the DU Impact Area will be determined. Fetter (, 1988, p.288) provides this perspective: *"Carbonate aquifers show a wide range of hydraulic characteristics. There are, to be sure, a number of 'underground rivers' where a surface stream disappears and flows through caves as open channel flow. At the other extreme, some carbonate aquifers behave almost like a homogeneous isotropic porous medium. Most lie in between these extremes."*

All local literature and the current observations on-site suggest a modest, lightly karstified aquifer. The extreme measures proposed by Mr. Norris throughout his testimony would support a decade of doctoral thesis projects in full academic research mode. But more to the point, the current understanding of the site does not support this level of investigation, and would frustrate researchers looking for and trying to characterize a complicated system that most likely does not exist.

Q28. Mr. Norris, in his Answer 16, stresses the importance of tracking water chemistry changes along transport paths at JPG. Do you agree?

A28. (SMS) Not necessarily. The statement that "transport of dissolved DU is independent of water velocity" is not entirely accurate. Freeze and Cherry (1979, pages 402-408) describe how "...reactive contaminants..." such as dissolved DU "...will travel at a rate depending on its relative velocity..." The relative velocity is a function of groundwater velocity and "retardation" resulting from the chemical reactions (e.g., adsorption-desorption, acid-base, dissolution-precipitation) and the transfer of dissolved DU to other phases (gas or solid). NUREG 6705 (page 24) states that, "...sorption, dilution, and precipitation are sufficiently effective sinks to limit short-term (years to decades) the advance of artificial U plumes. In long-term situations (thousands to millions of years), weathering processes and secondary precipitation of oxidized uranyl phases appears to limit advance of natural plumes..." How important water chemistry is, within the bounds of the variation of water chemistry across the DU Impact Area remains to be determined, but uranium concentrations will be evaluated along the pathway and will be sampled quarterly to account for seasonal variations. In addition, the concentrations and measurements of other parameters that influence the dissolution and transport of DU in groundwater (e.g., pH, redox) also will be obtained along pathways and at various times.

Q29. In his Answers 17 and 18, Mr. Norris suggests other factors influencing the transport of dissolved DU. Will sampling be conducted to detect entrained sediment and suspended transport of DU?

A29. (SMS) Yes. Since entrainment is a function of velocity, when the velocity is reduced, the mass of entrained-sediments will be dropped and deposited along the path from the source. These samples will be analyzed for DU. If DU is detected in sediments, additional testing to measure the mass flux of entrained sediments may be necessary.

Potential suspended DU will be measured by sampling unfiltered samples of water from streams and cave streams downgradient and upgradient from the DU Area.

Q30. Do you agree with Mr. Norris opinion, expressed in his Answer 19, as to the sources and types of data required for a meaningful DU fate and transport model?

A30. (SMS) No.

Q31. What is the basis for your disagreement?

A31. (SMS) In the first bullet of his Answer 19, Mr. Norris calls for *"Mapped critical pathways, presumably dominantly karst, of groundwater flow from source areas to discharge points, whether such discharge is within or outside JPG."* The mapping of individual groundwater pathways, in the sense that becomes obvious when reviewing his testimony as a whole, is impractical and unnecessary, especially in complex sites involving karst and fractured rock aquifers. Mr. Norris later explains that he feels it is necessary to trace individual conduit pathways, apparently similar to the way a spelunker would map a cave. Once again in bullet 3 Mr. Norris calls for the characterization of individual *"groundwater paths with measurements of chemical parameters."* The characterization of individual groundwater flow pathways is both impractical and unnecessary. What is necessary is the placement of appropriately constructed and designed monitoring wells that intersect preferential flow pathways or groundwater conduits that will facilitate the monitoring and characterization of the groundwater flow network comprising saturated karst and fracture features. The idea of mapping individual groundwater pathways is addressed numerous other times in response to Mr. Norris's repeated discussion of this concept.

In Answer 19, Mr. Norris, for the most part, lists a number of viable pathways for DU transport. He calls for direct measurement of DU concentrations under various conditions, as if one were going to attempt to numerically model all chemical transport from the site. I disagree that all conditions must be measured, which of course is nearly impossible. A blatant example is the call for sampling sediment and dissolved and suspended DU during a *"singular climate event such as a 25-year or rarer precipitation even."* Sampling of such an event would be prohibitively dangerous, not to mention logistically very difficult. Sampling DU concentrations and characterizing the potential for DU mobilization and transport during high-flow conditions will be accomplished by sampling sediment deposited along the surface water pathway downgradient from the DU areas. If the sampling indicates that high surface water flows are a significant mechanism for migration of DU, and it becomes necessary to sample during high-flow conditions to identify or quantify the risk to receptors, the investigation will be amended. In this manner, all pathways will be investigated, and any that indicate active migration of DU will be the subject of sufficient additional characterization to identify and quantify risks to receptors.

Q 32. Starting with his Answer 20, Mr. Norris lists and then discusses what he calls the "seven major elements of the hydrogeologic characterization program." Do you have any comments or responses to offer with regard to his Testimony?

A32. (SMS) Yes. I intend to respond to Mr. Norris's testimony regarding sections on Fracture Trace Analysis, EI Survey, Gauging of Streams and Caves and Staging of Streams, and Well Location Assessment and Selection. My colleague, Mr. Todd Eaby, will respond to Well Installation and Assessment and Surface Water Sampling and Sediment Sampling.

Fracture Trace Analysis

Q33. Do you agree or disagree with his testimony pertaining to deficiencies in the design of the fracture trace analysis for JPG?

A33. (SMS) I disagree.

Q34. What is the basis for your disagreement?

A34. (SMS) Mr. Norris is unfamiliar with even the basic definitions of words commonly used by those who use fracture trace analysis. Lattman (1958) organized the process of using aerial photographs to map linear features by defining fracture traces (straight features up to 1 mile in length) and lineaments (1 to 100 miles in length). But, admittedly, the awareness of that article among general practice geologists is low, although the reference was provided in the JPG FSP (SAIC 2005a). However, the basic college text book by Fetter (1988) provides these same definitions (p. 294). It should be obvious from this demonstrated lack of basic familiarity that Mr. Norris is not in a position to explain *"the complexity of a true fracture trace analysis."*

Q35. Do you agree or disagree with Mr. Norris's statement that fracture trace analysis can only identify fractures that have an expression on the surface of the earth and cannot distinguish fractures that are part of a karst network?

A35. (SMS) I disagree. The connection between fracture trace analysis and its ability to identify zones of preferential flow pathways, particularly in karst aquifers, is well-documented in the literature. One of the first such documentations is by Lattman and Parizek (1964), titled Relationship Between Fracture Traces and the Occurrence of Groundwater in Carbonate Rocks. The following is quoted from the abstract of this article: *"These data support the concept that fracture traces reflect underlying fracture concentrations and are useful as a prospecting guide in locating zones of increased weathering, solutioning and permeability."* I had the privilege of studying under and working with Dr. Parizek and learned his methodology first hand. I have located many successful high-yield production wells using fracture traces. Mr. Norris states that fracture trace analysis *"cannot distinguish between simple fractures and solution-enhanced fractures."* I disagree, in that the soil-tonal and vegetation differences, topographic features, and straight line stream segments overlying a karst aquifer are most often caused by karst activity, are often latent sinkholes or sags (Fetter 1988, p. 294). The question is moot, however, since either condition would represent a potentially significant high permeability condition in the otherwise massive and very low permeability bedrock.

Q36. Do you agree or disagree with Mr. Norris's statement, in his Answer 24, that "unless a bedrock fracture has propagated itself through the blanket of glacial sediments, it cannot be observed"?

A36. (SMS) I disagree. Mr. Norris's statement shows a general lack of familiarity with fracture trace analysis. Even without having the benefit of first-hand experience with fracture trace analysis, there are numerous examples in published literature that fracture trace analysis is effective in areas overlain by glacial sediments. The U. S. Geological Survey (USGS) report by Greeman (1981) for the JPG area quoted elsewhere by Mr. Norris states *"Pleistocene drift, averaging 25-30 feet thick, covers most of the bedrock, but did not restrict the mapping of lineaments and fracture traces from aerial photographs."* (p1, 3rd Paragraph). Page 8, 2nd to last paragraph continues to discuss glacial drift up to 81 feet thick and references studies mapping fracture traces through 350 feet of overburden. Fetter (1988), p.294 states *"The surface features can reveal fracture traces covered by up to 300 feet (100 meters) of residual or transported soils."*

Q37. In the same Answer 24 Mr. Norris's cites previous characterization studies, summarized in the Regional Range Study (USACHPPM No. 38-EH-8220-03, JPG, IN, Sep 02, Sub-section 6.2.3.1, page 4 of 41), in support of his position concerning the limitations of the utility of a fracture trace analysis. Is this citation accurate?

A37. (SMS) No. The referenced sentence actually reads *"Small-scale fractures* *and sand lenses within the till contribute to the higher hydraulic conductivity."* The context is a discussion of the range of hydraulic conductivities measured in the fairly tight tills south of the firing line at JPG. Fractures of the scale discussed in this reference (inches) have nothing to do with fracture traces that may occur in areas overlain by till and be seen on aerial photographs.

Q38. Also in his Answer 24 Mr. Norris criticizes the use of older black and white aerial photographs and advises use of more modern technology in conducting the fracture trace analysis. Do you agree with his criticisms?

A38. (SMS) No, not entirely. I have used color and false color (another name for infrared) aerial photography and satellite imagery in a number of investigations, and they are not without merit. Side looking airborne radar (SLAR) can be effective at locating fracture traces (EPA/625/R-92/007 Eastern Research Group (ERG), Sept 1993 p. 2-3), but ground penetrating radar (GPR) is not a remote sensing technique. Rather, it is an on-the-ground geophysical technique,that, from my experience, can penetrate only a few feet in typical clay-rich residual soils, as typically occurs over carbonate bedrock, like at JPG. My experience is supported by this quote from ERG (1993) p. 6-2 *"Attenuation is particularly severe in clay-rich soils and where water content exceeds 40 percent."* GPR is not used on UXO sites, due to safety hazards, as the induced energy may cause detonation of certain ordnance. The suggestion of the use of GPR on this site shows that Mr. Norris is quickly scanning the literature and throwing out anything that sounds good, not working from experience, or with any sincerity to resolve an actual problem.

This is not a research project requiring the uses of multiple technologies. Our goal in using fracture trace analysis and EI is to select locations where wells can be placed in zones of high hydraulic conductivity, and thus to characterize the network of preferential flow pathways in the bedrock aquifer. Allow me to quote a few sentences from Fetter (1988), p. 294: *"The selection of well locations in carbonate terrain is one of the great challenges for the hydrogeologist. As the* *porosity and permeability may be localized, it is necessary to find the zones of high hydraulic conductivity. One of the most productive approaches to the task is the use of fracture traces"..."As they represent the surface expression of nearly vertical zones of fracture concentrations, they are often areas with hydraulic conductivity 10 to 1000 times that of adjacent rock."*

Q39. Do you agree with Norris's statement that cave map and sinkhole information must be integrated into the fracture trace analysis?

A39 (SMS) I agree that cave mapping information by Sheldon is important information. It was considered and available to the team, as evidenced by the locations of cave streams selected for gauging in Figure 3-1 of SAIC's Well Selection Report (SAIC, 2007b, p. 3-3). However, locating of well using fracture traces does not require this correlation. Greeman's excellent academic paper (1981) on fracture traces and lineaments in Jennings County and surrounding counties, which makes specific reference to JPG, makes no reference to the occurrence of caves and the correlations with fracture traces and lineaments in the Silurian carbonates of Jennings County and JPG. Greeman indicates fracture traces and lineaments are the best locations to develop the most productive well sites, thus would be useful in finding groundwater flow pathways.

Q40. Do you agree with Mr. Norris's opinion that data from the Greeman study must be integrated into the fracture trace analysis?

A40. (SMS) No, I do not.

Q41. What is the basis for your disagreement?

A41. (SMS) The data from Greeman were reviewed during the fracture trace analysis. The fracture traces mapped as part of Greman's report, which covered 467 square miles, were transferred from the 1:48,000 (1" = 0.76 mi.) map and entered into the Geographic Information Systems (GIS) database. It was determined through this process, that the accuracy of the mapping from this map was insufficient to use in our study. The report data at this scale are of value for considering general trends of fracture trace orientation, but not accurate enough to use to locate wells on karst features. The general trends of fractures mapped by the Greeman study (*"oriented northeast-southwest and northwest-southeast"* Greeman 1981, p. 9) match the mapping conducted by SAIC: *"Seventy percent of the mapped traces were oriented either North 27 to 59° West (33 fracture traces) or North 31 to 56° East 43 fracture traces* (SAIC2007b, p. 4-4).

Q42. Do you agree with Mr. Norris's opinion, in his Answer 24, of the adequacy of the field reconnaissance at the DU area?

A42. (SMS) I disagree. I conducted a 2-day field reconnaissance of the JPG DU area during the process of writing the FSP, and prior to conducting the fracture trace analysis. This allowed me to get the lay of the land, a feel for the topography, and anticipate how a fracture trace analysis would be conducted.

Mr. Norris's statement that the field proofing *"should be done before, not after the analysis is complete"* demonstrates a general lack of understanding of the fracture trace analysis process. It is necessary to map fracture traces on aerial photographs in order to identify areas in the field that can be field checked. The process of mapping fracture traces is done by viewing aerial photographs one at a time and in pairs to view the images in stereo, which provides a three-dimensional view to the land surface. This is best done in an office or laboratory setting. After the mapping of fracture traces on individual stereo paired aerial photographs, the aerial photographs are georeferenced, and the fracture traces are placed in a GIS and then displayed on a map of the site. At this point, the hydrogeologist can take the map to the field and evaluate the mapped fracture trace.

Regarding Mr. Norris's comment that the walk-over should include areas off-road, this comment ignores the extreme health and safety concern caused by the high concentrations of UXO in the DU Impact area. The existing network of roads allows access to the complete perimeter of the DU Impact area, and crosses the DU Impact area in appropriate intervals and along important hydrogeologic features (like Big Creek). Even on sites where better walk-over access is available, my experience is that the majority of the observations are generally made along the road-ways due to the ability to see the terrain better, which often is extremely restricted by dense vegetation and woods.

Q43. Do you agree or disagree with Mr. Norris's statement that potentially important dipping fractures would not be identified by the fracture trace analysis?

A43. (SMS) I disagree. The previously quoted sentence from Fetter (1988, p. 294) in his discussion of fracture traces indicates that, by definition, fracture traces are vertical features: *"As they represent the surface expression of near vertical zones of fracture concentrations, they are often areas with hydraulic conductivity 10 to 1000 times that of adjacent rock."* Fracture traces are being employed to assist in locating wells in zones of high hydraulic conductivity. Fetter states that fracture traces are *"one of the most productive approaches"* to accomplish this. Mapping nonlinear photographic features is not part of the fracture trace analysis method.

Mr. Norris's opinion that "intersections of fractures that dip are likelier to develop major karst elements than are intersections of vertical fractures" is unsupported in his testimony, and is not shared by me, and to my knowledge is unsupported by published studies. Supporting my opinion is the statement by Greeman in an article previously referenced by Norris: *"Vertical bedrock fractures transmit a large part of the water that is moving through the limestone-dolomite aquifer…"* (Greeman 1981, p.13). This is a study that was conducted on Jennings County and JPG, thus, it represents information on the local conditions around the subject site.

However, the argument is still not significant because the goal of the fracture trace analysis, combined with the EI survey, is to locate areas where wells could be placed with a high likelihood they would intersect the network of preferential flow pathways through the karst aquifer that underlies the DU Impact Area. Any high hydraulic conductivity zones, vertical, subvertical, or horizontal, if sufficiently continuous to be significant for transport of groundwater across and from the DU Impact area, will be interconnected.

Q44. Do you agree or disagree with Mr. Norris's statement as to the significance of the fracture trace analysis deficiencies which he states in his Answer 26?

A44. (SMS) I disagree. All alleged deficiencies mentioned in this summary answer have been addressed in rebuttal to previous answers. Mr. Norris's opinion of the deficiency of using fracture traces to locate high-conductivity zones in karst are not shared by me or by the numerous authors cited or quoted. Mr. Norris raises one new alleged deficiency in Answer 26 that has not previously been addressed. This is his concern that the FSP (SAIC 2005a) may miss karst networks *"whose controlling fractures are too deep to reach the present day surface."* However unlikely this may be, it is inconsequential to the characterization of the groundwater flow system beneath JPG that may potentially transport DU from the site. DU has been deposited on the surface of the DU range and, therefore, the migration must start from there. If it is being transported by surface water or groundwater, it must start on the surface, and migrate downward to the water table. If there is a deep karst network "whose controlling fractures are too deep to reach the present day surface," it would not be in communication with the surface of the DU Impact Area, and therefore could not be a viable pathway for DU migration.

The plan outlined in the FSP (SAIC 2005a) will characterize the pathway from the surface to the streams and to the groundwater beneath, and as it leaves the site. In order to get to real or imagined distant or deep pathways, it must first pass through the shallow system. Characterization of that system is sufficiently scoped in the current FSP (SAIC 2005a) and its Addenda (SAIC 2006a, 2006b, and 2007a). If those investigations result in information that indicates a concern for exposure to receptors, the FSP will be augmented at that time in a focused manner.

Electrical Imaging Survey

Q45. Do you agree with Mr. Norris's opinion, in his answer 27, that the FSP Electrical Imaging (EI) survey needs to be a "grid application" so that three dimensional mapping of results can be done?

A45. (SMS) I do not agree.

Q46. Please state the basis for your disagreement.

A46. (SMS) Mr. Norris arbitrarily states that *"EI surveys are usually performed along a two-dimensional surface grid over an area of investigation."* This methodology is actually referred to as three dimensional (3D) EI. I have been conducting resistivity surveys (the precursor to EI, prior to computer-driven switching systems in the early 1990s) and EI studies for more than 30 years and have been associated with only one project researching the viability of a grid array application. Not until 1996 were data acquisition methods and processing software developed to effectively perform automated 3D resistivity surveys (Dahlin and Loke, 1997). 3D EI methods represent nontraditional method of data acquisition for the purpose of gathering resistivity measurements over a localized area to evaluate complex geologic or subsurface conditions (e.g., caves, sinkhole network, archaeological structures, etc). This method requires a fixed electrode grid be established over the entire area of interest at electrode spacing sufficiently close to meet target objectives. These surveys usually are focused on a few acres or less. Performing such surveys across the entire area of interest at JPG would not be practical and would be cost prohibitive, not to mention extremely dangerous, due to the UXO. These dangers were minimized/avoided during the EI survey at JPG because we took advantage of cleared corridors and used a delayed start to collect data while personnel retreated to a safe area.

Q47. Do you agree or disagree with the deficiencies in the EI survey which Mr. Norris lists in his Answer 30?

A47. (SMS) I disagree.

Q48. Please state the basis for your disagreement.

A48. (SMS) Mr. Norris apparently misunderstands or misrepresented a statement he references on page B-3 of Appendix B of the FSP (SAIC 2005a) regarding the orientation of EI traverses, stating that they should be "oriented normally to geologic features of interest". The actual language states *"The traverse should not be set up running parallel to subsurface utilities or other subsurface conductors."* There is no reference to geologic features of interest stated or implied. I have had the opportunity to test the success of locating wells on EI features that match up with fracture traces that cross both perpendicular and at an angle to the EI line and, in developing my skills, originally insisted that some of the EI survey lines be oriented such that they are perpendicular to the fracture trace. I have experienced no loss of success in placing wells in groundwater conduits using EI survey data that crosses fracture traces at oblique angles. Drilling targets, in most severely karst areas, are actually larger, since the fracture trace is in close proximity to the EI survey line for a greater distance. Given the extreme limitations in the ability to traverse off-road areas caused by the safety problems of UXO throughout the area of investigation, and the experience applying this technology at other sites, there was no concern that the orientation dictated by the existing roads would limit the effectiveness of the characterization study during this phase of the investigation.

Mr. Norris is also critical of what he describes as failing to lay out EI lines in straight lines. It is true that EI results are easier to interpret when lines are straight and that results near the bends in a survey line must be used with some degree of caution. However, segments away from the bends are perfectly fine and are not subject to the effects of the bend. The area covered by D Road, which parallels the course of Big Creek as it takes some gentle bends, was very important to the investigation, and the ability to get off the road to straighten the line was precluded by the existence of UXO. It was understood by the geophysicists and hydrogeologists collecting and interpreting the data, that EI data in the locations of bends in the survey lines should be considered with a relative degree of caution.

The EI survey was never intended to produce a 3D map of potential groundwater conduits, which is impractical and unnecessary. The two dimensional (2D) resistivity methods deployed at JPG covered important perimeter and internal areas along roadways that were safely accessible for the purpose of substantiating results of a fracture trace analysis study in order to optimally site groundwater monitoring wells along accessible roadways.

The purpose of the fracture trace and EI studies is to aid in locating areas with the potential to have increased **groundwater** flow due to the presence of fractures and/or solution enhanced features for use in characterizing potential groundwater impacts and the groundwater flow network. It is not to identify dry conduits that could potentially intermittently transmit water related to precipitation events that may not be related to groundwater. The potential that open solution features could intermittently transmit DU along with water from precipitation events and during high groundwater stage conditions is being investigated using the excellent survey information available from the cave survey work (Sheldon, 1997) that has been conducted on the JPG site. A number of the mapped caves are in the middle of the DU Impact Area and are oriented in such a manner that percolating and runoff water from precipitation that falls on the DU Impact area will be intercepted. Sampling of streams and sediment from these caves will be far superior to constructing dry wells in shallow unsaturated voids in the subsurface.

Norris also states that "Low-resistivity anomalies may represent the electrical signal of mineral content, not necessarily that of water-bearing conduits." Deposits of clay from karst weathering are actually what is most often mapped by the EI. These clay and silt deposits are the insoluble residue left after the soluble (calcium carbonate) portions of the bedrock are carried away by groundwater. Karst weathering is enhanced along zones of concentrated fracturing, due to increased exposed rock surface area and larger volumes of groundwater migrating through the more permeable area. Although compacted clay has a very low permeability, the sediment/bedrock interface and the adjacent fractured bedrock zones are often highly permeable, and provide a location where the network of karst conduits may be characterized and monitored.

Norris also criticizes the EI survey because possible variations in the electrical resistivity may be unrecognized variations in groundwater quality, not variations in hydraulic conductivity of the rock. Variations in the specific conductance of water sampled from the Environmental Radiological Monitoring (ERM) wells could be caused by factors unrelated to insitu groundwater quality, such as turbidity caused by sampling. It also could be a result of the two wells being placed in different geologic materials. The specific conductance of the groundwater has little ability to impact the electrical conductivity of bedrock, since groundwater occupies less than 1/10th of 1 percent of the volume in a typical unfractured bedrock aquifer. It is extremely unlikely that there are small pockets of natural groundwater with different specific conductance that will be mistaken for evidence of weathering along vertical fractures in the carbonate bedrock. Further, that pocket would have to line up with a mapped fracture trace to have a negative impact on the investigation.

Next, in his Answer 30, Mr. Norris discusses the possible effects of slow moving or stagnant groundwater on electrical conductivity. My experience on other sites does not match the conditions in this paragraph, which have most likely been developed from Mr. Norris's imagination and not his experience. A summary of observations from my experience on karst sites and in carbonate aquifers follows:

- Zones of clay that extend vertically down into the bedrock are often indications of weathering along vertical fractures. Although the clay itself has very low permeability, high-permeability zones often accompany these "plugs" of clay, either in the form of open channels through the clay, permeability along the clay-bedrock interface, or deposits of sand and gravel that were deposited in the same feature.

- Since these zones of clay are often formed along zones of concentrated vertical fracturing, well bores that penetrate through the clay often encounter permeable fractured rock.
- Saturated conduits filled with sand and gravel would clearly show in an EI survey as a low-resistivity area and would constitute a detectable and desired target of this investigation.

Finally, Mr. Norris completely misunderstood or misrepresented the concept behind the proposed well location methodology, and misquotes the referenced section in the FSP to help make his point sound viable. In Table 4.1, the EI survey is described as:

> *"Survey, combined with the fracture trace analysis, will be used to identify preferential flow paths and karst features for groundwater. Survey will be conducted to identify entry and exit pathways."*

Rather than indicating that the EI survey will identify entry and exit **points** of groundwater flow, the statement actually means that preferential flow pathways for groundwater up-gradient of the DU area that will naturally migrate into the DU area (entry pathways) will be identified. Likewise, preferential flow pathways for groundwater downgradient of the DU Area that will naturally migrate away from the DU Area (exit pathways) will be identified. This is conducted by running the EI survey along the upgradient and downgradient roads that perimeter the DU Area and matching the anomalies with fracture traces.

Mr. Norris misquotes a study by Wilson et al. (Wilson, John T., *et al.* 2001, An Evaluation of Borehole Flowmeters Used to Measure Horizontal Ground-Water Flow in Limestones of Indiana, Kentucky, and Tennessee, 1999, USGS Water-Resources Investigations Report 014139) in asserting that at most there will be one point well control where a conduit crosses a road and flow direction cannot be determined from a single well.

Mr. Norris compounds the misquote by suggesting that our survey is to *"determine entry and exit points of groundwater flow **in conduits**."* He also must have forgotten that the purpose of the fracture trace analysis/EI survey was to select locations to install wells, since he states that one of the problems with the FSP (SAIC 2005a) is that there has been no verification drilling. The verification will be completed during the well drilling and installation and subsequent water level monitoring. The general direction of groundwater flow will be determined by consideration of the water levels in all wells, not a single well. Although groundwater in karst may take a sinuous pathway, it will generally migrate toward its point of discharge in the network of interconnected flow pathways, which will be determined by considering the water level elevations in all wells and streams on-site. Connectivity between wells will be evaluated by determining responses to precipitation events by measuring water levels and monitoring continuous water level recorders in wells.

Q49. Do you agree or disagree with Mr. Norris's opinion, given in his Answer 31, of the significance of the deficiencies that he finds in the EI survey?

A49. (SMS) No, I disagree. The basis for my disagreement is as follows:

Section 6.2.1.1 of the Well Location Selection Report (SAIC 2007b, p. 6-1, 6-2) lists five criteria for the selection of proposed well pair locations, rather than a single criterion purported by Mr. Norris's statement. All other alleged deficiencies have been sufficiently refuted in previous rebuttals to individual questions in this section.

Mr. Norris apparently has developed a site conceptual model that involves isolated independent tubes that carry groundwater from the DU Area to receptors within or outside the DU Area. This is unrealistic and unsupported by local and regional geological publications, as well as a general understanding of karst hydrogeology. Rather, it is more likely that groundwater flow in bedrock is controlled by vertical fractures and bedding planes (Greeman 1981, p. 13).

The depth of the water-bearing zones is relatively shallow, as supported by this statement by Greeman: *"Data from the Jennings County area indicate that drilling below 125-150 ft has increased well yields at only a few sites."* Water-bearing zones in the aquifer beneath JPG may even be shallower because the lower sequence Silurian limestones and dolomites are *"extremely resistant to* *dissolution along vertical fractures and horizontal bedding planes"* because of the siliceous dolomite that caps this unit *(Greeman 1981, p. 12)*. Further to the west, where the majority of Jennings County lies, adequate domestic water supplies are commonly obtained due to the area being underlain by the upper sequence Silurian limestones and dolomites (Greeman 1981, pp. 12-13) Verification of the interconnectivity of the flow pathways will be verified by monitoring water level responses to precipitation (recharge) events in the multilevel wells.

Stream/Cave Gauging and Stream Staging

Q50. Does Mr. Norris in his Answer 34 correctly identify all of the major design elements of the stream/cave gauging and stream staging?

A50. (SMS) Mr. Norris incorrectly states that the Middle Fork Creek Cave is dropped from the FSP (SAIC 2005a) with the FSP Addendum 3 (SAIC 2006b). In Section 2. Monitoring Equipment Installation and Monitoring Plan (SAIC 2006b, p. 2-1) of the FSP Addendum 3, second paragraph it is stated that three cave spring stage gauging stations will be constructed and references Figure 2-1 of the Addendum, which illustrates the proposed locations of the gauging stations including the cave location JPG-MF-02 (identification nomenclature adopted from Sheldon, 1997) along Middle Fork Creek.

Q51. Do you agree or disagree with Mr. Norris's criticism of the stream/cave gauging and stream staging activities found in his Answers 35 through 37?

A51. (SMS) I disagree.

Q52. Please state the basis for your disagreement.

A52. (SMS) Mr. Norris's testimony on the FSP (SAIC 2005a) with regard to stream and cave stream gauging makes little sense. He begins his objections by stating that the original (pre-FSP) site conceptual model did not consider the potential that the DU Area is underlain by a karst aquifer. To prove that, he quotes SAIC's Well Location Selection Report (SAIC 2007b). I am, of course, in agreement with my report, had no control over the original work that was conducted at the site prior to SAIC's involvement, and have clearly taken the position that karst conditions on-site must drive the characterization investigation.

Much of his remaining discussion describes all of the problems that can be caused by not considering a site conceptual model that includes karst, which is bazaar, since that has been the basis for all of the work proposed on-site since the beginning of my involvement.

Mr. Norris then further confuses the issue (and this reader) by stating "The deficiency in the surface water gauging and staging tasks is that the premise of the current conceptual model is that there *is* karst flow underlying the JPG DU site." How this supports his argument is not clear to me. He then describes the potential that water in streams could be dropping into conduits (into the groundwater), resurging into the stream, and/or resurfacing into some other distant basin. This is highly speculative and is not shown or suggested to occur in any studies of the JPG area, including the extensive cave study by Sheldon or the local fracture trace analysis by Greeman. He indicates that this condition would not be detected by the FSP surface water gauging study, which is certainly incorrect. The gain or loss of water from Big Creek, the primary tributary through the middle of the DU Area, would certainly be detected by the location of the three gauges located at the upgradient and downgradient boundaries of the DU Area (SGC-BC-01 and 03) and one in between (SGC-BC-02). In addition, gauges on the northern tributary to Big Creek, where it exits the DU Area and four gauges on Middle Fork Creek and its tributaries, will allow the comparison of unit area recharge values between the basins and sub-basins. If there would be any inter- or intra-basin losses or gains, they would be detected by this comparison, and at that time would possibly require further investigation.

The method of measuring stream flow proposed by Mr. Norris, which is often called a seepage run survey, calls for numerous instantaneous (one-time) stream measurements along a stream course. The entire stream, or at least the portions of the stream that one wants to compare, must be conducted under the same hydrologic conditions. It requires a team of technicians to walk the stream courses and select and measure profiles and stream velocities at numerous points along the course of the stream. If it rains during the survey (which would take at least two weeks to complete the streams at JPG), the before and after measurements cannot be accurately compared. For small streams, like those at JPG, measurements will be drastically impacted by evapotranspiration (plant uptake), such that measurements made in the morning cannot be compared to measurements made in the afternoon during any time of the year when leaves are on trees. Since, as Mr. Norris stresses, the conditions we would be trying to define are transient (the influx of groundwater can range from no flow to large flows, depending on recharge conditions, and may reverse and take water from the stream at other times) this procedure would have to be performed during different seasonal conditions.

Trying to define these transient conditions without continuous readings is often not successful. In my experience, having recently conducted two such studies in karst terrain, in the most favorable conditions, general sections of streams can be identified as gaining or losing. Claiming to be able to actually pinpoint a small area on a stream that is a part of a conduit system to the degree that information would be useful for tracing subsurface conduits or positioning wells shows Mr. Norris's lack of first-hand experience with this technique. Only once have I successfully located sinkholes taking water from a stream using the method described by Mr. Norris, and that was in a stream that was flowing within a few hundred feet of a 200-foot-deep limestone quarry that was being dewatered to support a mining operation, a unique and extreme case.

The use of continuous stream and cave stream gauges, as proposed in the FSP (SAIC 2005a) and its' addenda (SAIC 2006a, 2006b, and 2007a), is a far superior method of evaluating the hydrologic properties of the site, than the instantaneous (one time) seepage run survey measurements described by Mr. Norris. Continuous gauging allows the comparison of stream water level and flows to other portions of the basin and other adjacent basins or sub-basins. It will permit the use of baseflow separation techniques that will allow us to understand and quantify what percentage of precipitation that falls on the DU Area runs off across the surface, what portion drops into vadose caves, and what portion reaches the groundwater table and travels to streams through the aquifer.

Well Location Assessment and Selection

Q53. Do you agree with the major elements of the Well Location Assessment and Selection as stated by Mr. Norris in his Answer 39.

A53. (SMS) No. Mr. Norris suggests that the selection criteria for proposed well locations among potential locations are changed to prioritize "... locations that are anticipated to provide coverage in possible flow directions from the DU Impact Area." when in fact this was an added selection criterion. We did not change the consideration of the previously stated selection criteria in the FSP or in the Well Selection Report pages 6-1 and 6-2, which considered the following:

- fracture trace locations,
- EI anomalies indicating the possible location of fractures or weathered bedrock,
- correlation of the presence of a fracture trace and EI anomaly,
- located along these identified features in a suspected down gradient direction from the areas suspected to have the highest density of DU penetrators,
- so that good site coverage is achieved in all possible down gradient flow directions (i.e locations not concentrated in one portion or side of the study area).

He also states that depth of bedrock was no longer among the selection criteria, but he himself states that "One location of paired wells is added to investigate an area of unusually thick unconsolidated sediment overlying the bedrock." This location was selected based on results of the EI survey where it identified the potential for an area of unusually thick unconsolidated sediment overlying the bedrock to be present. This also is presented in Section 6.2.1.2 Deep Overburden Well Pair Location (p. 6-2) of the Well Selection Report (SAIC

2007b). Depth to bedrock was obviously a selection criterion since this location was selected.

Q54. Do you agree or disagree with the deficiencies in the design for the well location assessment and selection that he lists in his Answer 41?

A54. (SMS) I disagree.

Q55. Please state the basis for you disagreement.

A55. (SMS) It is the intent to install wells into permeable materials if they are encountered in the unconsolidated materials as presented in Section 2.1 Well Locations and Proposed Depths (p. 2-5) of the FSP Addendum 4 (SAIC 2007b), which states "At all sites, if sufficiently permeable materials are identified in the unconsolidated deposits, the installation of a well with a screened interval in the permeable zone will be considered. A final determination for the installation of a well in permeable unconsolidated materials will be made based on discussion between the Army and SAIC's project hydrogeologist, project manager, and rig geologist." Discussion between the Army, SAIC's project hydrogeologist, project manager, and rig geologist does not constitute simply relegating the installation of these wells to the discretion of the licensee, as suggested by Mr. Norris.

Mr. Norris's argument that the wells that are drilled will not be characterization wells because of the methodology used is speculative and in his very argument he indicates that the methodologies that we are using to locate wells "may" be relevant to finding groundwater conduits at the site. To use numerous alternate methods for locating wells on conduits as suggested by Mr. Norris is not necessary, is not commonly practiced, wastes of both money and time, especially when we are applying tried and proven methods that are very well supported within the scientific community and USGS, as evident in their fracture trace report Greeman, 1981) which was completed on an area including JPG. Mr. Norris's statement that the wells are not characterization wells is inappropriate as they will be used for both verification of the well location selection process as well as characterization wells. The extent of the use for the wells as characterization wells will be determined following the completion of the Conduit Intersection Confirmation described in Section 6.2.3 of the Well Location

Selection Report (p. 6-7). All wells drilled at JPG are expensive regardless of their purpose due in part to the hazards presented at the site by the presence of UXO. The installation of expensive wells, used for the purpose of verification and/or characterization, would have to be installed following the well selection process presented by both the FSP and modifications to the process that Mr. Norris is calling for regardless of which process was completed, so to criticize the installation of these wells based on their cost is irrelevant. Mr. Norris once again implies in the final sentence above that "all of the active groundwater conduits at this site" need to be located for the characterization of the site, which is impractical, unnecessary and may be impossible, especially considering the time constraints that have been imposed for completing the characterization and submission of a decommissioning plan. Karst conduits, if effective at controlling the migration of groundwater across the site, will form an interconnected network (Mr. Norris apparently agrees with this concept, since he uses the word network or karst network eight times in CN Q&A 36 and 37 alone). The degree of interconnection of the wells and streams will be established by monitoring of water levels and analyzing responses to precipitation (recharge).

His errant insistence that each individual conduit pathway needs to be mapped to satisfy the criteria for license termination has been addressed. That a paleo-karst system, no longer part of the contemporary conduit system, may be important to the characterization of the DU site has been addressed. The whole concept is geologically absurd in that if DU deposited on the site may move through this karst network, it must be active and thus part of Mr. Norris's so-named "contemporary conduit system."

Mr. Norris suggests using his description of a flow survey on JPG streams as part of conduit mapping to identify points or reaches of streams where the streams are receiving flow from or losing water to the groundwater conduits. Mr. Norris presents a very simplified interpretation of the results of this type of flow study and his application of the results to the location of groundwater conduits. Complications with this method have been discussed previously.

Mr. Norris use of language such as "mouths and headwaters of active groundwater conduits" indicates a severe unfamiliarity with typical and accepted practices and concepts of fractured rock hydrogeology. This language is more appropriate for surface water, and I could understand a temptation to use of these words to describe vadose caves or even deeply karstified systems like Mammoth Cave. It is, however, inappropriate for characterization of fracture-controlled flow pathways in groundwater. Flow of water through vadose caves will be adequately characterized, and there is no evidence of a deeply karstified system at JPG. If such a system exists, it will be discovered by drilling of wells of fracture traces.

Mr. Norris simply makes a statement that "The cave survey that was performed at JPG in the mid- to late 1990s is not fully and appropriately incorporated into the location and selection process" and goes on to state facts or findings presented in the referenced report, with no supporting details as to the appropriate use of that report with respect to the well selection process. In fact, the report referenced has and continues to be evaluated during the planning and implementation of the site characterization efforts. For instance, the report data were used to help in locate and select appropriate cave stream monitoring locations and will be further used to help select water and sediment sampling locations.

The occurrence of recorded caves and sinkholes in the DU Impact Area provides a narrow strip of information through the center of the site, approximately 450 to 900 feet wide. These locations (there is some obvious error in the reported locations, since the given coordinates do not match basic descriptions of some caves, like "on the bank of Big Creek") and the extent of the mapped sections of the caves have been shown in Figure SMS-1 (attached as Exhibit SMS #2), in context with the extent of the entire DU Impact Area. To properly locate wells in an effort to characterize the migration of groundwater through the site, wells must be located across the entire site, similar to distribution of the candidate well locations shown on my figure. Use of the caves provides information on such a small portion of the site (2 percent of the designated DU Impact Area) that it is obvious that an additional method must be used to place wells on preferential flow pathways. One of the most productive approaches identified in the literature is the use of photogeologic fracture traces (Fetter 1988,, p. 294), which has been utilized on this site. The distribution of mapped fracture traces is also shown on my figure.

It has not, at this point, been demonstrated that caves overlie or constitute the locations of groundwater conduits. Since the caves have been explored, they are obviously above the water table for much of the year. Whether the streams that flow from some of these caves are supported by groundwater, or are simply the result of perched or percolating surface water, will be determined by long-term stream and cave stream monitoring in conjunction with groundwater level monitoring in wells. Groundwater flow in the shallow karstified zone of the aquifer may be a significant, even dominant, migration pathway or potential migration pathway for DU. This will be determined by baseflow separation of cave streams and surface streams, and by comparing flow responses to storm and precipitation events. This portion of the potential migration path for DU carried by water is well-represented by the network of caves and, particularly, the three caves that underlie the DU Area, two of which have been fitted with continuous gauging stations.

Whether the caves mapped at JPG are related to groundwater pathways is speculative. It was not expected that EI would necessarily identify the caves, since the dry portions of a cave above the water table would not be electrically conductive. The existence of a cave does not indicate the location of a groundwater flow pathway, since it is above the water table. If fractured and weathered bedrock and water- or sediment-filled solution channels are associated with the cave location, perhaps below the cave, as a result of formation along a zone of vertical fracturing, EI would identify such a feature and show a low-resistivity anomaly at that location. This, of course, would constitute a potential groundwater flow pathway, subject to verification by drilling.

I believe that the point that Mr. Norris is trying to make concerning the wells being "nine Isolated data points" is that he feels it is necessary to map individual groundwater flow conduits, as if they are isolated pipes, open to deposits of DU at the site, but sealed to any interaction with the groundwater, until they surface at a stream. There is no indication that such a system exists. Rather, the system acts more like an interconnected network, as illustrated by these points:

- Fracture-controlled aquifers have zones of relatively higher permeability along discontinuities in the bedrock, surrounded by more impermeable blocks of unfractured rock.
- Indications from Greeman (1981,, p. 9), and the fracture trace analysis conducted under the FSP (SAIC 2005a) are that fractures are oriented in two prominent directions: northeast-southwest, and northwest-southeast. This intersecting pattern of vertical fractures is superimposed on horizontal bedding planes. Migration of groundwater in the bedrock aquifer is along a combination of these interconnecting vertical fractures and the bedding planes.
- In a soluble carbonate rock, some of these discontinuities (joints, fractures, bedding plane partings) tend to capture more groundwater flow, and are enlarged by solutioning (Fetter 1988, p. 286).

Positioning characterization wells on the intersecting vertical fracture patterns, in close proximity to DU deposits, is the best way to determine if migration of DU is occurring, and to characterize the potential that it could be a migration pathway in the future. Interconnections and responses to precipitation and interaction with surface water will be determined by continuous water level monitoring. If migration is indicated by the characterization, that information will be used to develop potential pathways and exposure scenarios of dose modeling. That, in turn, may lead to more detailed studies or specific investigations of distant pathways, such as to Indian-Kentuck Creek.

Q56. Do you agree with Mr. Norris, as stated in his Answer 42, as to the significance of the well location and selection deficiencies he believes exist?

A56. (SMS) No. My concern that Mr. Norris mistakenly believes that numerical groundwater modeling is required for license closure was previously discussed in my earlier testimony. The lack of value in mapping the course of individual groundwater conduits to locate wells also was discussed. The practical problems and likely failure of a conduit mapping program as described by Mr. Norris are also discussed in my testimony. The unlikely potential that such conduits exist at JPG based on local studies was discussed.

The effectiveness of the methods employed to locate wells in carbonate rocks (fracture trace analysis and EI) also is discussed. The ability to characterize the interconnectivity of the aquifer by monitoring water levels in wells and streams is discussed. Development of potential pathways and exposure scenarios of dose modeling also is addressed.

These previous discussions in my testimony form the basis of my disagreement here.

Interactive considerations

Q57. Do you agree or disagree with Mr. Norris's opinion, in his Answer 60, that the deficiencies in the hydrologic sampling will not define or develop the critical inter-relationships needed for effective decommissioning?

A57. (SMS) I disagree.

Q58. Please state the basis for your disagreement.

A58. (SMS) For Mr. Norrris to suggest that the FSP (SAIC 2005a and its addenda (SAIC 2006a, 2006b, and 2007a) will not evaluate "critical inter-relationship" of the various tasks is refuted by the activities to date. The FSP, as modified by the various addenda, exemplifies this very process. The SAIC team has been very careful to plan each of the individual tasks in general, and then modify the details of the plans with addenda as more information becomes available. Each task was designed to build on the previous task, such as the use of fracture trace analysis, followed by EI, which is used to locate multi-level characterization wells. Wells will be installed and data collected from the wells will be used in many ways to refine the conceptual site model (CSM). Water samples from the wells will be used to evaluate the current potential for migration of DU from the site. Water levels in wells will be recorded, and compared to surface water levels. Water level responses to precipitation events will determine the interconnectivity of the aquifer.

On a separate track, DU corrosion rates will be measured in the laboratory and estimated from observation of recovered projectiles. Concentrations of DU beneath projectiles will be measured to determine the rate of migration through the soil. Shallow wells in saturated unconsolidated materials will be established to further track the potential DU pathway. This pathway then links up with the shallow karst system represented by the vadose caves and the fracture controlled groundwater flow system. The surface water pathway is likewise characterized by sampling of recent deposits of sediment and surface water.

Mr. Norris is correct that the FSP does not attempt to verify the pathway of individual conduits, particularly the shallow vadose caves that connect with sinkholes on the very limited portion of the site that is not covered with glacial till. This provides insight into only a small strip of the site, leaving no viable methodology to investigate the remaining 98 percent of the site that is superior to fracture trace analysis followed by El. Fracture trace analysis is described by Fettter as "one of the most productive approaches...to the selection of well sites in carbonate terrane." (Fetter, 1988, p. 294). Mr. Norris provides no references that indicate anyone has successfully utilized his proposed methods for determining exact flow paths on a micro scale, as proposed. He does not even provide unpublished experiential verification that he has attempted, let alone succeeded to accomplish any of the tasks that he says are essential to appropriately understanding the potential for DU migration from the site. He ignores the tremendous safety concerns due to UXO that are involved for personnel that go off of the cleared corridors. Such entry is extremely slow, but will be done for critical tasks such as the recovery of DU projectiles and soil sampling beneath and around projectile points.

Locating wells on fracture traces verified by El along the upgradient and downgradient perimeters of the DU Area is the best method available to characterize groundwater migration through the DU Area, considering all site conditions. These will not be disconnected isolated points, but the degree of interconnectivity of the aquifer will be determined by monitoring water levels.

The use of continuous stream and cave stream gauges is a far superior method of evaluating the hydrologic properties of the site, than the instantaneous (one time) seepage run survey measurements described by Mr. Norris. Continuous gauging allows the comparison of stream water level, flows, and recharge rates to other portions of the basin and other adjacent basins or sub-basins. It will permit the use of baseflow separation techniques that will allow us to understand and quantify what percentage of precipitation that falls on the DU Area runs off across the surface, what portion drops into vadose caves, and what portion reaches the groundwater table and travels to streams through the aquifer.

The method of measuring stream flow, proposed by Mr. Norris requires numerous instantaneous stream measurements, which are difficult to compare. Trying to define transient stream flow conditions without continuous readings is often not successful. In my experience, having recently conducted two such studies in karst terrain, only general sections of streams can be identified as gaining or losing. Claiming to be able to actually pinpoint a small area on a stream that is a part of a conduit system to the degree that information would be useful for tracing subsurface conduits or positioning wells shows Mr. Norris's lack of first-hand experience with this technique.

In some severely karstified aquifers, where there is significant channelization of groundwater flow, I have used seepage run surveys or thermal surveys, that detect the inflow of groundwater into a surface water by temperature differences (groundwater is warmer than surface water in the winter,and cooler than surface water in the summer). I will not hesitate to suggest this methodology at JPG if there appears that such conditions exist, and the information is necessary to appropriately characterize the potential for DU to be transported by water. I would not use these techniques to site wells or attempt to map conduits.

With respect to surface water and sediment sampling, as described by my colleague, Mr. Todd Eaby (TDE Q&A62), I quote the following: "The presentation of the surface water and sediment sampling locations in the FSP (SAIC 2005a) was completed for planning and budgeting purposes for providing a framework and starting point for initiating the site characterization. This task is not scheduled until after the first year of the plan and as stated in the FSP "...plans for this project are defined in detail for this FSP (SAIC 2005a) and the HASP (SAIC 2005b) for the first year (FY 2005-2006) of the project. Subsequent year tasks and associated activities will be planned and detailed as addenda to the FSP and HASP." Additional detail for surface water and sediment sampling will be further detailed in an FSP addendum.

Q59. Do you agree with Mr. Norris analysis, in his Answer 61, as to what is required to correct the deficiencies he lists?

A59. (SMS) I disagree.

Q60. Please state the basis for your disagreement.

A60. (SMS) Toward the beginning of his answer, Mr. Norris uses the phrase *"A simpler, more practical approach..",* showing a lack of experience in karst terrain studies. There is nothing simple about tracing or mapping underground conduits. Only rarely is this attempted, for projects such as evaluation of bridge or building foundations.

All components of Mr. Norris's proposed actions have been addressed previously, and summarized in these five bullets:

- Locating wells on fracture features located on the upgradient and downgradient perimeters of the DU area, as well as in the center, and along the creeks provide monitoring of groundwater as it enters and exits the DU Area. Comparison of up-gradient and down-gradient results will provide a characterization of the impact of the DU Area on the groundwater quality.
- Shallow vadose caves (above the water table) should not be detectable by EI, unless accompanied by deep fracturing and weathering. If deep fracturing and or weathering are present, the area would be a viable target identified by the EI. The locations of the caves as reported by Sheldon are not precise enough to adequately compare them to the fracture trace and EI work. These caves and associated sinkholes are probably an important pathway for shallow near surface

migration of precipitation runoff from the DU area to Big Creek, which will be determined by baseflow separation of stream hydrographs, but they are not conduits for groundwater flow. Monitoring of cave streams will adequately characterize this shallow water pathway, and additional wells on these pathways are not required.

- The use of vintage aerial photographs (prior to construction of JPG) to map fracture traces has the advantage of avoiding cultural interference and is a proven technique.
- Detailed mapping of individual conduits is nearly impossible, and in the best of conditions very time consuming and incomplete. Further, it is unnecessary to establish the circuitous route that groundwater may take through the aquifer, to characterize the potential for DU migration in groundwater. It is sufficient to characterize the upgradient and downgradient groundwater quality as it moves through the DU area. The use of 3D EI is impractical under any conditions at the scale of this project, seismic and GPR may trigger detonation of UXO. This is not a research project where untested methods can be developed. The safety conditions at the site are serious, and require the use of known, tested methods, which require minimal invasion off of roads and safe corridors.
- Tracer studies often are used in the study of karst terrain. To be effective, they must be done after considerable characterization of the karst network is completed in order to appropriately design and implement a successful study. As stated in numerous discussions previously, dye studies will be considered in the future if the information gained would be helpful to the characterization of the hydrogeologic flow regime.

XIV. SUMMARY AND CONCLUSION

As to Testimony of Charles Norris

Q61. Please summarize your testimony with regard to your disagreement with the testimony of Charles Norris herein.

A61. (SMS) My testimony can be summarized as follows:

STV, through their consultant, Mr. Charles H. Norris, has objected to numerous components of the FSP through 81 pages of written testimony, but his meaningful points are few and those can be summarized in just a few points:

1. Mr. Norris painstakingly presents each modification to each component of the FSP, presenting it as an inconsistency. These improvements or refinements are evidence of our iterative process at work. He fails to acknowledge that later phases of work will be modified as new site-specific data are collected and analyzed.

2. Mr. Norris wants to utilize numerous technologies, many of which he is obviously unfamiliar, to accomplish a single task. For instance, he calls for the use of multi-spectral remote sensing, side-looking airborne radar, GPR, color and false-color imagery, 3D EI, seismic surveys, electrical induction, as well as field-intensive measurements and inspections within the UXO-littered DU Impact Area to trace the "mouths and headwaters" of groundwater conduits in order to locate groundwater characterization wells to determine if DU is migrating from the site.

The Army selected a proven method of positioning characterization wells in carbonate rocks using a combination of fracture trace analysis conducted on pre-construction (to avoid cultural interferences) aerial photographs and EI to pinpoint likely fracture features in the bedrock. The EI was conducted on an excellent network of roads surrounding and passing through the DU Impact Area. These roads are safe corridors where UXO has been cleared, allowing safe data gathering and eventual access for drilling equipment.

3. Mr. Norris expresses concern that there is a DU migration pathway to a remote area (possibly a paleo-karst channel or network) that will go undiscovered and undetected. The geologic conditions at the site (flat-lying Silurian-aged siliceous dolomitic limestone) are not likely to host such a condition, and local geologic literature makes no reference to such a condition or potential. However, there is currently no indication that DU has even reached the groundwater table. If that condition is established, and there appears to be a potential for DU migration in groundwater, the pathway will be investigated further.

4. Plans to characterize surface water and sediment transport of DU are not satisfactory to Mr. Norris. This work is not scheduled to occur until after the installation of wells, so that concurrent sampling of all media can occur. Therefore, details of that program have not yet been prepared.

Implementation of the FSP (SAIC 2005a), including the practice of providing modifications to the FSP through addenda, should be allowed to continue so as not to impede the schedule of the application for license closure.

XV. REFERENCES

Q62. In your testimony you referred to several documents. Would you specifically identify those documents?

A62. (SMS) Yes.

1. Dahlin, T., and M. H. Loke. "Quasi-3D Resistivity Imaging – Mapping of Three Dimensional Structures Using Two Dimensional DC Resistivity Techniques", Proceedings of 3rd Meeting Environmental and Engineering Geophysics, Aahus, Denmark, 8-11 September 1997. Attached as Exhibit SMS # 3.

2. Eastern Research Group, 1993. Use of Airborne, Surface, and Borehole Geophysical Techniques at Contaminated Sites, EPA/625/R-92/007, Sept 1993.

Attached as Exhibit SMS # 4 .

3. Fetter, C. W., 1988, "Applied Hydrogeology", Merrill Publishing Company, Columbus, Ohio. Attached as Exhibit SMS # 5.

4. Greeman, T. K., 1981, "Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana", Open-File Report 81-1120, United States Department of the Interior Geological Survey, Indianapolis, Indiana.

5. Lattman, L. H. 1958, "Techniques of Mapping Geologic Fracture Traces and Lineaments on Aerial Photographs", Photogrametric Engineering, Volume 24, pp. 568-576.

6. Lattman, L. H. and Parizek, R. R., 1964. "Relationship Between Fracture Traces and the Occurrence of Groundwater in Carbonate Rocks", Journal of Hydrology 2(1964) 73-91; North-Holland Publishing Co., Amsterdam

7. Freeze, R. A., and Cherry, J. A. 1979. Groundwater, Prentice-Hall, Inc. Englewood Cliffs, New Jersey. Attached as Exhibit SMS # 6.

8. SAIC (Science Applications International Corporation). 2005a. Field Sampling Plan. DU Impact Area Site Characterization, JPG, Madison, Indiana. Final. May.

9. SAIC. 2005b. Health and Safety Plan, Depleted Uranium Impact Area Site Characterization, Jefferson Proving Ground, Madison, Indiana. Final. May.

10. SAIC. 2006a. Field Sampling Plan Addendum 2, Depleted Uranium Impact Area Site Characterization – Soil Verification, Jefferson Proving Ground, Madison, Indiana. Final. July.

11. SAIC. 2006b. Field Sampling Plan Addendum 3, Depleted Uranium Impact Area Site Characterization – Other Monitoring Equipment Installation, Other Monitoring (Precipitation, Cave, and Stream/Cave Spring Gauges), and Electrical Imaging Survey, Jefferson Proving Ground, Madison, Indiana. Final. July.

12. SAIC. 2007a. Field Sampling Plan Addendum 4, Depleted Uranium Impact Area Site Characterization: Monitoring Well Installation Jefferson Proving Ground, Madison, Indiana. Final. January.

13. SAIC. 2007b. Well Location Selection Report, Depleted Uranium Impact Area Site Characterization: Soil Verification, Surface Water Gauge Installation, Fracture Trace Analysis, and Electrical Imaging, Jefferson Proving Ground, Madison, Indiana. Final. January.

14. Sheldon, R. 1997, "JPG Karst Study Report"

15. Wilson, J. T. , et. al. 2001. "An Evaluation of Borehole Folwmeters Used to Measure Horizontal Ground-Water Flow in Limestones of Indiana, Kentucky, and Tennessee, 1999. U.S.G.S. Water Resources Investigation Report 01-4139.

Q63. Does that conclude your testimony?

A63. (SMS) Yes, it does.

SNYDER TESTIMONY

Exhibit SMS # 1

Résumé

STEPHEN M. SNYDER, P.G.

Project Director

Education:	B.S. in Geology, 1973 College of William and Mary Continuing Education, Hydrogeology Pennsylvania State University
Registrations/ Certification:	Professional Geologist - VA #2801-000170; PA #PG-000169-G; TN #TN-3622; WI #240; AL #830; MS #0370 OSHA-certified for Hazardous Waste Operations

Mr. Snyder has 32 years of experience as a project manager, principal investigator, or project hydrogeologist on more than 200 groundwater development, site characterization, environmental remediation, and waste disposal projects. He has managed and conducted investigations of aquifer contamination and designed and implemented remediation at dozens of landfills, lagoons (waste pits), Department of Defense (DOD) facilities, and industrial sites in Pennsylvania, New Jersey, Alabama, Tennessee, and Texas. He has managed major Comprehensive Environmental Responses, Compensation and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) remediation projects for United States Environmental Protection Agency (EPA) and private industry. He has provided hydrogeologic expert witness testimony for wastewater spray irrigation and groundwater development (well interference) projects and has provided expert litigation support services for an industrial contamination dispute, all of which were settled or decided in favor of his client.

He has developed a specialty in fractured and karst bedrock aquifers, utilizing aerial photo and remote sensing analysis, geophysical testing, and dye trace studies, as well as geologic mapping and aquifer pumping tests to develop groundwater supplies or characterize and design remediation for these sites.

Mr. Snyder serves as technical advisor, client representative, contract administrator, and regulatory liaison. He has a working knowledge of key environmental legislation including Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)/Superfund Amendment and Reauthorization Act (SARA); RCRA; Clean Water Act (CWA); National Environmental Policy Act (NEPA); Safe Drinking Water Act (SDWA); Toxic Substances Control Act (TSCA); and Pennsylvania's Act 2 (Land Recycling) Program. He has worked extensively with the Susquehanna River Basin Commission on behalf of clients requiring groundwater and consumptive use allocations.

Mr. Snyder applies his experience to the investigation and remediation of hazardous waste sites. As project director for Superfund projects, Mr. Snyder has been responsible for management of investigative activities as well as developing remedial design solutions. His Superfund experience is supported by his design, operations, and remediation work on more than 30 landfills in Pennsylvania and New Jersey. He joined SAIC in 1979.

PROJECT EXPERIENCE

Project Director, BMY, Inc., York, PA - Directed development and implementation for the closure of an RCRA-permitted wastewater treatment lagoon containing listed hazardous waste (F019). Directed excavation of waste and contaminated soil. Oversaw design, permitting, and construction of an EPA-approved, double-lined (minimum technology requirements) hazardous waste landfill to contain the stabilized waste, saving the client over $2 million in disposal costs had the materials been disposed off-site. Also directed the design, construction, and operation and maintenance (O&M) of two groundwater remediation systems and a mobile soil gas extraction system on the 135-acre industrial facility. Led development of post-closure monitoring plans.

Carroll County, Maryland, Water Resources Study - Assisted in the development of the hydrogeologic framework of various community planning areas of Carroll County, preparing baseline inventories of available water sources in these areas during this eight-year project. Assisted in the completion of a county-wide evaluation of groundwater development potential. Conducted a study of six small municipal water systems.

Project Director, Chambersburg School District, Chambersburg, PA - Oversaw the hydrogeologic evaluation and recovery of fuel oil resulting from a leaking heating oil tank. Designed remedial program including recovery of free product, pumping and treating of contaminated water, and construction of a new water supply well in fractured carbonate rock.

Peer Reviewer, Ciba-Geigy Oversight and Advisory Committee, Ocean County, NJ - Provided peer review and comment on the EPA's Remedial Investigation Report on Toms River Chemical Plant Superfund site.

Technical Advisor and Peer Reviewer, Combe Fill South Landfill, Morris County, NJ - Evaluated the areal extent and migration pathways of contamination in the subsurface. Evaluated the installation of monitoring wells, piezometers, pumping and slug tests. Developed preliminary remedial alternatives during feasibility study (FS) and evaluated the recommended alternative which included gas venting, an aquifer pumping system, and on-site groundwater treatment.

Project Director, Cumberland County Landfill, Cumberland County, PA - Expansion and cell closure.

Project Scientist, Delaware River Basin Commission (DRBC) - Completed lineament mapping from Lansat imagery for two different study areas.

Project Director, Grove Worldwide, Shady Grove, PA - Has directed and managed numerous investigative and remedial activities at this 330-acre industrial facility where hydraulic cranes and man lifts are manufactured. Mr. Snyder directed the investigation of a solvent still spill and the design and implementation which involved excavation and removal of contaminated soils and soil gas extraction system with thermal fume treatment. Led the site-wide investigation to collect information to defend Grove in federal and commonwealth courts against suits by neighboring property owners regarding groundwater flow and groundwater contamination in this karst fractured rock environment. Provided hydrogeologic expert opinions and report regarding the source of groundwater contamination, which resulted in an out-of-court settlement in favor of Grove. The use of advanced geophysical methods to trace groundwater pathways resulted in convincing evidence that led to the favorable decision.

Project Director, Harley-Davidson Motor Company, York, PA - Directed investigative and remediation activities at a 200-acre former naval ordnance plant site involving contamination of groundwater and soils with metals, volatile organic compounds (VOCs), and cyanide. Investigative activities included aquifer testing, characterization of fracture flow and karst aquifer, groundwater and soil sampling and laboratory analyses, geophysical surveys, historical aerial photograph analysis, soil gas surveys, and off-site source assessments. Also led the design and installation of a groundwater extraction and treatment system, remediation of fuel-contaminated soils using bioremediation and soil gas extraction, and four major metals-contaminated soil removal and disposal projects. Much of the remediation work was carried out inside existing buildings, making building integrity and subcontractor scheduling and management a critical component. Work continues with O&M of the 17-well, 300-gpm groundwater pump-and-treat system, including a thermal fume incinerator, major construction projects in contaminated and potentially contaminated areas, and in the development of continued site-wide remedial investigations. This project has recently joined Pennsylvania's "One Cleanup Program", a cooperative initiative between the state and the USEPA.

Project Director, Harmony Grove Landfill, Waste Management, Inc., York County, PA - Led hydrogeologic investigation/design/installation under Superfund guidance of a groundwater extraction system in fractured rock aquifer. Wells in low-yielding shale aquifer were successfully hydraulically fractured, resulting in a cost savings.

Project Director, Harris Corporation/Brault Lagoon, Clinton County, NY - Directed a hydrogeologic investigation to determine the extent of contamination resulting from disposal of solvents in an unlined disposal pit. The investigation involved characterizing the fracture-controlled pathways in the sandstone bedrock and aquifer testing and modeling to design the placement of extraction wells and to establish design criteria for the treatment and conveyance system. A network of monitoring wells was established and monitored to demonstrate capture of contaminated groundwater. Subsequently oversaw design and implementation of a 20-well groundwater pumping system and treatment plant and continues to perform annual monitoring to evaluate system effectiveness. Special O&M procedures for the air stripping tower and wells/pumps, which are subject to biofouling, have been developed for this project.

Project Director, Hazleton City Water Authority, Hazleton, PA - Provided investigation and report on groundwater development potential for over 120 square miles of area surrounding the greater Hazleton area. Directed project to quantify the amount and availability of good quality groundwater and to select and locate sites for development of high-yield groundwater supply wells. Established an emergency groundwater development program and determined the leakage potential of nearby reservoirs. Evaluated the threat of area pollution to an existing production well, as well as the extensive underground drainage tunnels connecting the mine workings within the Hazleton area. Resulted in the development of new water supplies for the City Authority.

Project Manager, Helen Kramer Landfill Superfund Site, Gloucester County, NJ - Project manager and senior hydrogeologist on this $1 million remedial investigation/feasibility study (RI/FS) to characterize the site, assess its threat to human health and the environment, and evaluate remedial alternatives.

Project Manager, Kelly Air Force Base Remedial Design, San Antonio, TX - Developed and directed studies to obtain remedial design parameters for this $3 million effort. Coordinated data-gathering efforts with design team. Effort involved design of 8 small groundwater extraction systems and approximately 60 soil operable units.

design, operations, and remediation work on more than 30 landfills in Pennsylvania and New Jersey. He joined SAIC in 1979.

PROJECT EXPERIENCE

Project Director, BMY, Inc., York, PA - Directed development and implementation for the closure of an RCRA-permitted wastewater treatment lagoon containing listed hazardous waste (F019). Directed excavation of waste and contaminated soil. Oversaw design, permitting, and construction of an EPA-approved, double-lined (minimum technology requirements) hazardous waste landfill to contain the stabilized waste, saving the client over $2 million in disposal costs had the materials been disposed off-site. Also directed the design, construction, and operation and maintenance (O&M) of two groundwater remediation systems and a mobile soil gas extraction system on the 135-acre industrial facility. Led development of post-closure monitoring plans.

Carroll County, Maryland, Water Resources Study - Assisted in the development of the hydrogeologic framework of various community planning areas of Carroll County, preparing baseline inventories of available water sources in these areas during this eight-year project. Assisted in the completion of a county-wide evaluation of groundwater development potential. Conducted a study of six small municipal water systems.

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Project Director, Harley-Davidson Motor Company, York, PA - Directed investigative and remediation activities at a 200-acre former naval ordnance plant site involving contamination of groundwater and soils with metals, volatile organic compounds (VOCs), and cyanide. Investigative activities included aquifer testing, characterization of fracture flow and karst aquifer, groundwater and soil sampling and laboratory analyses, geophysical surveys, historical aerial photograph analysis, soil gas surveys, and off-site source assessments. Also led the design and installation of a groundwater extraction and treatment system, remediation of fuel-contaminated soils using bioremediation and soil gas extraction, and four major metals-contaminated soil removal and disposal projects. Much of the remediation work was carried out inside existing buildings, making building integrity and subcontractor scheduling and management a critical component. Work continues with O&M of the 17-well, 300-gpm groundwater pump-and-treat system, including a thermal fume incinerator, major construction projects in contaminated and potentially contaminated areas, and in the development of continued site-wide remedial investigations. This project has recently joined Pennsylvania's "One Cleanup Program", a cooperative initiative between the state and the USEPA.

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Project Manager, Helen Kramer Landfill Superfund Site, Gloucester County, NJ - Project manager and senior hydrogeologist on this $1 million remedial investigation/feasibility study (RI/FS) to characterize the site, assess its threat to human health and the environment, and evaluate remedial alternatives.

Project Manager, Kelly Air Force Base Remedial Design, San Antonio, TX - Developed and directed studies to obtain remedial design parameters for this $3 million effort. Coordinated data-gathering efforts with design team. Effort involved design of 8 small groundwater extraction systems and approximately 60 soil operable units.

Project Director, Lancaster Area Refuse Authority, Lancaster, PA - Completed electromagnetic conductivity and seismic refraction survey of carbonate terrain to determine site suitability for a proposed solid waste resource recovery facility. Utilized geophysical surveys, aerial photograph analysis, and soil and rock borings.

Project Director, Lebanon County Redevelopment Authority, Lebanon, PA - Worked with the Authority and private industry to encourage and permit the redevelopment of a former steel manufacturing facility.

Project Director, Lehigh Portland Cement - Conducted hydrogeologic evaluation to reduce stream infiltration to a quarry via sinkhole collapses. Responsibilities included site investigation, remedial design and permitting, and construction monitoring.

Technical Advisor, Lipari Landfill Superfund Site, Pitman, NJ - Served as technical advisor for the hydrogeologic RI/FS investigation. Developed drilling and sampling procedures. Conceptualized and evaluated remedial alternatives. Prepared specifications for long-term maintenance of the recommended impervious cover. Peer reviewed RI/FS text.

Project Director, Mercersburg Borough, Franklin County, PA - Directed evaluation of hydrogeology for suitability for spray irrigation.

Project Director, Spectron, Inc., Superfund Site, Elkton, MD - Responsible corporate officer and project director for this investigation of a four-acre fuel blending/solvent recycling site near Elkton, Maryland, where VOCs were present in the groundwater. Aquifer was fractured metamorphic granodiorite. The project evaluated mass flux of methylene chloride, trichloroethane (TCA), methyl ethyl ketone (MEK), acetone in the creek and evaluated the effectiveness of an existing groundwater extraction facility. Remedial technologies were evaluated for site application.

Project Director, Sunny Farms Landfill, Waste Management, York County, PA - Led hydrogeologic investigation and determination of impact on two closed landfill areas totaling 15 acres. Oversaw piezometer installation, permeability measurements, mapping of soils and geology, water quality impacts, and determination of groundwater flow directions. Directed construction of leachate collection trench and containment facility.

Project Director, United Defense, L.P., York, PA - Served as Responsible Corporate Officer in directing the development and implementation for the closure of a RCRA-permitted wastewater treatment lagoon containing listed hazardous waste (F019). Directed excavation of waste and contaminated soil. Oversaw construction of an EPA-approved, double-lined hazardous waste landfill to contain the stabilized waste. Led development of post-closure monitoring plans.

Project Hydrogeologist, United States Army Corps of Engineers (USACE)/Alabama Army Ammunition Plant, Childersburg, AL - Developed and implemented a work plan for this complex RI/FS to identify conduits of groundwater flow at a site with complex karst geology. Applied and integrated several analytical methods and technologies, such as fracture trace analysis using historical aerial photographs, electrical imaging (geophysics) to confirm and pinpoint the locations of conduits, and thermal imaging and sounding to locate groundwater discharges to surface water. Designed and implemented a dye trace study to demonstrate conduit-controlled groundwater flow direction and point of groundwater discharge to surface water. Thermal and dye test results were used to pinpoint surface water and sediment sampling locations, and to assess environmental impact. Constructed a GIS project to manage and interpret data. Results are supporting cost-effective remedial alternatives analyses.

Project Director, Waste Management, Inc. - Harmony Grove Landfill, York County, PA - Led hydrogeologic investigation/design/installation of a groundwater extraction system in fractured rock aquifer. Wells in low-yielding shale aquifer were successfully hydraulically fractured.

Project Director, Waste Management, Inc. - Modern Landfill, York, PA - Performed a detailed hydrogeologic analysis of subsurface conditions to determine potential for sinkhole activity within a proposed 21-acre lined landfill area.

Project Director, Waste Management of North America - Modern Landfill, York, PA - This project evaluated remedial alternatives and resulted in design and construction of a 30-well groundwater extraction system to prevent off-site migration of leachate for this Superfund site. Design parameters for the extraction system and treatment plant required extensive pumping tests, well efficiency tests, measurement of directional permeabilities in the aquifer, chemical concentrations, and maximum and minimum flows. O&M of the extraction wells subject to biofouling required development of chemical and physical treatment procedures. Also directed solid waste permitting activities for two major expansions (over 60 acres) of landfill area.

Project Director, Waste Management - Pottstown Landfill, Pottstown, PA - Directed hydrogeologic investigation/design/installation/O&M of a groundwater extraction system in fractured rock aquifer. Wells in low-yielding shale aquifer were successfully hydraulically fractured. The pump-and-treat system was monitored and annually evaluated for performance. Well treatment procedures for iron bacteria were also implemented.

Waste Management of North America - Overall responsibility for the design of a groundwater monitoring plan in conjunction with a groundwater assessment and pump-and-treat remediation for an entire 60-acre landfill site. Plan involved 36 monitoring wells, 30 groundwater extraction wells, and 12 surface water points.

Project Director, Constellation Power, Inc. (Division of Baltimore Gas and Electric) - Conducted a modified Phase I environmental assessment of a portion of the former Marietta Air Force Station, Marietta, PA.

Project Hydrogeologist, RI/FS Anniston Army Depot, Alabama USACE Mobile District - Provided expertise in fracture flow and karst hydrogeology for identification of potential groundwater flow pathways. Integrated fracture trace analysis, electrical imaging results with seismic reflection, refraction, and borehole geophysics to identify a fault zone for the purpose of evaluating the potential for contaminant transport along the fault. Constructed a GIS for display and analysis of data.

Project Hydrogeologist, Loring Air Force Base, ME - Conducted fracture trace analysis of plume area in fractured rock aquifer. Interpreted results of electrical imaging survey and located monitoring wells for the purpose of tracing contaminant migration. Data were managed and displayed on an ArcView GIS project.

Delivery Order Manager, SI, FUSRAP, Wayne, NJ, USACE New York District - Led $1.1 million characterization study of the former W.R. Grace fuel processing facility. Developed work plan integrating USACE, EPA Region II, and NJDEP protocols. Completion of field activities and report on an aggressive schedule allowed New York District to meet its excavation schedule.

Project Manager, RD, A-E Environmental Services, Kelly AFB, TX - Developed and directed studies to obtain remedial design parameters for this $3 million effort. Coordinated data gathering with design team. Effort involved design of groundwater extraction systems and soil operable units.

Project Hydrogeologist, Tyco Electronics Corporation, Former Manufacturing Facility, Selinsgrove, PA - Developed, directed, and evaluated groundwater and source area characterization of chlorinated solvents in this fractured rock aquifer, using geologic field mapping, historical aerial photo analysis, fracture trace analysis, passive and active soil gas surveys, and installation and testing of multilevel piezometers/monitoring wells. Data and analysis were managed using ArcView geographical information system.

Project Hydrogeologist, Tyco Electronics Corporation, Former Terminix Facility, Harrisburg, PA - Developed, directed, and evaluated groundwater and source area characterization of chlorinated solvents in this karst aquifer, using historical aerial photo analysis, fracture trace analysis, passive and active soil gas surveys, and installation and testing of multilevel piezometers/monitoring wells. Data and analysis were managed using ArcView geographical information system. A fate and transport study is currently underway.

Project Manager and Hydrogeologist, Volunteer Army Ammunition Plant, Chattanooga, TN - Developed and implemented a work plan to identify conduits of groundwater flow at a site with complex karst geology. Applied and integrated fracture trace analysis using historical aerial photographs, and electrical imaging to support the characterization of the groundwater regime and predict contaminant transport.

Senior Hydrogeologist, Jefferson Proving Grounds, Madison, IN - Work plan development and implementation to characterize the depleted uranium (DU) impact area to support license termination and decommissioning. This project involves use of fracture trace analysis and geophysics, stream gauging, precipitation monitoring, and groundwater stage monitoring, as well as analytical testing to characterize migration of DU in the soil, groundwater, and surface water. Area is highly karst, and efforts are complicated by unexploded ordnance (UXO).

Project Director, Gaumer's Chassis Engineering, Chambersburg, PA – Characterized fill areas and developed closure plans for three unpermitted foundry sand landfills. Work was done for counsel, assisted in negotiating fines, scope of services, closure plan requirements. Construction is scheduled for summer 2006.

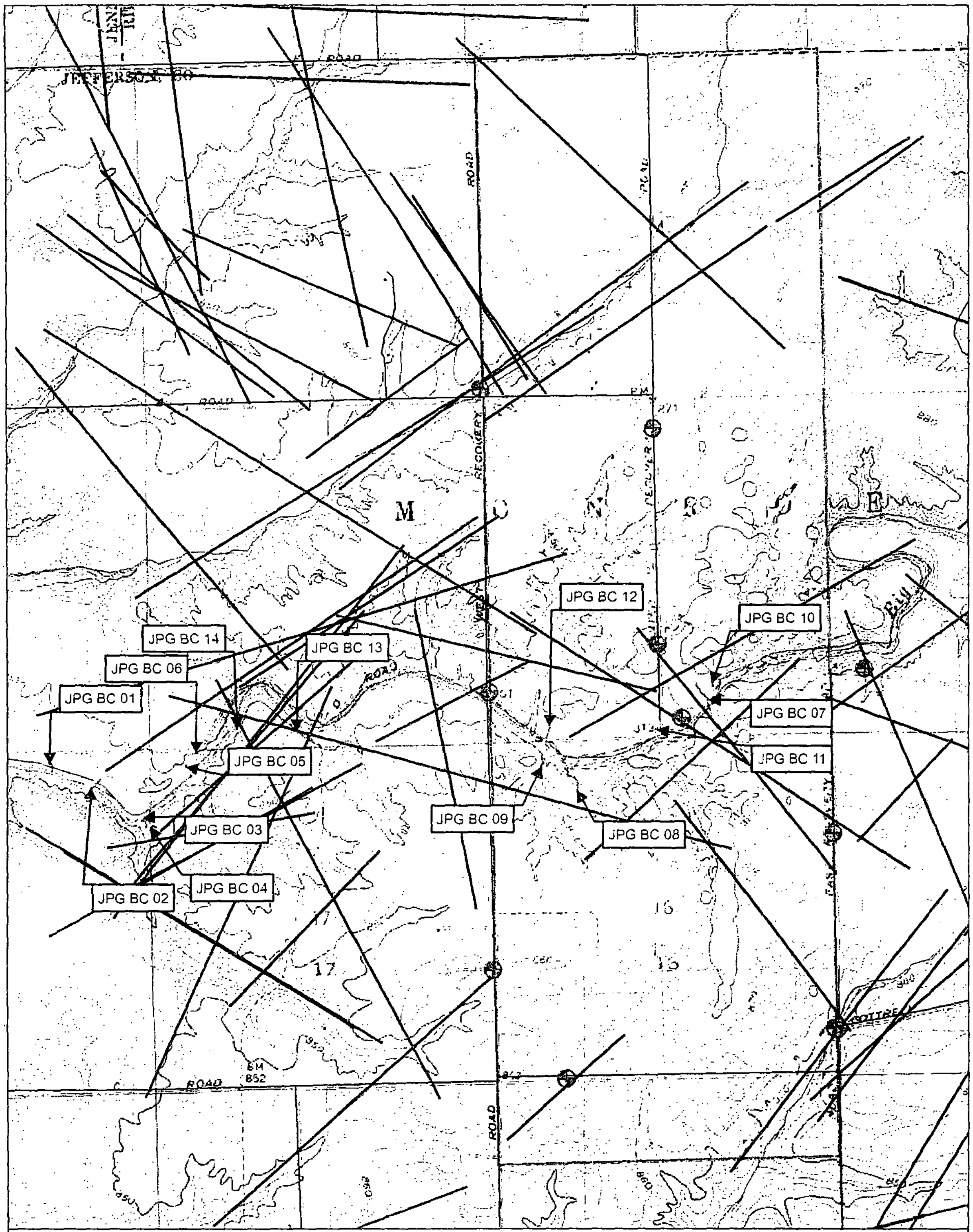
Project Director, Principle Investigator, Spring Creek Groundwater Resources Plan, Dauphin County, Pennsylvania – Work is in progress for Hershey Entertainment and Resorts to satisfy Susquehanna River Basin permit requirements. Work involves quantifying basin boundaries, recharge, discharge, and groundwater surface water usage for the karst basin.

Project Director, William Dick Lagoons Super Fund Site, OU-2 (Groundwater), Chester County, Pennsylvania – Design and construction of an interim groundwater pump and treat system using SAIC's patented Ozinox system for ex-situ treatment. Fractured rock aquifer contaminated by chemicals from tanker truck washing operation disposed into unlined lagoons. Work involves baseline characterization of three square mile area, design, construction and operation of a groundwater extraction system, followed by evaluation of performance and recommendations for further action. Work is in progress.

EXHIBIT SMS #2

Figure No. SMS-1

Distribution of Caves Near DU Impact Area
Dated 8/14/07, Job # 01-1633-04-3211-400



Legend

- Candidate Well Pair Location
- Cave Center Lines
- Fracture Traces
- Streams
- Roads
- uR/hr Exposure Rate
- DU Impact Area

Note. Base map from the 7.5 min USGS Clifty Falls and San Jacinto Quadrangles.

Jefferson Proving Ground
Madison, Indiana

Distribution of Caves Near DU Impact Area

Figure No. **SMS-1**

SAIC

K:\GIS_Data\JPG\Projects\Cave Mapping SMS-1.mxd

Exhibit SMS # 3.

Dahlin, T., and M. H. Loke. "Quasi-3D Resistivity Imaging – Mapping of Three Dimensional Structures Using Two Dimensional DC Resistivity Techniques", Proceedings of 3rd Meeting Environmental and Engineering Geophysics, Aahus, Denmark, 8-11 September 1997.

Stephen M. Snyder Testimony

Exhibits SMS #3, SMS #4, SMS #5, and SMS #6 contain copywrite information and were not placed in ADAMS.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before Administrative Judges:

Alan S. Rosenthal, Chair
Dr. Paul B. Abramson
Dr. Richard F. Cole

In the Matter of	)	Docket No. 40-8838-MLA
	)	
U.S. ARMY	)	ASLBP No. 00-776-04-MLA
	)	
(Jefferson Proving Ground Site)	)	August 2, 2007
	)	

TESTIMONY OF TODD D. EABY
ON STV CONTENTION B-1
BASIS ITEMS "b", "c", "g", "h" AND "i"

SUBJECTS: Stream Gauging Study; Poor Water Quality; Well Installation and Assessment; Number of Wells; Conduit Wells; Dry Well Abandonment; Colluvium Wells; Permeability Testing; Borehole Geophysical Testing; Surface Water Sampling and Sediment Sampling Programs; Surface Water/Sediment Sampling Locations.

I. WITNESS BACKGROUND

Todd D. Eaby ("TDE")

Q1. Please state your full name.

A1. (TDE) My name is Todd D. Eaby.

Q2. By whom are you employed and what is your position?

A2. (TDE) I work as a Geologist/Project Manager with Science Applications International Corporation (SAIC) in their Harrisburg, Pennsylvania office. SAIC acts as the Army's technical consultant and expert on selected tasks related to the planned decommissioning of the U.S. Nuclear Regulatory Commission (NRC) materials license at the Jefferson Proving Ground (JPG).

Q3. Please summarize your professional and educational qualifications.

A3. (TDE) My professional and educational experience is summarized in the résumé attached to this testimony as "Exhibit TDE #1". Briefly summarized, I am a Licensed Professional Geologist in both Indiana and Pennsylvania. I have been actively employed as an environmental consultant for more than 15 years and I have been a licensed geologist in Pennsylvania for more than 3 years.

I have experience in the completion of site characterizations with respect to determining impacts of historical activities as well as contaminant transport at sites with varied soils, hydrologic and geologic settings, most notably and related at sites with Karst and fractured bedrock as is the condition at JPG.

I have been involved in groundwater characterization at over three large (200 acres or more) and numerous small sites where Karst is present as well as over six large and numerous small sites in varied hydrogeologic settings, some of which included groundwater flow dominated by the presence of bedrock fractures, which add to the complexity of the hydrogeology.

Most recently, I am the Project Manager for a Supplemental Remedial Investigation (RI) at a former Naval Ordnance Plant being completed for the present property owner and the U.S. Army Corps of Engineers (USACE) Baltimore District, where Karst and fractured bedrock is contributing to the contaminant transport at the site.

I received a B. S. degree in Geology from Millersville University in 1990. I have certification in OSHA Supervisor Training, OSHA Hazardous

Waste Operations Training, OSHA Confined Space Entry Training and OSHA Excavation Competent Person Training.

Q4. Please summarize the nature of your professional involvement with JPG.

A4. (TDE) I have been providing technical support to the Army's JPG facility since early 2004. I have visited JPG on several occasions and have both participated in field work and provided oversight and technical direction of field personnel. These field activities consisted of an initial tour and site reconnaissance of the Depleted Uranium (DU) Impact Area, the electrical imaging (EI) study, surface water gauging station installations, soil verification, surface water flow monitoring and well location selection and installation. During several of these site visits, I have personally examined DU penetrators including several embedded in soils in the DU Impact Area.

II. OVERVIEW

Issues Raised By Basis Item "b" to STV Contention B-1

Q5. What is the purpose of your testimony?

A5. (TDE) The purpose of my testimony is to address, on behalf of the Army, hydrological and geological issues at JPG as raised by Save The Valley ("STV") as part of its Contention B-1 in these proceedings.

A group named Save the Valley, Inc (STV) has asserted in Contention B-1 in a May 31, 2006 filing with the NRC that:

"As filed, the FSP is not properly designed to obtain all of the verifiable data required for reliable dose modeling and accurate assessment of the effects on exposure pathways of meteorological, geological, hydrological, animal, and human features specific to the JPG site and its surrounding area."

In that filing STV provided 18 supporting bases for their contention, lettered "a" through "r" (basis "p" was withdrawn with this filing of the Final Contentions of STV).

The purpose of my testimony is to provide evidence and expert opinion that refutes the assertions and/or provides clarification to the statements made in basis items "b," "c," "g," "h," and "i." I will also be providing testimony pertaining to the testimony of Charles Norris, submitted herein and dated July 13, 2007

STV's Basis Item "b" states:

"The discussion in section 6.2.1 is disturbing in its failure to set out the chemistry of the monitoring system at this stage and its cavalier dismissal of ground water as a direct exposure route to humans due to its supposedly 'poor quality.' The 'poor quality' that is being cited is, in part, a function of existing data being sampled from wells that are definitely not in 'conduits' that would presumably flush frequently and carry good water. Instead, the 'poor quality' data are drawn often from tight, clayey wells and wells that may well have had multiple types of contaminating material falling into them due to poor maintenance."

Q6. What is your understanding of the technical issues raised by basis item "b" of STV's Contention B-1?

A6. (TDE) In its license amendment application Army is seeking an alternate schedule to perform site characterization work for the submission of a decommissioning plan for JPG. STV's basis item "b" raises alleged issues relating to the basic framework of the "chemistry" for the site characterization and to the discussion of the site water "quality" as both are set out in the Field Sampling Plan. By implication, STV asserts that the license amendment should not be approved unless the Army provides more specific information at the outset as to the analysis to be conducted at the JPG site.

Q7. Do you agree with the assertions contained in Basis Item "b" of STV Contention B-1?

A7. (TDE) No.

Q8. What is the basis for your disagreement?

A8. (TDE) I disagree with STV's statement that the laboratory analysis or "chemistry" has not been specified in the May 2005 Field Sampling Plan (FSP) (SAIC 2005a, ADAMS ML051520319). The May 2005 FSP indicates the basic framework of the laboratory analysis for the site characterization by providing sample types, analyses, media, volume, sample containers and preservatives on Table 8-1. Total and isotopic uranium is specified to be analyzed for all samples collected.

As intended and stated in Section 4.1 Task Description (p. 4-1) of the FSP, "...plans for this project are defined in detail in the FSP and the Health and Safety Plan (HASP) (SAIC 2005b) for the first year (fiscal year [FY] 2006) of the project...Subsequent year tasks and associated activities will be planned and detailed as addenda to the FSP and HASP."

An example of this refinement of the site characterization plans is demonstrated with the Well Location Selection Report (SAIC 2007a, ADAMS ML070220461), in Section 6.2.3, where additional "chemistry" details are planned and proposed. In addition, further details on sampling and laboratory analysis are provided in the original Quality Assurance Project Plan (SAIC 2005c). In this way of continuing to revise and further define the site characterization plan based on continuing site observations and collected data, the site characterization plan is not static, but is continually evaluated, and tailored to collect the data required based on actual site conditions and not only on the original assumptions, which would occur under STV's desire to have the "chemistry" set from the onset.

The FSP (SAIC 2005a) was prepared in this fashion, with the intent to provide additional details for future tasks, so that the originally proposed characterization tasks could be modified and proposed through FSP addenda to allow the evaluation and use of collected data from the preceding tasks. In this manner the need for additional data could be identified and additional data collection and more appropriate data collection methods could be considered, proposed and included in the characterization.

Another example of the evolution of the characterization of the DU Impact Area is demonstrated by the Army making provision to have the U.S. Geological Survey (USGS) sample and analyze ground water and dissolved gases if warranted by data currently being and proposed to be collected under the FSP (SAIC 2005a) and addenda.

III. Discussion

Specificity of "Chemistry"; Water Quality

Q9. Please describe the technical or analytical bases for your disagreement with STV's Basis Item "b".

A9. (TDE) This process of evaluating and revising a site characterization plan based on acquired site specific data is a common and accepted practice in completing environmental site characterizations.

The first steps of our program following the collection and review of published site background data is to install wells and develop the monitoring system, by collecting preliminary initial data that are used to help define the monitoring program and then develop and propose the monitoring program, sample collection method details, and specific laboratory analysis that will be completed.

The more complex the hydrogeologic setting and potential transportation mechanisms that are present at the site, the more complex the characterization may be requiring careful, tiered or phased investigations based and designed on collected and observed site-specific data and conditions, not on assumptions alone. JPG, based on known site conditions, and as defined in NUREG 1757, Volume 2 (NRC 2006), has "complex" technical aspects. Furthermore, it is stated in NUREG 1757, Volume 2 that:

"Technically complex sites are generally sites with one or more of the following conditions:...planned license termination under restricted conditions (10 CFR 20.1403);... unusual physical or lithologic properties, such as a highly fractured formation, karst features, or sinkholes that may significantly impact assumptions of transport models or the overall conceptual model."

And that:

"Technically complex sites may require more advanced remediation, survey planning, or performance assessment modeling and analysis approaches...collect characterization data..., and design site- or source-specific survey plans. Because of the complex nature of these sites, the scope of NRC staff review will depend on site-specific conditions and on the degree of site complexity. Therefore, a generic NRC staff review of complex sites cannot be articulated in this volume."

To propose the specifics of the monitoring program and laboratory analysis to that detail suggested by STV in their basis at the onset of the characterization before collecting site-specific data that will be acquired during the initial field tasks would be making assumptions about site-specific conditions that could be clarified with the initial data collected and would be contradictory to the guidance provided in the sections of NUREG 1757, Volume 2 (NRC 2006) referenced above.

Q10. Do you agree or disagree with STV's statement "*...its cavalier dismissal of ground water as a direct exposure route to humans due to its supposedly 'poor quality.'*"

A10. (TDE) I disagree.

Q11. What is the basis for your disagreement?

A11. (TDE) In the very FSP (SAIC 2005a) section that STV cites in this basis (Section 6.2.1), it is stated "Onsite and offsite human and ecological receptors could be impacted by DU leaching through soil to the underlying aquifer. Contaminated drinking water can enter the human or ecological food chain indirectly (e.g., livestock drinking water) or directly (e.g., drinking water supply)."

Furthermore, groundwater as a potential exposure pathway was acknowledged in Figure 2-7, (Conceptual Site Model of DU Transport Through The Environment At and Around the JPG DU Impact Area) of the FSP (SAIC 2005a) and in Figure 1-2 (Conceptual Site Model of DU Transport Through the Environment) included in the November 2004 final "Responses to The Nuclear Regulatory Commission May 20, 2004 Request for Additional Information Regarding The Environmental Monitoring Program Plan" (2004) response to NRC question 1.

In addition, in that response to NRC question 1 it is stated that "Impacted surface water and groundwater *could* (emphasis added) migrate to drinking water sources."

Furthermore, why would we and the Army waste the large amount of time and resources completing the fracture trace analysis, EI survey, locating proposed drilling locations on potential groundwater "conduits" and installing the monitoring well pairs to evaluate and characterize groundwater flow and potential for contaminant migration, if we and the Army were not acknowledging that the groundwater could be a direct exposure pathway?

STV incorrectly states that "The 'poor quality' that is being cited is, in part, a function of existing data being sampled from wells that are definitely not in 'conduits' that would presumably flush frequently and carry good water. Instead, the 'poor quality' data are drawn often from tight, clayey wells and wells that may well have had multiple types of contaminating material falling into them due to poor maintenance." The citation of "poor quality" was from a 2002 Montgomery Watson Harza report (MWH 2002) and was not determined or derived from data resulting from historical sampling of the wells located at JPG, specifically the wells in proximity to the DU Impact Area, but by the fact that the aquifer is not considered to be a good source of readily available groundwater and therefore, from an economic standpoint is an aquifer of "poor quality." The Army has repeatedly responded and modified it's assertion in Section 6.2.1 of the FSP (SAIC 2005a) that "the aquifer is not a drinking water source..." and has since stated that "...there are few wells in the vicinity of the JPG that are used for domestic supplies..."

Furthermore, the DU Impact Area at the closest point is nearly 2 miles from the JPG boundary; therefore, the closest domestic supply well can safely be assumed to be located at least 2 miles away assuming conservatively that a domestic supply well is located immediately outside of the JPG boundary.

STV has expressed in discussions with the Army and previous responses that they do not agree with our opinion that the aquifer generally has "low productivity" or lack of sufficient volume for domestic water supplies. It is my professional opinion that the aquifer underlying the study area generally has a low yield and without extensive investigation (e.g., fracture trace, EI) the majority of wells drilled into the aquifer will not encounter features or conditions that provide sufficient yield for supply wells or an appropriate monitoring location for evaluating the potential for DU migration from the DU Impact Area.

My opinion is further supported by the statements in the USGS open-file report entitled "Lineaments and Fracture Trace, Jennings County, and Jefferson Proving Ground, Indiana" (Greeman 1981, page 1, Eaby References given at Answer 63, Item 1) that *"Jennings and several adjacent counties are economically restricted by inadequate water supplies...Many wells tapping this aquifer are unable to supply single-dwelling needs...well placement is important in this area, as fractures are a principal source of water to wells."* The report goes on to cite low productivity in the aquifer numerous times and how many areas are not supplied by groundwater, but by water companies that use surface water that often is transmitted by pipe long distances from the source to the users.

Q12. Are you familiar with the testimony offered by Charles Norris in this hearing?

A12. (TDE) Yes, I have reviewed his written testimony dated July 13, 2007.

Q13. Do you agree or disagree with his opinions and conclusions concerning the adequacy of the hydrogeological characterization program?

A13. (TDE) I disagree. But let me first state that Mr. Norris identifies seven major elements of the hydrogeological characterization program. I will be testifying as to three elements of the deficiencies which he identifies in his Answer 20 as the focus of his testimony. These elements are:

- well installation and assessment,
- surface water sampling and
- sediment sampling programs.

The remaining four elements will be the subject of the testimony of my co-worker, Stephen Snyder.

Q14. Would you briefly state the general basis for your disagreement with Mr. Norris as to the element of well installation and assessment?

A14. (TDE) Yes. Mr. Norris contends in his testimony that the FSP, and, in particular, the well installation and assessment, is inadequate to provide for the proper site characterization for the Army to prepare a decommissioning plan. Mr. Norris criticizes the methods of well installation and construction while either choosing not to acknowledge the apparent drilling and well construction difficulties due to the subsurface conditions that are normally present where karst features are suspected or is demonstrating his lack of understanding of characterization methodology, data reduction, and interpretation. His criticism of the construction details appears to be either a result of a choice to not understand the details in the FSP or the lack of working knowledge of the construction materials and their application in constructing wells. His criticism of the well assessment and the lack of acknowledgement of the evaluations included as described in the FSP addendum 4 (SAIC 2007a, ADAMS ML070220165) and the Well Selection Report (SAIC 2007b) also demonstrates his choice to either ignore the details of the assessment as presented or his lack of understanding of characterization methodology, data reduction, and interpretation.

Q15. Would you briefly state the general basis for your disagreement with Mr. Norris as to the two elements of surface water and sediment sampling?

A15. (TDE) Yes. In essence, Mr. Norris' testimony concerning groundwater, surface water and sediment contends that the current sampling programs for these media under the FSP (SAIC 2005) are deficient in meeting the eventual requirement for the Army to submit an effective decommissioning plan in 2011.

Mr. Norris demonstrates a misunderstanding of, and misstates the Army's approach, specifically demonstrated by his continual failure to recognize that, as stated in the FSP (SAIC 2005) and presented numerous times to STV, the FSP (SAIC 2005) provides the framework for the site characterization of the DU Impact Area and included the investigation details only for the first year of investigation. Details for the following year's investigations would be provided in future addenda providing the crucial and necessary ability to modify the FSP (SAIC 2005) based on the newly acquired and evaluated site-specific data. With an investigation of this magnitude and complexity, the phasing and "building" of the investigation on acquired site-specific data is the most efficient and accurate process for completing a meaningful and adequate site characterization.

Many of Mr. Norris' claims are premature and will be or have been adequately addressed in future addenda.

He claims a need for identifying and completely mapping every individual potential pathway including each and every groundwater conduit and area of influence of those transport mechanisms for DU to move through groundwater, surface water and sediment, no matter how minor, or improbable to be present at the site. He suggests the need for characterization of potential conditions or transport mechanisms, but provides no site-specific data to support the need for investigation at this stage of collecting basic site data. The FSP presented will allow the collection of the basic site-specific data that will account for these unique conditions while evaluating site conditions and most probable transport mechanisms present allowing site characterization for the purposes of providing a sufficient decommissioning plan.

Mr. Norris attempts to present inconsistencies within the FSP and addenda to cast doubt on the adequacy of the entire program and my testimony will demonstrate that he misunderstands, misinterprets and misstates the Army's site characterization approach. More specifically, he continually calls for investigation and characterization of anticipated receptors, mechanisms of transport and conditions where he has no site-specific data to suggest these items are present or are potentially occurring.

Mr. Norris suggests over and over the need for investigating and evaluating the potential for transport outside of JPG and even outside of the most probable drainage and transport area when there is absolutely no current data that suggests that this could be a possibility and is potentially occurring. To look "far" away from the source to characterize the potential for transport or impact to that "far" away location would be inappropriate and potentially misleading without some site-specific data that would suggest a need or possibility of transport to that location.

Our approach, which is normal and accepted in the scientific community, is to first investigate the most probable location for impacts and transport mechanisms so that data will be collected that can be used to develop a meaningful refined and accurate site conceptual site model (CSM) that will be used along with the collected data to provide updated inputs for development of the RESRAD model for preparation of a decommissioning plan.

IV. SUMMARY AND CONCLUSION

As to Basis Item "b"

Q16. Please summarize your testimony with regard to Basis Item "b".

A16. (TDE) My testimony can be summarized as follows:

The suggestion by STV that the "chemistry" should be set out from the beginning would result in a plan based mostly on assumptions of site conditions not on actual site conditions. Our plan of a tiered approach based on the results of previous studies and actually determined site conditions and data will result in a more complete, accurate, and representative site characterization. The project should continue as presented in the FSP by using the basic framework proposed for the "chemistry" with the sample analysis and the groundwater monitoring details being developed following the collection of the data from the monitoring wells. To set the complete sample analysis parameters prior to collection of at least some basic site data could be counterproductive and would likely require modifications based on the data received from well installations.

The future development of the FSP and addenda will be monitored and evaluated by the NRC as indicated in the following statement:

"NRC anticipates having annual (or more frequent) meetings at NRC headquarters, open to the public, to discuss the Army's progress in completing the site characterization and new decommissioning plan. These meetings should occur prior to the initiation of significant planned field activities, such as determining the number and location of new monitoring wells."

Taken from *Technical Review of Request for an Amendment to License SUB-1435 (Docket No. 040-08838) Proposing an Alternate Schedule for the Submission of a Decommissioning Plan for Jefferson Proving Ground, Madison, Indiana* (U.S. Army 2006a). This is the official date that the Army's request for an extension to the schedule was approved.

V. OVERVIEW

Issues Raised By Basis Item "c" to STV Contention B-1

Q17. What is your understanding of the technical issues raised by basis item "c" of STV's Contention B-1?

A17. (TDE) In Basis Item "c" STV stated that:

"The wells to be used for staging should not be limited by assumption to six wells, as proposed in section 6.2.2. Six may be enough, but it also may not be. The actual number should be a function of results achieved, not

assumptions made. (It is hoped that the last sentence in this section mistakenly left an "s" off the word "well."

By implication STV asserts that the license amendment should not be approved unless the Army is required to commit to completing groundwater staging at more than six wells at the JPG site.

Q18. Do you agree that the Army is only committing to complete groundwater staging at six wells in its FSP?

A18. (TDE) No. Even in the basis presented by STV, they state that six wells may be enough and do not present a meaningful dispute.

Furthermore, it has been stated numerous times and places as well as in the response to basis b above that the FSP (SAIC 2005a) was a starting point and would be modified by addenda following the collection and evaluation of data. This way the characterization of the DU Impact Area would not be designed in a vacuum, and be static, but would be designed in steps building on the preceding site-specific data collected, resulting in a more meaningful and accurate site characterization. The Army has indicated previously in discussions with STV that the number of groundwater staging wells will not be limited to the six wells that constrain the FSP (SAIC 2005), rather that the eventual appropriate number of wells will be determined. Furthermore, the design of the characterization will be modified over time as site-specific data is acquired and evaluated and will be discussed during annual meetings with the NRC staff as stated in the previous response.

By the way, an "s" was mistakenly left off the word "well" in Section 6.2.2 of the FSP.

VI. SUMMARY AND CONCLUSION

As to Basis Item "c"

Q19. Please summarize your testimony with regard to Basis Item "c".

A19. (TDE) My testimony can be summarized as follows:

The project should continue with the realization that the number of wells which will be used to collect groundwater staging data will not be limited to six. Following the well installation and preliminary evaluation of the aquifer conditions, the appropriate number of wells for collection of groundwater staging data will be reviewed.

VII. OVERVIEW

Issues Raised By Basis Item "g" to STV Contention B-1

Q20. What is your understanding of the technical issues raised by basis item "g" of STV's Contention B-1?

A20. (TDE) In its Basis item "g" STV states:

"The FSP states in section 6.2.4.4 that the new wells will not be tested for permeability. Granted, if a particular well is sunk into a well-developed conduit, it will not be feasible to measure permeability. But, the nature of karst features is to be hard to locate precisely, so it is likely that at least some of the wells will simply be in bedrock with some enhanced permeability, which should be measured if it can be. Moreover, the conductivity of the rock adjacent to and feeding the conduit is a major determinant of flow through the system. The same holds true for aquifer testing. If pumping the aquifer shows interconnection among two or more of these conduit pairs, that result will provide very valuable information about the system transporting DU from the site, so it should be determined and reported when it occurs."

By implication STV once again asserts that the license amendment should not be approved unless the Army is required to commit to more specific analysis, here permeability and aquifer testing, at the JPG site.

Q21. Do you agree with the position asserted in Basis Item "g" of STV Contention B-1?

A21. (TDE) No.

VIII. Discussion

Permeability and Aquifer Testing

Q22. What is the basis for your disagreement?

A22. (TDE) STV has incorrectly stated in their basis that: "The FSP states in section 6.2.4.4 that the new wells will not be tested for permeability." The FSP in section 6.2.4.4 actually states: "No aquifer testing is scheduled <u>at this time</u>..."

The February 2006 response to NRC Request for Additional Information (RAI) #2 (Army 2006b, ADAMS ML060590379) described the phased approach to the investigation including the consideration of aquifer testing following the installation of the monitoring network and the collection of basic information and data on the aquifer system.

STV is speculating that the proposed wells will be installed within areas that have conditions that can be tested with simple methods (e.g., slug testing) for estimating hydraulic conductivities. The proposed well locations are being developed to intersect Karst conduits and/or fractures and by nature are anticipated to have hydraulic conductivities that are greater than that can be reasonably measured with simple testing methods so that required basic information needs to be collected prior to designing and proposing a plan for aquifer testing at these proposed wells and of the monitoring network.

Blindly proposing aquifer and well testing without additional basic site-specific data as suggested by STV would most likely result in a waste of time, effort and money as well as collecting useless data for the purpose of site characterization, refinement of the conceptual site model (CSM) and providing site-specific updated inputs for RESRAD.. It is more appropriate and efficient to have consideration and design of applicable well and/or aquifer testing following the collection of basic monitoring location specific data during well installation and the following monitoring as the Army has proposed in the FSP (SAIC 2005) and previous NRC requests for additional information RAI responses. This phased approach of basic data collection followed by consideration and design of aquifer testing would more likely result in appropriate and useful aquifer testing and aquifer specific data that could be used for site characterization, refinement of the conceptual site model (CSM) and providing site-specific updated inputs for RESRAD.

IX. SUMMARY AND CONCLUSION

As to Basis Item "g"

Q23. Please summarize your testimony with regard to Basis Item "g".

A23. (TDE) My testimony can be summarized as follows:

Proposing aquifer testing without knowledge of the basic aquifer parameters and well construction details is inappropriate at this point in the site characterization. The project should continue in the fashion presented in the FSP (SAIC 2005a) and addenda (SAIC 2006a, 2006b, 2007b, respectively ADAMS ML061930256, ML061930287 and ML070220165) to allow the collection of the necessary basic site-specific data that will be used for site characterization. This basic site-specific data will be used to complete an evaluation and determination of the need for additional tests and studies, which could include aquifer testing if determined to be useful and necessary to provide a reasonably accurate characterization of the DU Impact Area and the potential for DU migration to potential receptors for the purpose of preparing a decommissioning plan.

X. OVERVIEW

Issues Raised By Basis Item "h" to STV Contention B-1

Q24. What is your understanding of the technical issues raised by basis item "h" of STV's Contention B-1?

A24. (TDE) In its Basis item "h" STV states:

"Contrary to section 6.2.4.3, geophysical testing and video taping of all of the well drilling should be required in intervals where it is physically possible. The understanding obtained from cuttings, particularly air-drilled cuttings, what material has been drilled through and in which a well is being completed is extremely limited. Logging and videoing the borings as they are being drilled actually records what the boring encountered and provides much valuable information for reasonably interpreting the water data that is later collected over time. If turbidity precludes video taping of a boring, teleview logging is a valuable alternative. Where boring logs cannot safely be run, logging through the casing can and should be done."

STV is asserting that geophysical testing and borehole video taping of all well drilling is appropriate at the JPG site and that the license amendment should not be approved unless the Army is required to perform such taping and testing.

Q26. Do you agree with the position asserted in Basis Item "h" of STV Contention B-1?

A26. (TDE) No.

XI. Discussion

Borehole Geophysical Testing

Q27. What is the basis for your disagreement?

A27. (TDE) Useful and necessary geophysical and video logging of the wells for the purpose of completing an accurate site characterization cannot be conducted using the drilling techniques necessary and proposed because the majority of borehole logging methods and specifically the methods suggested by STV require an open borehole.

STV suggests that "...logging through the casing can and should be done." The drilling method proposed in both the FSP (SAIC 2005) and FSP Addendum 4 (SAIC2007a, ADAMS ML070220165) anticipates difficult drilling conditions and proposes having a steel casing advanced in the borehole simultaneously while drilling. The geophysical borehole logging methods that can be completed through steel casing are very limited and would not provide any additional aquifer information that is not determined by the rig geologist's observations.

To complete the STV's suggested logging method, alternate drilling methods would have to be applied. My experience from previous attempts at advancing boreholes into these types of identified features using methods other than that with casing advancement have resulted in lost or broken tooling, unstable boreholes, and borehole collapse/loss. If an alternate method, other than that proposed, were adopted, borehole collapse and muddy conditions would result in incomplete geophysical/video data.

Down-hole video and geophysical tooling are very expensive (from $1,000s to tens of $1,000s), and most owners of the equipment would not be willing to risk their equipment in known unstable boreholes. In addition, the revised drilling method (selected for safety reasons due to the presence of unexploded ordnance (UXO) will provide rock cores from the borings that can be directly observed, eliminating the need or usefulness of many of the borehole geophysical methods.

Q28. Do you agree or disagree with STV's statement that, "The understanding obtained from cuttings, particularly air-drilled cuttings, what material has been drilled through and in which a well is being completed is extremely limited."?

A28. (TDE) I disagree.

Q29. What is the basis for your disagreement?

A29. We have successfully used the proposed methods and sequence of investigation tasks to locate and place well-screen intervals into Karst features and bedrock fractures at several other sites with numerous wells.

As stated in Applied Hydrogeology (Fetter 1988, page 287), "Karst is a term applied to topography formed over limestone, dolomite or gypsum; characterized by sinkholes, caverns and lack of surface streams." The understanding we gained at those sites from the combination of the fracture trace analysis, EI, and the rig geologist's observations and prepared drilling logs provided sufficient understanding required to complete the task of installing wells in groundwater flow pathways or conduits necessary to characterize the site and the potential for contaminant migration.

This being said, the well installation method and process that is presently proposed for the well installation at JPG will provide even more data and detail on the subsurface than the air-rotary method originally proposed.

The FSP (SAIC 2005) was submitted in May 2005 and as stated in Section 4.1 Task Description (p. 4-1), "...plans for this project are defined in detail for this FSP and the HASP (SAIC 2005a) for the first year (FY 2005-2006) of the project. Subsequent year tasks and associated activities will be planned and detailed as addenda to the FSP and HASP." Additional detail for activities to be completed following the first year will be further detailed in FSP addenda.

The FSP (SAIC 2005) was prepared in this fashion, with the intent to provide additional details for future tasks, so that the originally proposed characterization tasks could be modified and proposed through FSP addenda to allow the evaluation and use of collected data from the preceding tasks. In this manner, the need for additional data could be identified and additional data collection and more appropriate data collection methods could be proposed and included in the characterization.

With this said, FSP Addendum 4 (SAIC 2007b) has provided much more detail on the well installation methods and the data that will be collected during the well installation task. One boring at each well pair location will be advanced through the overburden (soil) materials to bedrock or auger refusal while collecting continuous split spoon samples of the overburden materials. These soil "cores" will be inspected, logged and placed into labeled storage bottles or bags by the rig geologist. The soil "cores" will be stored at JPG in a secure location for inspection if required in the future.

To address potential UXO safety concerns, the originally proposed drilling method has been changed to include the use of rock coring and rotary casing advancement drill tooling at each boring/well location. The revised drilling method will provide rock cores from the borings as well as other important data such as intervals of drilling fluid loss, drill tooling penetration rates, core recoveries, etc. that the rig geologists record on the drilling logs completed in the field.

In addition, the rig geologist will examine and log the actual rock cores, collect data from the cores such as rock type, bedding, rock quality designation (RQD), voids, fractures, etc. and record these data on the field prepared drilling logs. The rock cores will be placed in labeled core boxes in the sequence drilled and following photographing of the cores will be stored at JPG in a secure location for inspection if required in the future. These types of data are used to evaluate the conditions present in the subsurface and for determining relative permeability and presence of features or conditions that are indicative of groundwater flow.

We have used the proposed methods of fracture trace analysis, EI survey, and the proposed drilling method including casing advancement at numerous sites in Karst aquifers to find groundwater flow conduits. Porosity is the ratio of the volume of void space in the rock or sediment to the total volume of the rock or sediment. Some rocks as is often the case with carbonate rocks (i.e. limestone and dolomite), have very low primary porosity. In bedrock with low primary porosity, but with developed secondary porosity (i.e., fractures, Karst conduits), it is critical to identify the locations or zones of increased or effective porosity for characterization of groundwater flow and contaminant transport. Effective porosity is the volume of void spaces through which water or fluids can travel in rock or sediment divided by the total volume of the rock or sediment. We have demonstrated numerous times at several Karst aquifer sites that this method, when properly executed, results in the successful location of groundwater flow pathways or zones of increased porosity allowing characterization of a site such as at JPG.

The fracture trace analysis and EI survey are used to locate these areas of probable secondary porosity (conduits) and identify drilling locations for wells to be constructed within the conduits. An experienced rig geologist is able to accurately log, characterize the rock core, and use drill penetration rates as well as other observations to: (1) support interpretation of subsurface conditions and (2) properly direct the construction and design of the wells such that the most hydraulically connected sections of the well to the aquifer are monitored.

These conduit features, which present very difficult drilling conditions (weathered and fractured rock), often result in unstable subsurface conditions. In addition, as stated in the USGS open-file report (Greeman 1981) entitled *Lineaments and Fracture Trace, Jennings County, and Jefferson Proving Ground, Indiana* "...Drilling into vertical bedrock fractures and their intersections may also impose some difficulties on the driller...In many holes, greater lengths of casing than normal are needed to seal out mud that has slumped into solution openings." These conduit features present the most probable locations and pathways for significant and often high-volume and velocity groundwater flow; therefore, it is critical that monitoring wells are installed within these features so that they can be monitored and characterized. Because of the difficult drilling conditions, non-typical drilling methods consisting of a casing advancement system have been found to be most successful at overcoming and mitigating the unique and highly variable drilling conditions.

As work progresses, the Army will have the capability of having the USGS perform additional testing for comparison of flowmeter-based and water-level-based directions of ground-water flow at JPG.

Q30. In his Answer 44 of his testimony, Mr. Norris gives his impression of the major design elements for well installation and assessment described in the FSP (SAIC 2005) and Addenda. Do you have any comments relating to Mr. Norris' impressions?

A30. (TDE) Yes. Mr. Norris discusses the drilling and well construction details present in both the original FSP (SAIC 2005) and the FSP Addendum 4 (SAIC 2007). Undue safety hazards were identified with using the originally proposed drilling method due to the presence of UXO and possibility of causing of an accidental detonation due to uncontrollable vibration and potential disturbance to the subsurface. This uncontrollable danger associated with using the original drilling method was realized following additional consideration that occurred after the submission of the original FSP.

An alternate drilling method was selected to mitigate the danger due to the presence of UXO and as a result the initially proposed well construction required modification to accommodate the revised borehole diameters. FSP Addendum 4 (SAIC 2007) presented the fully revised drilling and well construction details. It is unnecessary to discuss those drilling and well construction details originally proposed since they have been replaced and are no longer relevant.

Mr. Norris states a major design element as modified by FSP Addendum 4 (SAIC 2007) as "Nine well pairs will be completed in bedrock and one well pair will be completed in anomalously thick overburden." This is incorrectly stated with respect to the tenth well pair location. The EI survey results indicated a "...greater than average depth to bedrock."

and at this tenth location "...the shallow well will be installed in the overburden or at the bedrock-soil interface..." as stated in the FSP Addendum 4 (p2-2, 2-5; SAIC 2007).

Q31. Do you agree or disagree with Mr. Norris' opinion, expressed in his Answer 45, that the design for the well installation and assessment is inadequate for purposes of JPG DU site characterization?

A31. (TDE) I disagree with Mr. Norris' opinion that the design for the well installation and assessment is inadequate for the purposes of completing a site characterization for development of a decommissioning plan. I will provide support for my disagreement in my ensuing testimony related to a number of Mr. Norris answers and I will demonstrate that Mr. Norris has a general lack of understanding of characterization methodology, data reduction, and interpretation for what is adequate for sufficiently characterizing the site and preparing a decommissioning plan that the Army has proposed.

Q32. Do you agree or disagree with the six deficiencies Mr. Norris identifies as to the design for the well installation and assessment which he sets forth in his Answer 46?

A32. (TDE) I disagree as to each of the alleged deficiencies.

Q33. Please give the basis for your disagreement with the first alleged deficiency?

A33. (TDE) The first alleged deficiency given by Mr. Norris in his answer concerns the original drilling details proposed in the original FSP and is irrelevant following the submission of FSP Addendum 4 (SAIC 2007) with the selection of a new drilling method and only serves to complicate the discussion.

He refers to a typographical error in the FSP Addendum 4 (SAIC 2007) and contends that is an example of "...inconsistencies that make it uncertain what will or won't be done and what is or is not expected." His argument demonstrates his lack of understanding of characterization methodology that is planned to be used in that his example of the typographical error cited would be obvious to a geologist experienced in well construction and well construction techniques. By reviewing the actual references to the use of centralizers in the FSP Addendum 4 (SAIC 2007) it is apparent to an experienced geologist what was intended and appropriate.

Centralizers when applied correctly are used to centralize or hold the well screen or riser materials centrally in the borehole to assist in well construction and are necessary when the difference between the borehole diameter and the well materials diameter is such that placing the well centrally can be difficult, which is often the case when there is a large diameter borehole in relation to the diameter of the well materials (not a condition present under the present well installation procedures).

The first reference to centralizers in the FSP Addendum 4 (SAIC 2007) is in Section 2.2.2.1 (page 2-9) where the typographical error is present. It states "The annulus between the screen assembly and the borehole will be small such that the use of centralizers will be necessary." The annulus referred to in this sentence is the space between the borehole wall and the outside of the well screen or well riser pipe.

This is a typographical error which is obvious to those familiar with well construction and appropriate application of centralizers because of the portion of the sentence as follows "The annulus between the screen assembly and the borehole will be small..." The sentence should have included the word "not" to say "The annulus between the screen assembly and the borehole will be small such that the use of centralizers will **not** be necessary." This is further supported by the second discussion on centralizers in Section 2.2.5.4 Centralizers, of the FSP Addendum 4 (p2-12; SAIC 2007) where it is stated in the first sentence "It is not anticipated that centralizers will be required during this well installation." The wells are proposed to be constructed using pre-packed or U-Pack (filter pack installed into the screen in the field prior to deploying into the borehole) as stated in the FSP Addendum 4, section 2.2.2.1 (p2-9; SAIC 2007).

Again, an experienced rig geologist should know that this type of screen assembly guarantees that a well screen will be surrounded by a uniform and continuous sand pack (a primary reason that centralizers are utilized when not installing U-Pack or pre-packed screens), and further reduces the annulus and therefore further eliminates the need for centralizers. In addition, a grout basket is indicated to be used immediately above the screen. The grout basket's intended purpose isn't to centralize the well materials, but as a result of it's proper function it is attached to the well riser pipe above the screen and extends outwards to the borehole wall and as a result provides additional centralization of the well materials. Without a doubt Mr. Norris improperly identified this as a significant contradiction in the FSP Addendum 4 (SAIC 2007). Had he reviewed the additional detail provided and demonstrated a basic understanding of the well construction and materials being used, he would have realized this was an obvious typographical error and not a contradiction.

Q34. Please give the basis for your disagreement with the second deficiency alleged in Norris' Answer 46?

A34. (TDE) Mr. Norris, in this statement of his alleged deficiency of the well installation and assessment program, illustrates an error in data use and interpretation made by those that are not familiar with interpreting the results of certain geophysical studies such as Electrical Imaging. Mr. Norris refers to the anomalies that were presented in the EI results and illustrated on Figures 5-1 through 5-5 of the Well Location Selection Report (SAIC, January, 2007b) and states the obvious observation that the anomalies "...showed a host of styles....", but goes on to make the mistake of interpreting the modeled resistivity anomalies as direct representations of the actual physical condition and orientations of the features or structures that cause the resulting measurement and identification of a resistivity anomaly.

The illustrated anomalies are a representation of a measured voltage drop or apparent resistivity and many different orientations and conditions can produce a similar looking anomaly. Mr. Norris is making the mistake in interpretation by considering the EI results as a picture of a cross-section of the subsurface and is considering the edges or boundaries of modeled electrical fields or anomalies as actual physical surfaces, such as bedrock surfaces, solution cavity walls, fracture faces, etc, when this is not the case at all. That is why when drilling an anomaly represented on an EI survey, the rig geologist needs to make actual field observations during drilling while reviewing the EI anomaly representation.

Following this observation and determination of the actual subsurface conditions present, the rig geologist will review these observations and the targeted EI anomaly with the project hydrogeologist and senior hydrogeologist. This process of collection of site specific subsurface data, review of the EI anomaly characteristics, discussion and review will allow the most appropriate final depth and well construction to intersect and monitor the saturated permeability encountered and potential groundwater conduit to be selected. By keeping the target depth approximate the investigation has the flexibility to extend the boring deeper to evaluate conditions deeper than anticipated if the need is determined to be warranted based on review of both the EI results and the site-specific conditions.

Q35. Please give the basis for your disagreement with the third deficiency alleged in Norris' answer 46?

A35. (TDE) Contrary to Mr. Norris' assertion in his answer, it is my opinion that geophysical logging of the boreholes during drilling is not necessary for the purpose of this investigation, specifically refining the CSM in support of updating RESRAD inputs and completing a decommissioning plan.

Mr. Norris asserts that the modification to the originally proposed drilling method to include retrieval of rock cores is a correction of an alleged deficiency in the original FSP (SAIC 2005). I do not agree with Mr. Norris in his assertion and feel that the original drilling method was adequate for the purpose of installing the intended monitoring wells and observing and recording basic information necessary for documenting subsurface conditions at the well locations and was not a deficiency. Regardless, the change in drilling and well installation was made not to address a supposed deficiency as suggested by Mr. Norris, but to provide a safe drilling, borehole advancement and well construction method, considering the presence of UXO in the immediate vicinity to the well locations.

The change in drilling does provide additional opportunities to observe soil and rock cores further reducing any suggested "need" for borehole geophysics. The soil "cores" will be inspected, logged and placed into labeled storage bottles or bags by the rig geologist. The revised drilling method will provide rock cores from the borings as well as other important data such as intervals of drilling fluid loss, drill tooling penetration rates, core recoveries, etc. that the rig geologist will record on the drilling logs completed in the field.

In addition, the rig geologist will examine and log the actual rock cores, collect data from the cores such as rock type, bedding, rock quality designation (RQD), voids, degree of weathering, fractures, fracture face staining, field hardness, etc. and record these data on the field prepared drilling logs. The rock cores will be placed in labeled core boxes in the sequence drilled and following photographing of the cores will be stored at JPG in a secure location for inspection if required in the future. These types of data derived from handling and actually observing the soil and rock cores are used to evaluate the conditions present in the subsurface and for determining relative permeability, saturation and presence of features or conditions that are indicative of groundwater flow.

The additional tests on the rock core and borehole testing suggested by STV are in excess and are not necessary for completing an adequate site characterization for the purpose of preparing a decommissioning plan and the suggestion that this is necessary demonstrates a failure to understand the decommissioning process and what is required to provide a sufficient and adequate characterization for that purpose. The tests suggested by Mr. Norris would be of little value to the site characterization.

I have found in my experiences in working with geologists that have worked in the oil exploration industry that they often do not understand the ability for a trained rig geologist to appropriately evaluate borehole features that provide information to design and construct a functional monitoring well and often suggest unnecessary borehole geophysical analysis for this purpose. Most borehole logging methods provide results that also require interpretation and do not have a unique response, and thus can represent several different conditions.

Q36. Please give the basis for your disagreement with the fourth deficiency alleged in Norris' answer 46?

A36. (TDE) Contrary to that suggested by Mr. Norris, it is inappropriate to detail and propose aquifer testing prior to collecting basic information on the aquifer being characterized and demonstrates his misunderstanding of the Army's approach, specifically the phased approach in this case. Blindly proposing aquifer and well testing as suggested by Mr. Norris without additional basic site-specific data would most likely result in a waste of time, effort and money as well as collecting useless data for the purpose of site characterization. It is more appropriate and efficient to follow a phased approach to the characterization by having consideration and design of applicable well and/or aquifer testing following the collection of basic monitoring location specific data during well installation and the subsequent monitoring. This phased approach has been discussed both in the FSP (SAIC 2005) and the previous request for additional information (RAI) responses to the NRC staff. This phased approach of basic data collection followed by consideration for and design of aquifer testing would result in appropriate and useful aquifer testing and aquifer-specific data that could be used for refining the CSM and characterization if determined to be necessary.

Therefore I do not consider the absence of scheduled permeability and/or aquifer testing at this stage of the investigation as indicated by the FSP to be a deficiency.

Q37. Please give the basis for your disagreement with the fifth deficiency alleged in Norris' answer 46?

A37. (TDE) Construction of wells in dry sections of the subsurface that may become wet for days or minutes throughout a year is not necessary or an appropriate strategy for constructing groundwater monitoring locations. The potential pathway that may become saturated intermittently during storm events or seasonal high conditions (portions of the subsurface above the normal water table) are already represented by caves that are located in the DU area. Monitoring of cave stream discharges will sufficiently characterize this potential pathway.

Permeability testing is not required or necessary for the purpose of installing these monitoring wells. An experienced rig geologist can make a field determination of the relative permeability and the presence of saturated conditions of the materials encountered during drilling for determining suitability for constructing a functional well. The field determination of permeability and the location of the water table is based on a host of observations during the drilling. Some of these observations consist of relative speed of drill tool penetration, losses of drilling fluid, drill tool drops or rapid free-falling drill tools, actual rock characteristics suggesting possible permeability (i.e., vuggy, weathered, fractured, porous, etc.), stained fracture faces, Rock Quality Determination (RQD), etc. In-situ permeability measurements are not normally completed during monitoring well installation unless investigating the subsurface in unique applications for specific reasons such as grout wall placement, etc. During the majority of environmental investigations the final determination for the well screen interval and decision for abandonment due to lack of permeability below the water table are made based on the direct observations by the rig geologist.

Mr. Norris makes the statement "...a conduit that is filled with fine sand, silt, and/or clayey sediments may have low hydraulic conductivity, a well in it can still provide important information for site characterization..." and thereby assumes or suggests that a well would not be considered or constructed in this situation. Mr. Norris' assumption demonstrates his lack of understanding of characterization methodology, such that we did not state in either the FSP (SAIC 2005) or the FSP Addendum 4 (SAIC 2007) that "a conduit that is filled with fine sand, silt, and/or clayey sediments with low hydraulic conductivity will be abandoned." In fact this could be a potential feature that could be present at a location identified by the FT and/or EI and targeted for drilling. These very conditions are often realized as an anomaly during EI surveys and observed during drilling in karst environments where there has been unconsolidated material infill of a conduit. This type of feature would definitely be considered for well installation since, although it may have a "low hydraulic conductivity," these types of features often have permeabilities and hydraulic conductivities, many times greater than the surrounding solid bedrock and have adequate permeability for a functional well. I have personally observed such conditions and have directed the completion of wells into features such as these on previous investigations at other sites with karst, based on my experiences that these features can be a groundwater conduit or pathway of potential migration. The rig geologist would observe these conditions and the field determination of relative permeability and "low" hydraulic conductivity would not automatically suggest abandonment of the location, rather through discussion of the observed conditions and the EI survey anomaly, the feature would be considered for placement of the well screen. Therefore, I would not consider this a valid point in determining that the FSP (SAIC 2005) and associated addenda are deficient. It is important to allow flexibility in the plan, especially in the early stages of investigation, before basic subsurface conditions have been observed and realized, for modifying the well construction and specifically the screen interval based on **actual site conditions** so that appropriate and meaningful characterization and monitoring points are established.

Q38. Please give the basis for your disagreement with the sixth deficiency alleged in Norris' answer 46?

A38. (TDE) Mr. Norris states that "...Addendum 4 asserts in Section 4.2, pages 4-3 and 4-4, that the evaluation of a single round of water levels (elevations) from the new characterization wells, the ERM wells and the Range Study wells..." and with his assertion demonstrates a lack of understanding of the characterization methodology, data reduction and interpretation. The referenced section actually states "Following the installation of the proposed well pairs, survey of the well coordinates and the elevations, and collection of initial groundwater stage data, an evaluation will be completed." It does not assert, as Mr. Norris suggests, that the evaluation will be of a single round of water level data, instead it states that an evaluation will be completed. The anticipated evaluation was further described in section 6.2.3 Conduit Intersection Confirmation of the Well Location Selection Report (p. 6-7; 2007b) and would include at least those elements such as the following selection from that report:

During and following the installation of the "conduit" well pairs, a preliminary evaluation will be completed to determine if placing the well screen into a preferential flow pathway or "conduit" was successful. The evaluation will consist of the following:

- *Observations by the rig geologist of drilling conditions and evidence of high groundwater yields; fractured, broken or weathered zones; drill fluid loss; tool-drop; and other evidence of the presence of subsurface voids.*
- *Review of the rig geologist-prepared drilling and well construction log for evidence of fractures, voids, and other conduit features.*
- *Following the collection of groundwater stage data from the newly installed wells, the stage data will be evaluated along with precipitation and surface water stage/flow data to further evaluate the degree to which the well is connected to preferential flow pathways in the aquifer.*
- *Groundwater samples will be analyzed for common anions and cations. Relative concentrations of these constituents will be higher in nonconduit wells in comparison to conduit wells due to the length of contact time with the aquifer materials.*

These stated evaluation elements clearly demonstrate that the evaluation consists of much more than the single round of water level data that Mr. Norris alleges.

Mr. Norris continues by stating, "There is no scientific or technical basis to support the proposition that one can conclude anything about the usefulness or validity of including an existing well in ongoing characterization based upon an initial measurement of head levels in the new and existing wells." He fails to acknowledge that the proposed evaluation includes more than the evaluation of "...an initial measurement of head levels..." and therefore his position continues to speculate about the nature of work that was generally described in the FSP (SAIC 2005) and will be further defined in a future FSP addendum. This type of basic evaluation of the installed wells is both appropriate and necessary and does not represent a deficiency in the FSP.

Existing wells (according to previous statements by STV) are poorly constructed, developed and maintained. Therefore, there may be no need for the continued use of some of these and, if this is determined, the continued use of them will not benefit the investigation. It might then be possible that there will be enough available information to include or eliminate existing wells after the installation of the proposed wells. The data will be evaluated and a decision will made be to determine if sufficient information is available to eliminate existing wells or if more data is necessary to make a decision. It is also possible that it will be determined that more info may be required to make these determinations.

Mr. Norris, in presenting his analogy of a sewer system, demonstrates a lack of understanding of characterization methodology, data reduction and interpretation in that he does not acknowledge the possibility and probability of the connectivity often present in karst controlled systems. He continues to discuss the need to evaluate single karst conduits as individual disconnected flow pathways without site specific data to support this condition. More commonly, karst conduits are interconnected through the numerous features and discontinuities such as solution enhanced bedding planes, vertical fractures and joints in the bedrock. It is not probable, as Mr. Norris suggests, that the bedrock wells will be completed in hydraulically independent systems. The interconnected system of groundwater conduits can be evaluated, at least in part, by groundwater elevation monitoring and when considered with other data such as surface water elevations and responses to precipitation events, it can be evaluated for connectivity with surface water. This potential for communication with surface water will most definitely be useful in selection of surface water sample locations. For instance, using a very basic and limited evaluation, if it were determined that the surface water elevation immediately adjacent to an installed well pair, was significantly lower in elevation relative to the groundwater elevation in the shallow well, it could be concluded that based on the most basic principle of head differences, that there is a potential for groundwater to be discharging to surface water in the vicinity of the well pair. This very basic evaluation is most definitely useful in selecting potential surface water sample locations. This example of a basic evaluation will not be the only consideration, but will be further developed by combining with the evaluation of the remainder of the wells, surface water and precipitation data as well as other factors as previously described.

If it is determined that additional data is necessary to make decisions for monitoring and to determine interconnectivity, studies such as aquifer testing (pumping tests) and tracer tests could be considered, designed based on acquired site specific data and proposed. Proposing such tests before collecting the basic site specific data described is premature.

Q39. Do you agree or disagree with Mr. Norris' opinions and conclusions in his Answer 47 as to the significance of the deficiencies he lists in his Answer 46?

A39. (TDE) No, I do not agree.

Q40. What is the basis of your disagreement?

A40. (TDE) As I stated in my previous testimony, his six points do not represent deficiencies. However, I present further testimony and clarification as to the following subsections of his Answer 47:

His item 1. In the previous discussion by Mr. Norris concerning centralizers and the evident typographical error in the FSP Addendum 4 (SAIC 2007) for his Answer 44 and my testimony concerning his Answer 46, alleged deficiency 1., it is clear that the centralizer typographical error does not present or support the suggestion by Mr. Norris that there are contradictory well installation procedures.

His item 2. Mr. Norris incorrectly states that nine well pair locations were picked based on EI survey results since the EI survey results were also used to locate the tenth well pair location. A portion of Mr. Norris' answer is essentially a re-statement of his Answer 46, bullet 2. My testimony concerning that answer refutes this point also.

His item 3. The statement by Mr. Norris that "The modified FSP characterization program for new wells unnecessarily reduces the level of understanding of the geologic materials which are in and around the DU impact area and potentially associated with local conduits." is an error in fact and is completely incorrect and inappropriate. He never explains how this program would "reduce" the understanding. How can the collection of site-specific data, observation of actual site-specific conditions and subsurface materials during drilling "reduce the level of understanding of the geologic materials which are in and around the DU impact area"? Any drilling and retrieval of subsurface materials, especially soil and rock cores, for examination by a trained rig geologist as well as other observations collected and documented by the rig geologist will provide a multitude of site-specific information that was not realized prior to the drilling and well installation. The information gathered will most definitely increase the understanding of the geologic materials in and around the DU impact area.

Borehole geophysical testing is not necessary for completing an accurate and representative site characterization for the purpose of preparing a decommissioning plan and is addressed in my rebuttal for bullet three of Mr. Norris' Answer 46.

Mr. Norris states that "...final interpretation of the geology that controls the hydrogeologic movement of DU will be based upon the speculative translation of visual characteristics into hydrogeologic properties or entirely non-site-specific data." With this statement Mr. Norris demonstrates his lack of understanding of characterization methodology, data reduction and interpretation. First of all, the data and site-specific parameters and understanding of the properties of the subsurface materials present in and around the DU impact area acquired by the rig geologist and even information acquired by borehole geophysical methods suggested by Mr. Norris are just those, data and properties of the subsurface materials. The rig geologist will follow the documented and approved procedures in our FSP (SAIC 2007) for collection and documentation of drilling and subsurface observations. This acquired data is only one small portion of the site-specific data that would be collected and considered during the interpretation of the geology that controls the hydrogeologic movement of DU and will not **determine** the final interpretation. Mr. Norris accuses the Army that the information collected by the rig geologist will be a "...speculative translation of visual characteristics into hydrogeologic properties or entirely non-site-specific data." This is unfounded speculation and is incorrect. The rig geologist is an educated, experienced and field trained scientist and will be able to collect and record **informed,** not speculative interpretations of the basic site-specific characteristics of the materials encountered with the drilling based on his training and experience. The use of this collected data by the rig geologist during drilling along with other data proposed to be collected and evaluated, will positively impact the accuracy and precision of characterization data, rather than making it less precise and more uncertain or unreliable as Mr. Norris alleges.

His item 4. In Mr. Norris' Answer 46, he introduces the alleged deficiency in which he asserts that measurements such as permeability be collected during drilling and aquifer testing are required. There are other methods available to calculate or estimate the amount and speed of flow through a system other than that suggested by Mr. Norris.

Additionally, Mr. Norris is suggesting that head potentials along a single flow path and permeabilities along that flow path need to be quantified for this characterization and demonstrates his misunderstanding of the Army's approach. A more appropriate and representative approach useful for characterizing the site than that suggested by Mr. Norris is to consider the quantity and speed of flow through the **entire system** and not an individual flow pathway. If it is determined to be necessary after the installation of the proposed wells and collection of the most basic of site-specific data, aquifer tests will be considered. If an aquifer test is determined to be necessary, the data collected from the initial wells and existing site-specific data at that time, will be used to design and propose a meaningful aquifer test, which could involve the installation of an appropriately designed pumping and monitoring well(s). Aquifer tests, if necessary, must be appropriately designed, otherwise the test could be a failure and the data may not be useful, further demonstrating the necessity of the Army's phased approach.

His Item 5. Mr. Norris is suggesting that we should install wells (dry wells) into dry conduits or karst features that **may or may not** have transient water flow that is most likely not groundwater and demonstrates his lack of understanding of characterization methodology, data reduction and interpretation. The purpose of the monitoring wells is for characterizing **groundwater**. Groundwater is not simply water below the ground surface, but rather, as defined in "Applied Hydrogeology" (Fetter, C.W. 1988, p. 5), groundwater is defined as water that is present below the water table and the water table is defined as the top of the saturated zone. The monitoring of surface water and cave discharges (springs or streams) will provide better data, for water migrating through subsurface features above the water table, than from a dry well where flows will be transient and **may or may not** be able to be monitored.

Mr. Norris irresponsibly discounts the ability for an experienced rig geologist to make a field determination of the relative permeability of a formation or subsurface materials based on his direct observation of the actual materials and the other observations gained by drilling through said materials and provide guidance if the conditions would provide a functional well for the purpose of the characterization. He is using this argument in an attempt to gain credence for his desire to require in-situ permeability measurements, which are unnecessary for this purpose and demonstrates his failure to understand the decommissioning process and what is required.

The conditions of sediment plugged karst features described by Mr. Norris are possible in a karst environment, but would not be considered to constitute or represent the majority of the potential for migration. This potential transient or episodic water flow or sediment transport will be better addressed and more accurately quantified by the monitoring of the groundwater flow system, cave monitoring and surface water and sediment monitoring and sampling. This is not to say that if a karst feature or conduit is determined during drilling that is "plugged" with saturated unconsolidated sediments and exhibits characteristics of "low" permeability that a well will not be installed in the feature. Quite the contrary, this consideration has been supported in the rebuttal to CN answer #046 specifically alleged deficiency #5.

His item 6. Complete mapping of the pathways of individual karst conduits is not practical and probably not possible at any expense, and I know of no effective way to accomplish it at a scale of this project. This insistence by Mr. Norris demonstrates his lack of understanding of the decommissioning process and what is necessary for updating RESRAD and preparation of a decommissioning plan. In addition, access and methods available are further reduced and complicated when considering the drilling difficulties and safety hazard presented by the presence of UXO throughout the DU Area. Our plans call for construction of monitoring wells that intersect the network of interconnected preferential flow pathways. We will be able to determine connectivity of these pathways by monitoring water levels and responses to storm events and surface water stage.

The initial groundwater elevation data will be used along with other data to provide an initial determination of the potential for connectivity with and flow towards the surface water and will provide initial head potentials within the flow system. This will provide some guidance for additional data needs and development of the following investigations such as groundwater stage monitoring and surface water monitoring and sampling.

The remainder of the subsection of this answer was already addressed with my testimony in regard to Mr. Norris' Answer 46, specifically alleged deficiency #6.

XII. SUMMARY AND CONCLUSION

As to Basis Item "h"

Q41. Please summarize your testimony with regard to Basis Item "h".

A41. (TDE) My testimony can be summarized as follows:

I would not recommend geophysical borehole logging and/or borehole video at this time, especially considering the change in drilling and well installation method and the potential for additional data should the USGS become involved. The present method will provide actual soil and rock cores for examination and logging, eliminating the need or necessity of the STV requested borehole logging. Geophysical and video logging can be useful tools when necessary and applied in the right situations, but with the conditions expected at JPG during placement of the conduit wells, it is not practical and not necessary for completing an accurate and representative site characterization for the purpose of preparing an adequate decommissioning plan.

XIII. OVERVIEW

Issues Raised By Basis Item "i" to STV Contention B-1

Q42. What is your understanding of the technical issues raised by basis item "i" of STV's Contention B-1?

A42. (TDE) In its Basis item "i" STV states:

"Specifying the exact number and precise locations of the surface water sampling and gauging points at the outset of FSP implementation, as proposed in section 6.4.1, is not acceptable practice. Until the analysis of ground water data shows where to look for discharges and the discharges confirmed by inspection, such points cannot be reasonably selected. There is no scientific reason why the locations for surface water sampling and sediment sampling need to be the same locations. Each medium should be sampled at locations that are appropriate for that medium. Sediment buildup has nothing to do with the location of base flow connections between ground and surface water. Similarly, the FSP concept in section 6.4.2 of installing only five gauging stations, which are all sited before the ground water system is better understood, is both too limited in the number and may well be counter productive in the locations of the stations."

In this Basis Item "i", STV raises issues concerning the number and placement of surface water sampling and gauging locations contained in the FSP.

Q43. Do you agree with the position asserted in Basis Item "i" of STV Contention B-1?

A43. (TDE) No.

XIV. Discussion

Surface Water Sampling and Stream Gauging.

Q44. What is the basis for your disagreement?

A44. (TDE) STV asserts that specifying the number and locations of surface water sampling and gauging locations at the outset of the FSP (SAIC 2005a) implementation *"...is not acceptable practice."* STV fails to acknowledge that there is an evolutionary aspect to the FSP in general, including the proposed surface and sediment sampling program.

STV goes further to state: *"Until the analysis of ground water data shows where to look for discharges and the discharges confirmed by inspection, such points cannot be reasonably selected..."* calling for the exact evolutionary aspect to the FSP that the Army has presented and defended from the beginning following the submittal of the FSP. Here, unlike in Bases b, c, d, f, and g, STV does not want specific details at the outset, but rather requests the collection of other data first. The 14 specific sample locations referenced by STV in this basis and presented in the FSP are not the final surface water and sediment sampling locations. Rather, they are only used for purposes of program planning, scheduling and budgeting.

STV states: *"There is no scientific reason why the locations for surface water sampling and sediment sampling need to be the same locations."* While I agree with this statement, there is no scientific reason on the other hand why the locations for surface water and sediment sampling might not be best placed at the same locations. STV's statement is purely speculative and final locations of surface water and sediment sampling will be addressed in future FSP addenda and will include the ability to adjust locations to collect appropriate and representative samples based on site-specific conditions where conditions are appropriate for the specific medium.

The Army has never said that the sediment and surface water sample locations have to be co-located and it has always been the intent to base the sample locations on actual site conditions observed and evaluate the most appropriate and representative location for sample collection.

STV states in this basis that, "*...the FSP concept in section 6.4.2 of installing only five gauging stations, which are all sited before the ground water system is better understood, is both too limited in the number and may well be counter productive in the locations of the stations...*" In order to gain site-specific data and understanding, one must start by initiating some sort of collection of data consisting of some basic investigations or studies. It is a very common practice in the scientific community to collect basic principle data and then following evaluation of the initial data, design follow-on studies that are more tailored to the site-specific conditions.

We have initiated such a characterization approach in September of 2006 by installing surface water gauging stations at 10 locations including seven automatic recording stream gauge stations, two automatic recording cave stream gauging locations, and one manual/visual staff gauge monitoring location. This is in excess of the five locations originally stated in the FSP (SAIC 2005). The installation of the surface water stage gauging locations and monitoring was moved forward in the characterization plan schedule as a result of discussions with the NRC.

Following the agreement for this change in the schedule and during the subsequent evaluation of site observations and preparation of FSP Addendum 3 (SAIC 2006b), it was determined that additional surface water gauging stations should be installed.

Once again, this demonstrates the intent of the Army to appropriately modify and design successive studies. These modifications to the plan will be based on the evaluation of the characterization needs, site observations, results of the preceding studies, and the acquisition of site-specific data and documented in FSP addenda and prepared reports. This evolving characterization plan is crucial to accurately designing and installing an appropriate and representative monitoring network.

We have been collecting surface water stage data continuously since September 2006 and completed manual flow measurements at the gauging stations monthly for gauge station calibration purposes. As with all aspects of the characterization, the surface water gauging locations and resulting flow data will be evaluated for the need for additional locations or movement of the existing stations.

The STV statement that the gauging stations, "...may well be counter productive in the locations of the stations..." is a speculative and an inappropriate statement and there is no scientific reasoning supporting STV's statement. All of the surface water gauging stations installed as part of this characterization will provide, at a minimum, useful data for developing an understanding of the interaction between precipitation, groundwater, and surface water.

Q45. Do you agree or disagree with Mr. Norris' characterization of the major design elements of the FSP's sediment sampling as found in his Answer 50?

A45. (TDE) No. I do not agree.

Q46. What is the basis of your disagreement?

A46. (TDE) In stating the "major" design elements of sediment sampling as he interpreted them, Mr. Norris identifies an alleged contradiction or two Programs as suggested in his later Answer 52 and he demonstrates that he misunderstands or misinterprets the Army's Site Characterization approach.

In the first bullet of his answer he refers to FSP section 6.6 where it is described that at minimum six sediment sample locations would be established. The "six locations" was a description of the starting point of the sediment sampling establishing the minimum number of locations considered. The second bullet in his answer refers to the Sub-section 6.6.1.1 where additional detail is provided on the sediment sampling program stating that sediment will be collected from fourteen locations, both in streams and caves streams within Big Creek and Middle Fork Creek. One must keep in mind, as Mr. Norris conveniently fails to do and by so doing demonstrates his misunderstanding of the Army's approach, that the actual number and locations selected will be presented in a FSP addendum for sediment sampling and the actual locations presented are general locations and will be modified based on "...where the surface water flow is low and/or deposition is likely, such as bends in the creeks." As stated in Section 6.6 of the FSP (SAIC 2005, p.6-38).

Q47. Do you agree or disagree with his opinion, as stated in Norris Answers 51 and 52, that the sediment sampling plan is inadequate and has design deficiencies?

A47. I disagree.

Q48. What is the basis for your disagreement?

A48. I disagree with both of Mr. Norris' answers. This section of the FSP is exactly what it was intended for and that is a framework to build upon and modify, based on the preceding investigations following the acquisition of basic site specific data, and provide for a basic framework for budgeting and scheduling purposes. The question should be more appropriately asked "Considering that the FSP (SAIC 2005) only provided details for the first year's investigation tasks and additional details for subsequent year's tasks would be provided in future addenda, is the general approach presented in the FSP for the sediment sampling adequate for the purposes of the JPG site characterization?" and the answer would be yes.

The first alleged "major deficiency" of there being two sediment sampling programs, as stated by Mr. Norris in his Answer 52, is incorrect. As previously stated in my testimony concerning his Answer 50, he misunderstands or misinterprets the Army's Site Characterization approach. There is only one program and Mr. Norris incorrectly interprets the defining of basic minimum design parameters as presented in Section 6.6 of the FSP (SAIC 2005) as a "first" program. There is only one sediment sampling program, for which the framework is presented in the FSP (SAIC 2005) and will be finalized with an addendum as stated in the FSP (SAIC 2005).

The opinion of Mr. Norris is that the FSP (SAIC 2005) is inadequate with regard to the sediment sampling based on his reference for the potential for groundwater and surface water to transport DU to locations where sediment can than subsequently be "contaminated." Although the potential for this condition is valid, the potential for this occurrence will be evaluated and thoroughly characterized during the surface and groundwater water investigations and is not a valid deficiency of the sediment sampling investigation. The transport of DU will be evaluated during the surface and groundwater investigations and this mechanism of transport has to be confirmed and evaluated before a meaningful evaluation of the potential for contamination of sediments by these mechanisms. Without this crucial step attempts at verifying this condition or sampling for this situation would be without any site-specific guidance for the sample locations and they would be guesses and random sampling at best, which is unnecessary and inappropriate.

Mr. Norris appears to suggest that numerical modeling is necessary for the site characterization and is incorrect, further demonstrating his failure to understand the decommissioning process and what is required. Identification of all end point exposure points and sampling at those locations is not a requirement for updating the RESRAD model and preparation of a sufficient and adequate decommissioning plan.

What needs to be sampled are representative potential pathways to the potential exposure locations and his example of "...no locations that sample sediments contaminated by DU in groundwater that is transported through karst conduits that discharge outside JPG." is a condition that has never been identified present at the site or have any scientific reasoning based on site-specific data. The investigation focuses first on the areas most likely to demonstrate an impact from the presence of DU. Furthermore, evidence for this type of potential pathway will be investigated and identified during the groundwater investigation and characterization.

Mr. Norris' allegation that "This program does not sample the sediments that are actively being transported from the DU impact area by ground- and surface water, or the rates of that transport "is incorrect since surface and groundwater samples will be collected and analyzed for DU and there will be no separation or removal of suspended or entrained sediments in these samples. His statement demonstrates his lack of understanding of characterization methodology, data reduction and interpretation. Surface water staging and flow monitoring has already been established and the rates of potential transport will be able to be evaluated for these samples.

The actual sediment sample locations will be established at the locations where sedimentation has occurred or is occurring and will be documented in the final FSP addendum for sediment sampling. The sediment sample locations presented in the original FSP (SAIC 2005) are a starting point for planning and locating the general areas anticipated to be sampled. The actual sample locations will be based on actual site conditions as observed in the field and following final sample location selection and collection, the selected location will be documented. Mr. Norris fails to acknowledge the following statement in section 6.6.1.1 of the FSP (p6-39):

> *Details regarding the sediment samples and determining the sampling locations will be developed continually based on ongoing investigations activities such as soils verification, surface soils, characterization locations of physical features (e.g. caves, fracture traces), and hydrogeologic investigations. Through the course of surface sample collection and gamma walkover surveys, additional surface water drainage ways and areas of erosion (sediment transport) may be identified and proposed for additional sediment sampling locations.*

This provides details for the selection process and the flexibility required to collect the necessary and appropriate site-specific data. Mr. Norris suggests that "...the sediments that are sampled may even be sediments deposited prior to the use of DU in the impact area," without considering that the sediment samples are planned to be collected from the top 15 centimeters, which should represent the most active or recently active sediments. The gamma scan of the stream banks will also identify areas above the screening threshold above background which could aid in the identification of potentially impacted areas of deposition since the operation of the DU impact area.

Q49. Do you agree with Mr. Norris' assessment, in his Answer 53, of the significance of the inadequacy and design deficiencies of the sediment sampling which he alleges?

A49. (TDE) No. The basis of my disagreement is as follows: The sediment will be sampled and monitored at a "sufficient variety of locations" including sediment locations in surface water, along stream banks and cave discharges. The program uses all available site-specific data available at the time of the completion of the planned FSP addendum for sediment sampling and the observed site conditions during sample collection and site location to select the most appropriate sediment sampling locations.

The general planned sampling locations have been placed in the most probable locations to evaluate if transport of DU impacted sediments is occurring. If transport of DU impacted sediment is found to be occurring, then additional sampling and evaluation will be considered to evaluate additional transport and potential pathways. There is no need or justification for sampling far from the source before evaluating the potential for contaminant transport close to the source where it is most likely to be detected.

Additionally, surface water and groundwater sampling programs will further evaluate the total potential contribution of entrained and suspended sediment transport during those sampling activities because the samples will not be filtered and the analysis will include those fractions of the sample. It is not necessary to evaluate separately from surface water and groundwater the entrained or suspended contribution as long as the analysis is completed on the whole sample and it is not filtered for removal of sediments.

Q50. Do you agree or disagree with Mr. Norris' characterization of the major design elements of water sampling contained in the FSP, as he states in his Answer 56?

A50. (TDE) I disagree.

Q51. What is the basis for your disagreement?

A51. (TDE) In stating the "major" design elements as he interpreted them, Mr. Norris identifies the surface water sample volumes presented in the FSP and Appendix A and apparently is suggesting a conflict indicating an inadequacy. His suggestion demonstrates a lack of understanding of characterization methodology and I do not agree with Mr. Norris' accusation for the following reasons. The sample volume of 100 ml indicated in sub-section 6.4.5 of the FSP is a general reference to the sample volume required for isotopic analysis of Uranium since this is the contaminant of concern. Additional information concerning the sample volumes is included in the testimony of Harry Anagnostopolous' concerning Mr. Norris' Answer 73. This is all planned on being further defined in an addendum to the FSP (SAIC 2005) as indicated within original FSP (SAIC 2005).

Q52. In his Answers 57 and 58, Mr. Norris expresses the opinion that the surface water sampling is not adequate for the purposes of JPG site characterization and identifies the deficiencies he says support his opinion. Do you agree or disagree with his opinion and his alleged deficiencies?

A52. (TDE) No. I do not agree with his opinion or his alleged supporting deficiencies.

Q53. What is the basis for your disagreement?

A53. (TDE) As I stated, I disagree with both of Mr. Norris' answers.

The section of the FSP dealing with water sampling is exactly what it was intended for and that is a framework to build upon and modify based on the preceding investigations following the acquisition of basic site specific data and provide for a basic framework for budgeting and scheduling purposes. The question should be more appropriately asked "Considering that the FSP (SAIC 2005) only provided details for the first year's investigation tasks and additional details for subsequent year's tasks would be provided in future addenda, is the general approach presented in the FSP for the surface water sampling adequate for the purposes of the JPG site characterization?" and the answer would be yes.

Mr. Norris alleges that the "surface water sampling program in the FSP...does not address the rationale for the task...," which demonstrates his misunderstanding of the Army's approach. The surface water sampling program will evaluate the potential that DU is being transported by surface water from the DU impact area and may present a pathway to potential receptors. This pathway evaluation is most appropriately completed by first evaluating the most likely and probable locations in surface water for detecting the potential for DU transport and migration which is within and immediately below the DU impact area. Mr. Norris introduces into his discussion, groundwater transport and sediment sampling locations. Transport by groundwater and sediment is and will be thoroughly addressed by those specific programs presented in the FSP (SAIC 2005) and addressed in my earlier testimony.

Mr. Norris appears to suggest that numerical modeling is necessary for the site characterization and is incorrect, further demonstrating his failure to understand the decommissioning process and what is required. Identification of all end point exposure points and sampling at those locations is not a requirement for updating the RESRAD model and preparation of a sufficient and adequate decommissioning plan.

What needs to be sampled are representative potential pathways to the potential exposure locations and his example of "...no locations that sample sediments contaminated by DU in groundwater that is transported through karst conduits that discharge outside JPG." is a condition that has never been identified present at the site or have any scientific reasoning based on site-specific data. The investigation focuses first on the areas most likely to demonstrate an impact from the presence of DU. Furthermore, evidence for this type of potential pathway will be investigated and identified during the groundwater investigation and characterization.

Groundwater transport as previously stated will be thoroughly investigated as described in the specific sections of the FSP (SAIC 2005) and it is crucial that the most probable locations (within the DU impact area and at its border) where DU impacts can be documented and monitored be targeted first to provide meaningful data for updating the CSM, RESRAD model and preparation of the decommissioning plan.

Q60. Do you agree or disagree with Mr. Norris' assessment, in his Answer 59, of the deficiencies he alleges in surface water sampling in his Answer 58?

A60. (TDE) I do not agree with Mr. Norris' assessment.

Q61. What is the basis for your disagreement?

A61. (TDE) Mr. Norris' Answer 59 demonstrates his misunderstanding of what is necessary and required in the decommissioning process. The proposed investigation focuses first on the areas most likely to demonstrate an impact from the presence of DU that will identify and provide sufficient data to adequately refine the CSM, update the RESRAD model for preparation of a sufficient and adequate decommissioning plan. Mr Norris suggests the need for sampling and evaluating conditions that have not been identified present at the site, but does not have or present any scientific reasoning based on site-specific data to suggest that they exist at the site. The FSP (SAIC 2005) presented will allow the collection of the basic site-specific data that will account for these unique conditions while evaluating site conditions and most probable transport mechanisms present allowing site characterization for the purposes of refining the

CSM, providing inputs for updating inputs to RESRAD and preparation a sufficient decommissioning plan.

XV. SUMMARY AND CONCLUSION

As to Basis Item "i"

Q62. Please summarize your testimony with regard to Basis Item "i".

A62. (TDE) My testimony can be summarized as follows:

The presentation of the surface water and sediment sampling locations in the FSP (SAIC 2005a) was completed for planning and budgeting purposes for providing a framework and starting point for initiating the site characterization. This task is not scheduled until after the first year of the plan and as stated in the FSP "...plans for this project are defined in detail for this FSP and the HASP (SAIC 2005a) for the first year (FY 2005-2006) of the project. Subsequent year tasks and associated activities will be planned and detailed as addenda to the FSP and HASP." Additional detail for surface water and sediment sampling will be further detailed in an FSP addendum.

These further refinements to the site characterization will be monitored and evaluated by the NRC as indicated by the following:

"NRC anticipates having annual (or more frequent) meetings at NRC headquarters, open to the public, to discuss the Army's progress in completing the site characterization and new decommissioning plan. These meetings should occur prior to the initiation of significant planned field activities, such as determining the number and location of new monitoring wells."

Taken from *Technical Review of Request for an Amendment to License SUB-1435 (Docket No. 040-08838) Proposing an Alternate Schedule for the Submission of a Decommissioning Plan for Jefferson Proving Ground, Madison, Indiana* (U.S. Army 2006a, ADAMS

ML053320014). This is the official date that the Army's request for an extension to the schedule was approved.

The project should continue in the fashion presented in the FSP (SAIC 2005a) and addenda (SAIC 2006a, 2006b, 2007b) to allow the collection of the necessary basic site-specific data. These data will be used for site characterization and the evaluation and determination of the need for additional tests and studies to provide a reasonably accurate characterization of the DU Impact Area and the potential for DU migration to potential receptors.

XV. REFERENCES

Q63. In your testimony you referred to several documents. Would you specifically identify those documents?

A63. (TDE) Yes.

1. Fetter, C.W. 1988. Applied Hydrogeology, Second Edition. Merrill Publishing Company, Columbus, Ohio. Attached as Exhibit TDE #2.

2. Greeman, T.K. 1981. Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana: U.S. Geological Survey Open-File Report 81-1120. Attached as Exhibit TDE #3.

3. MWH (Montgomery Watson Harza). 2002. Phase II Remedial Investigation, Jefferson Proving Ground, Madison, Indiana, Volumes I & II - Text, Tables, & Figures. Prepared for U.S. Army Corps of Engineers, Louisville District, Louisville, Kentucky under Total Environmental Restoration Contract DACW27-97-D-0015, Task Order 4008. September. Attached as Exhibit TDE #4.

4. NRC (Nuclear Regulatory Commission). 2004. Request for Additional information to Support NRC's Evaluation of the Proposed Changes to the Environmental Radiation Monitoring Program Plan for Jefferson Proving Ground (License SUB-1435). Letter from Tom McLaughlin, Project

Manager, Materials Decommissioning Branch, NRC to Colonel Mike Mullins, Rock Island Arsenal, U.S. Army. May 20.

5. NRC. 2006. Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria. NUREG-1757, Vol. 2, Rev. 1. Final Report. Division of Waste Management and Environmental Protection, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

6. SAIC (Science Applications International Corporation). 2005a. Field Sampling Plan. DU Impact Area Site Characterization, JPG, Madison, Indiana. Final. May. ADAMS ML051520319

7. SAIC. 2005b. Health and Safety Plan. DU Impact Area Site Characterization, JPG, Madison, Indiana. Final. May. ADAMS ML051520319

8. SAIC. 2005c. Quality Assurance Project Plan. DU Impact Area Site Characterization, JPG, Madison, Indiana. Final. May. ADAMS ML051520319

9. SAIC. 2006a. Field Sampling Plan Addendum 2, Depleted Uranium Impact Area Site Characterization – Soil Verification, Jefferson Proving Ground, Madison, Indiana. Final. July. ADAMS ML061930256.

10. SAIC. 2006b. Field Sampling Plan Addendum 3, Depleted Uranium Impact Area Site Characterization – Other Monitoring Equipment Installation, Other Monitoring (Precipitation, Cave, and Stream/Cave Spring Gauges), and Electrical Imaging Survey, Jefferson Proving Ground, Madison, Indiana. Final. July. ADAMS ML061930287.

11. SAIC. 2007a. Well Location Selection Report, Depleted Uranium Impact Area Site Characterization: Soil Verification, Surface Water Gauge Installation, Fracture Trace Analysis, and Electrical Imaging, Jefferson

Proving Ground, Madison, Indiana. Final. January. ADAMS ML070220461.

12. SAIC. 2007b. Field Sampling Plan Addendum 4, Depleted Uranium Impact Area Site Characterization: Monitoring Well Installation Jefferson Proving Ground, Madison, Indiana. January. ADAMS ML070220165.

13. U.S. Army. 2006a. Technical Review of Request for an Amendment to License SUB-1435 (Docket No. 040-08838) Proposing an Alternate Schedule for the Submission of a Decommissioning Plan for Jefferson Proving Ground, Madison, Indiana. Memorandum Daniel M. Gillen, Deputy Director, Decommissioning Directorate, Division of Waste Management and Environmental Protection, Office of Nuclear Material Safety and Safeguards to Mr. Alan G. Wilson, Garrison Manager, Office of the Garrison Manager, Department of the Army, 1 Rock Island Arsenal, Rock Island, IL 61299-5000. April 26. ADAMS ML053320014.

14. U.S. Army. 2006b. Responses to the Nuclear Regulatory Commission January 18, 2006, Request for Additional Information Regarding the Proposed Field Sampling Plan for Jefferson Proving Ground (License SUB-1435). Submitted to the U.S. Department of Army Installation Support Management Agency, Aberdeen Proving Ground, Maryland. Prepared by Science Applications International Corporation, Reston, Virginia. 2006. ADAMS ML 060590379.

Q64. Have any of the references you have listed in your Answer 63 not been filed with the NRC as part of the license amendment proceedings?

A64. (TDE) Yes, the first three listed references have not been filed. I have attached true and correct copies of the portions of those references mentioned in my testimony as Exhibit TDE #2 (Fetter), Exhibit TDE #3 (Greeman) and Exhibit TDE #4 (Montgomery Watson).

Q65. Does that conclude your testimony?

A65. (TDE) Yes, it does.

Résumé

TODD D. EABY, P.G.

Project Manager/Geologist

Education:	B.S. in Geology, 1990 Millersville University
Registrations/ Certification:	Licensed Professional Geologist - PA OSHA Supervisor Training OSHA Hazardous Waste Operations Training OSHA Confined Space Entry Training OSHA Excavation Competent Person Training

Mr. Eaby manages and participates in environmental assessments, hydrogeologic evaluations, site characterizations, site remediation, and Brownfields/redevelopment activities. His responsibilities include managing and conducting environmental assessments, management of field activities such as contaminant delineation and characterization, well installation and subsurface investigations, remediation oversight, remediation pilot tests, and hydrogeologic investigations. Mr. Eaby joined SAIC in 1991.

- Diamond drill coring.
- Well installation using numerous drilling techniques.
- Aquifer testing - pumping tests, slug tests, artesian flow tests.
- Site characterization.
- Site assessments.
- Monitored natural attenuation studies.
- Site remediation.
- Hydrogeologic investigations

PROJECT EXPERIENCE

Project Manager/Project Geologist, Harley-Davidson Motor Company, York, PA – Project manager responsible for completing a supplemental remedial investigation to address identified data gaps in a remedial investigation completed by a previous consultant. The project is ongoing and includes direct push technology soil borings and soil sample collection, bedrock and overburden monitoring well installation, monitoring well sampling using a modified micro-purge procedure, sediment and surface water sampling, geophysical studies including electrical imaging and electromagnetic surveys, a thermal survey of an adjacent creek, soil vapor point installation and sample collection, and stream gauge installation.

Project Manager/Project Geologist, Quality Distribution Inc., William Dick Lagoon Superfund Site, Coatesville, PA – Project manager responsible for the completion of the Baseline Assessment phase prior to completion of construction and start-up of a groundwater pump and treatment plant. As project manager was responsible for writing the comprehensive sampling and analysis plan for approval by the EPA. Baseline assessment tasks are ongoing and being managed include: residential supply well sampling, monitoring well re-development, monitoring well re-habilitation, monitoring well sampling, installation of recording weather station and groundwater stage recorders, and macroinvertebrate sampling at the proposed discharge stream and reference stream. System start-up activities will include pumping tests for the recovery wells, monitoring of groundwater response to pumping, system influent and effluent sampling.

Project Hydrogeologist, Jefferson Proving Grounds, Madison, IN – Hydrogeologist for support to the US Army during the decommissioning process for their NRC license associated with the former depleted uranium (DU) projectile testing range. The project is ongoing. Responsible for developing work plans, specifications and cost estimating for characterization of the potential impacts due to the presence of DU projectiles and refinement of the existing conceptual site model. Supported the Army with formal requests for additional information from the NRC staff and at meeting with the NRC staff and the US Army counsel. The project has numerous tasks including, but not limited to fracture trace studies, electrical imaging, soil verification, installation and monitoring of automatic and continuous recording stream gauges, hydrograph analysis, biota sampling and analysis, monitoring well installations, and soil and groundwater sampling.

Project Geologist/Health and Safety Officer, Chevron Texaco Corporation, Brooklyn, NY – Provided health and safety support as the site health and safety officer and rig geologist support during an intensive well installation task inside of an operating warehouse. Well installation inside the warehouse was determined to be necessary to continue with characterization of a hydrocarbon plume from previous site and neighboring property activities from petroleum fuel terminals and refineries. The drilling was completed with rotary sonic drilling techniques and required the construction of a negative pressure vapor control enclosure surrounding the drill rig and rig geologist work area to maintain safe working conditions while not adversely impacting the air quality in the remainder of the warehouse. Providing assistance in developing protocols for evaluating the aquifer, tidal influences and completing aquifer tests. Also assisting in analysis of the aquifer test data.

Project Geologist, Claremont Polychemical Superfund Site, HTRW Related services under Long Term Response Action (LTRA) program (USACE Kansas City), Old Bethpage, NY – Geologist for the installation of deep monitoring wells using sonic drilling techniques and discrete interval groundwater sampling with rapid turn around laboratory analysis to make field decisions on well construction and screen depth placement at Claremont Polychemical Site. The wells were installed to investigate the up gradient limits of the VOC plume. Interfaced with EPA and USACE personnel to relay groundwater chemistry data and field observations to aid in construction design and screen depth selection. Completed preliminary elevation surveying and well location mapping. During a scheduled treatment system shutdown, conducted recovery and system start-up hydrogeologic testing and analysis to determine transmissivity values for the aquifer to be used in groundwater modeling efforts. Installed electronic monitoring devices into the monitoring wells, supervised and completed collection of field measurements during the tests and conducted the data reduction and analysis of the test data. Conducted quarterly monitoring well sampling consisting of using micro-purge techniques and associated equipment. Assisted in preparation of work plans, specifications and cost estimating for the three phases of the well installations. Completed hydrogeologic reporting from aquifer testing and well completion reports.

Project Geologist, Forbes Atlas S-7 Missile Site, HTRW Related services under Long Term Response Action (LTRA) program (USACE Kansas City), Wamego, KS – Site Geologist for preparation of plans, specifications and cost estimating associated with the well design, construction and installation of injection, vapor extraction, monitoring and extraction wells at Forbes Atlas S-7 Missile Site, Ozinox Pilot Test. Prior to well installation, verified the site conditions and well locations in the field. Documented the installation of the injection, vapor extraction, monitoring and extraction wells using Odex® continuous casing advancement techniques. Completed oversight of the construction and development of the newly installed wells.

Project Geologist, Shell Oil Products US, Springfield, PA – Project geologist responsible for development of the drilling work plan, specifications and cost estimating for the installation of test borings, and monitoring wells. Utilized combinations of hollow-stem auger, diamond core drilling and air rotary drilling techniques for the test borings and well installations. Supervised the geophysical borehole logging of diamond core boreholes and interfaced with the project manager and geophysics operator for comparison of visual lithologic log and borehole geophysics log for well screen interval selection and well construction details. Provided oversight for all drilling activities including diamond coring, hollow-stem auger and air rotary as well as construction of single and nested monitoring wells and a large diameter recovery well.

Field Manager/Project Geologist, Bethlehem Steel Corporation, Bethlehem, PA - Supervised and conducted numerous assessments and limited compliance audits at the entire Bethlehem facility consisting of an 1,800-acre heavy industrial facility. Managed the site characterization activities and expanded investigations at the facility for Act 2 consideration and characterization. Characterization activities included well installation, aquifer slug testing, soil sampling, well sampling, sample collection with Geoprobe® (air, soil vapor, soil, water), soil gas surveys using both Emflux® and Gore-sorber® technologies, borehole logging, electrical imaging (EI), ground-penetrating radar (GPR), EM61/EM31 geophysical surveys, test pits, and soil borings. Well installation and production well rehabilitation activities were accomplished using various drilling methods including Odex® continuous casing advancement system, air-rotary, hollow stem auger, mud-rotary, and cable-tool drilling techniques. Developed and managed a Monitored Natural Attenuation (MNA) evaluation and sampling task.

Field Manager/Project Geologist, Bethlehem Steel Corporation, Sparrows Point, MD - Managed, supervised, and conducted well inventory and well installation phase of a nature and extent study as part of compliance with a United States Environmental Protection Agency (EPA) issued consent order. The well installations consisted of using both hollow-stem auger and rotary-sonic drilling methods. Isoflow® discrete interval groundwater sampling was used during the rotary-sonic drilling task to vertically profile the contaminant plume and assist in decisions concerning the well screen interval selection and well construction.

Field Manager/Project Geologist, Harley-Davidson Motor Company, York, PA - Managed and participated in investigation of area of proposed road relocation and former waste disposal sites. Investigation consisted of Geoprobe® soil borings and test pit activities to identify areas where waste had been deposited and collect samples for characterization, risk analysis and remedial option evaluation.

Project Geologist, South Jersey Clothing Company Superfund Site, Buena Vista, NJ - Supervised the drilling and installation of observation and injection wells using mud-rotary drilling techniques. Collected samples for grain size analysis during observation well installation and assisted in the analysis and design of the well screens for the injection wells. Provided supervision of the development and capacity testing completed on the installed injection wells.

Project Geologist, Alabama Army Ammunition Plant (ALAAP), Childersburg, AL - Supervised the drilling and installation of monitoring and pumping wells for characterization and aquifer pumping tests. The site is karst and presented challenging drilling. The well installations were accomplished using Odex® continuous casing advancement drilling techniques and tooling. The well locations were selected based on results from electrical imaging, which identified potential groundwater conduits within the karst system. Provided supervision for the installation of pilot hole borings for the potential pumping well locations. The pilot holes were drilled using reverse rotary drilling techniques. Following the installation and evaluation of pilot hole borings, the final location of the pumping well was selected. Provided supervision for the installation of the pumping well using large-diameter Odex® drilling techniques. Participated and assisted with setting up an aquifer pumping test on the high yielding pumping well. Used various electronic water level data collection devices in the pumping and monitoring wells during the test.

Project Geologist, Bethlehem Steel Corporation, Bethlehem, PA - Conducted river bottom elevation survey in area surrounding river water intake on the Lehigh River. Constructed profiles and contours of river bottom in the area of the water intake to evaluate impacts of low and high water conditions on ability to pump water from the Lehigh River and whether dredging of the intake area was needed. Determined that dredging was not needed.

Project Geologist, Ravenna Army Ammunition Plant, Ravenna, OH.- Supervised the drilling and installation of monitoring wells during a remedial investigation using air diamond drill coring of the well locations and air-rotary reaming of the core holes prior to well construction.

Project Geologist, Bonney Forge, Allentown, PA - Conducted slug test aquifer testing. Analyzed slug test data and prepared a hydrogeologic report.

Project Geologist, Brush Wellman, Shimersville, PA - Conducted monitoring well and quality assurance/quality control (QA/QC) sampling as part of Resource Conservation and Recovery Act (RCRA) closure and monitoring of a process lagoon. Conducted stream gauging and piezometer monitoring task to characterize groundwater recharge/loss from the stream flowing through the site. Conducted aquifer slug tests on monitoring wells. Analyzed slug test data and prepared hydrogeologic report.

Field Manager/Project Geologist, Various Industrial and Federal Facilities - Performed environmental assessments and limited compliance audits at various manufacturing, distribution, and laboratory facilities. Work involved reviewing waste management documentation, spill control plans, storage tank recovery, and other site information related to the environmental condition of the facilities. Based on the initial assessment findings, several of the facilities were investigated further for Act 2 redevelopment consideration.

Project Geologist, GE/RCA, Cherry Hill, NJ - Collected monthly groundwater samples in compliance with discharge requirements. Responded to the unique operation and maintenance (O&M) needs of this remedial system, such as fuel oil buildup on system control probes. Performed sampling utilizing SAIC's Geoprobe® system to delineate the extent of the No. 6 fuel oil plume that extended under a site building. Supervised the emplacement of a temporary groundwater depression system and the excavation of impacted soils above and below the groundwater. Conducted various soil sampling activities to confirm site conditions prior to property transaction.

Project Geologist, J. E. Baker, York, PA - Assisted corporate geologist during many field activities ranging from mapping rock outcrop to surveying for future quarry activities. Principal responsibility was to complete lithologic logs of diamond drill core and collect chip samples from the core for chemical analysis. The drill logs and chip samples were being used for valuation of quarry expansions and ongoing operations.

Project Geologist, K. I. Sawyer Air Force Base, Marquette, MI - Supervised drilling and well construction of high yielding recovery wells as part of the installation of a large-capacity groundwater remediation system to remove hydrocarbons and protect public drinking water sources. Well installation included drilling in unconsolidated heaving sands, constructing double cased wells, and telescoping continuous wire-wound stainless steel well screens. Monitored air quality for health and safety around the drilling rig. Monitored health and safety conditions when the project involved confined space entry. Supervised development of the high-capacity wells.

Project Geologist, Lancaster Battery PRP Group, Lancaster Battery Superfund Site, Lancaster, PA - Conducted soil and QA/QC sampling during the characterization and removal of impacted soils following EPA Region III protocol. Assisted in on-site sample screening using a portable X-ray fluorescence (XRF) unit.

Project Geologist, Pennsylvania Department of Environmental Protection (DEP), Hazleton, PA - Assisted DEP personnel in tracing a vapor/floating hydrocarbon plume during an emergency response by collecting soil, water, soil vapor, and floating hydrocarbon samples by utilizing a Geoprobe® sampling system.

Project Geologist/Field Manager, Pennsylvania Department of Environmental Protection, Hometown, PA - Performed three aquifer pumping tests and assisted with data interpretation and modeling of the site hydrogeologic settings. Supervised drilling and construction of bedrock and overburden monitoring wells used to characterize the extensive hydrocarbon plume. Conducted sampling of monitoring wells for groundwater characterization. Supervised and conducted Geoprobe® sampling of soil and groundwater and on-site analysis of samples to delineate the hydrocarbon plume in areas where the plume was present in an unconsolidated aquifer.

Project Geologist/Field Manager, Pennsylvania Department of Environmental Protection, Kennett Square, PA - Collected soil vapor samples and delineated a vapor plume utilizing a Geoprobe® sampling system. Supervised on-site sample analysis of the soil gas samples by portable gas chromatograph (GC). Oversaw drilling and installation of bedrock monitoring wells and supervised sampling of monitoring and private supply wells. Performed an aquifer pumping test and completed a vapor extraction pilot test at this site which was contaminated by benzene, toluene, ethylbenzene, and xylene (BTEX). Conducted an analysis of the aquifer pumping test data and modeled the site hydrogeologic setting. Prepared a hydrogeologic report on the results of the pilot tests for the DEP.

Project Geologist, Pennsylvania Mines Corporation, Pine Flats, PA - Managed field sampling and field activities for a major hydrogeologic investigation of a drainage basin and aquifers overlying an abandoned bituminous coal mine. Duties consisted of supervision of rock coring and evaluation of rock core to identify and construct the stratigraphic column and cross sections; piezometer installations; seep identification and sampling; seep flow measurements and sampling; stream gauging and sampling; conducting pumping and artesian aquifer tests; and slug testing of aquifers and analysis of aquifer tests; and coordination of results with project team which included hydrogeologists, engineers, and attorneys.

Project Geologist, Rock Island Arsenal, Rock Island, IL - Assisted in data collection phase of an RI at the old arsenal landfill under the direction of the U. S. Army Corps of Engineers (USACE). Activities consisted of supervising diamond drill coring and saddle packer testing for permeability evaluation of the aquifer for both consideration of optimum depth of monitoring well screen placement and suitability of a grout curtain. Supervised the installation of vertical and angle alluvial and bedrock monitoring wells using a combination of rotary-sonic, air-rotary and hollow-stem auger methods. Supervised soil borings conducted with hollow-stem auger method and collected characterization samples for laboratory analysis. Supervised installation of temporary well points using hollow-stem auger methods. Developed and sampled monitoring wells. All field activities were conducted under supervision of and in accordance with USACE specifications.

Project Geologist/Field Manager, SICO Oil Company, Gilbertsville, PA - Completed monthly groundwater sampling in compliance with discharge permit requirements. Measured groundwater levels, and levels of free gasoline product. Collected groundwater samples from on-site recovery wells, and from several residential wells on adjacent properties. Also collected effluent samples to assure compliance with the National Pollutant Discharge Elimination System (NPDES) requirements.

Project Geologist, Star Enterprise, Coraopolis, PA - Supervised and installed sparge and vacuum extraction points using a Geoprobe®. These points were utilized for a large remediation system at an operating fuels terminal.

Project Geologist, U. S. Army Corps of Engineers, Lang Superfund Site, Browns Mills, NJ - Developed injection wells that were connected to a high capacity remediation system. Collected groundwater samples from monitoring wells.

Project Geologist/Field Manager, United States Department of Agriculture (USDA), Confidential Location - Reviewed off- and on-site records and files; conducted interviews with selected federal government personnel; and performed an on-site reconnaissance to identify hazardous materials usage, storage, and disposal as well as any documented releases. Compiled information regarding targets, migration pathways, and receptors. Assisted in formulation of Hazardous Ranking Score (HRS) to prioritize future work. Managed and participated in site inspection (SI) task of areas of concern identified during the preliminary assessment (PA) phase. Supervised and coordinated sampling teams, drilling crews, and air stack sampling crews. The SI phase consisted of soil sampling, surface water sampling, sediment sampling, monitoring well installation, groundwater sample collection, and air emissions stack testing. Used the SI phase data to refine the HRS for submission to EPA Region II.

Project Geologist, City of York - Broad Street Garage, York, PA - Supervised the excavation of an 8,000-gallon underground storage tank (UST). Provided quality control oversight and inspection during the actual tank retrieval. Screened on-site soils for hydrocarbon content using an organic vapor analyzer (OVA). Assessed the OVA results to determine where additional soils should be excavated for subsequent treatment and disposal. Conducted site characterization and supervised the drilling and construction of monitoring wells. Collected monitoring well samples and QA/QC samples.

Drilling technique experience:

- Auger drilling
- Angle auger drilling
- Air-rotary drilling
- Angle air-rotary drilling

- Diamond core drilling
- Angle diamond core drilling
- Air diamond core drilling
- Mud-rotary drilling
- Odex®, Stradex®, Tubex® continuous casing advancement systems
- Reverse-rotary drilling
- Rotary sonic drilling
- Angle rotary sonic drilling
- Cable tool drilling

Miscellaneous:

- Continued Education, NGWA: Analysis and Design of Aquifer Tests, including Slug Tests and Fracture Tests, 1995, 2.8 CEU.
- American Safety and Health Institute Approved Adult CPR Refresher Training
- American Safety and Health Institute First Aid Training

EXHIBIT TDE #2

Fetter, C.W. 1988. *Applied Hydrogeology, Second Edition*. Merrill Publishing Company, Columbus, Ohio. Cover, Title Pages, pages 5 and 287.

Todd D. Eaby Testimony

Exhibits TDE #2, TDE #3, and TDE #4 contain copywrite information and were not placed in ADAMS.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before Administrative Judges:

Alan S. Rosenthal, Chair
Dr. Paul B. Abramson
Dr. Richard F. Cole

In the Matter of	)	Docket No. 40-8838-MLA
	)	
U.S. ARMY	)	ASLBP No. 00-776-04-MLA
	)	
(Jefferson Proving Ground Site)	)	August 14, 2007
	)	

TESTIMONY OF MICHAEL L. BARTA ON STV CONTENTION B-1 BASIS ITEMS "n" AND "o"

SUBJECTS: Environmental and Ecological Risk; Ecological Sampling

I. WITNESS BACKGROUND

Michael L. Barta ("MLB")

Q1. Please state your full name.

A1. (MLB) My name is Michael L. Barta.

Q2. By whom are you employed and what is your position?

A2. (MLB) I work as a Senior Ecological Risk Assessor for Science Applications International Corporation (SAIC) in their Memphis office. Currently, I serve as the lead ecological risk assessor at Army sites in Illinois and Arkansas and Air Force sites in New Jersey and Texas. I also serve as the project manager/deputy program manager for range condition assessments at Navy testing and training ranges in Virginia and California. These assessments evaluate the potential for munitions constituents to migrate off-range. In addition to these responsibilities, I provide technical support and serve as the deputy project manager for SAIC on the planned decommissioning of Jefferson Proving Ground's (JPG's) U.S. Nuclear Regulatory Commission (NRC) materials license.

Q3. Please summarize your professional and educational qualifications.

A3. (MLB) My professional and educational experience is summarized in the résumé attached to this testimony as Exhibit MLB #1. Briefly summarized, I have been practicing ecological risk assessment (ERA) for more than 15 years. During this time, I was the lead scientist on 26 ERAs and provided technical support on an additional 22 ERAs. I have experience designing and executing biological field studies for ERAs at Army installations such as Picatinny Arsenal and Savanna Army Depot. I have been providing technical support to the Army's JPG facility since early 2004. I designed the recent deer sampling study at JPG and assisted with the deer collection.

My academic credentials include a B.A., B.S., and M.S. in Zoology, with an emphasis on environmental toxicology while in graduate school. I have published and presented 9 technical papers at national technical meetings. I am a member of the Society of Environmental Toxicology and Chemistry and Sigma Xi.

Q4. What is the purpose of your testimony?

A4. (MBL) The purpose of my testimony is to address, on behalf of the Army, Basis Items "n" and "o" submitted by Save The Valley ("STV") as part of its Contention B-1 in these proceedings.

In its Contention B-1, STV asserts that:

"As filed, the FSP is not properly designed to obtain all of the verifiable data required for reliable dose modeling and accurate assessment of the effects on exposure pathways of meteorological, geological, hydrological, animal, and human features specific to the JPG site and its surrounding area."

STV provided 18 supporting bases for their contention, lettered "a" through "r."

The purpose of my testimony is to provide evidence and expert opinion pertaining to the assertions made in Basis Items "n" and "o."

STV's Basis Item "n" states:

"In order to really do a site-specific environmental and human health risk assessment, understanding the fate and transport (F&T) of DU within the JPG ecosystem is critical. In order to develop such a model, standard eco-risk-associated field sampling practices specify samples from different parts of the ecosystem within the same approximate period of time and definitely within the same field season in order to identify the distribution of the contaminant (DU) at that time. Further it is best to take multiple samples from these different locations over time. Thus, to truly model F&T within the JPG ecosystem (which is NOT the Yuma or Aberdeen Proving Ground ecosystem), a particular sample taken at a particular time should include all media and relevant biota and each of these media and biota should be sampled on multiple occasions. Ideally, samples should also be taken under different types of field conditions, as appropriate for the changes that occur at the site of concern. For example, at a site that floods, as JPG does, samples should be taken from all media and biota at high flow (flood season) and low flow. Similarly, in a seasonal environment like JPG, samples should be taken from all media and biota in different seasons. When reproduction is seasonal for the biota of potential concern, seasonal sampling is of special concern. See, e.g., , *G.W. Suter II,* et al., *Ecological Risk Assessment for Contaminated Sites, CRC Press [Lewis Publishers], Boca Raton, FL (2000), esp. at 77. Thus, the much more limited sampling described in section 6.3 of the FSP is deficient for purposes of adequate site characterization."*

II. OVERVIEW

Issues Raised by Basis Item "n" to STV Contention B-1

Q5. What is your understanding of the technical issues raised by Basis Item "n" of STV's Contention B-1?

A5. (MLB) In its license amendment application, the Army is seeking an alternate schedule to perform site characterization work for the submission of a decommissioning plan for JPG. STV's Basis Item "n" raises the issue of whether an ecological risk assessment (ERA) or a comprehensive research study is necessary for decommissioning at JPG. STV asserts that the license amendment should not be approved unless the Army is required to perform such an ERA or comprehensive research study.

Q6. Do you agree with the assertion in STV Contention B-1, Basis Item "n", that the Army's application for an alternate decommissioning schedule should not be approved unless an ERA or a comprehensive research study is a condition to the approval of the license amendment?

A6. (MLB) No.

Q7. What is the basis for your disagreement?

A7. (MLB) STV cites a leading authority (Suter 2000) in the ecological risk assessment field. Although some of the principles discussed in Suter (2000) could be applied at JPG ***if*** the objective were to complete an ERA or a comprehensive research study, there is no regulatory requirement nor any need to conduct such an extensive sampling program to collect the data necessary for decommissioning at JPG. The JPG site characterization program is in support of the NRC's decommissioning process as required by 10 Code of Federal Regulations (CFR) Part 20 et seq. Suter's suggestions do not specifically apply to the type of site characterization necessary for a restricted use NRC decommissioning.

Furthermore, an ERA is neither planned for by the Army nor required by NRC. NUREG 1757 (NRC 2006) specifies that Group 6 sites (Restricted Use) need to evaluate residual radiation doses to humans based on the use restriction and if the restrictions fail. In order to meet this requirement, the Field Sampling Plan (FSP) (SAIC 2005a) specifies additional abiotic data that will be collected to update the RESidual RADioactivity (RESRAD) model. There are no requirements in NUREG 1757 (NRC 2006) to collect biological data as model inputs or to evaluate risks to the biota themselves. The Environmental Assessment to be prepared by NRC will address ecological and human health risks from the perspective of the National Environmental Policy Act (NEPA).

III. Discussion

Environmental and Ecological Risk

Q8. Did you participate in the design of the biological or biota sampling to be conducted at JPG as part of the Army's site characterization?

A8. (MLB) Yes.

Q9. Please describe the analytical bases for the design of the biota sampling to be conducted at JPG.

A9. (MLB) The biota sampling program proposed in the FSP (SAIC 2005a) and Addendum 1 (SAIC 2005b) was designed to respond to requests from the NRC as well as align with the Army's approach to conduct the sampling in a step-wise or phased manner. As a result, deer were proposed for sampling first (see also the response to FSP Comment "o" below) because NRC had indicated a concern from the exposure of hunters to depleted uranium (DU) through the ingestion of deer tissue collected at JPG. The biota sampling plan was reviewed by NRC as required by the Army's license and regulations guiding license termination and decommissioning as specified in 10 CFR Part 20 et seq.

Based on the deer sampling results, which indicated that DU was not present in the deer tissues, no additional deer sampling is warranted. Other biota were proposed for collection only if DU was detected in the deer tissues. NRC, after review of the FSP (SAIC 2005a), FSP Addendum 1 (SAIC 2005b), and Deer Tissue Sampling Report (SAIC 2006), did not request the collection of more deer or other biota.

Because the focus of the decommissioning is the protection of human health, there is no need to collect any biota data except those associated with potential human consumption. The property north of the firing line, including the DU Impact Area, became Big Oaks National Wildlife Refuge (NWR) in 2000.

There are no agricultural scenarios at the refuge from which human receptors could be exposed. Hunting is permitted only for deer, turkey and, most recently, squirrel in the refuge. Deer were selected for sampling in response to an NRC request (NRC 2004). Approximately 400 to 800 deer are harvested per year, whereas the number of turkey harvested each year is approximately 50. The squirrel harvest is limited by days allowable to hunt squirrel rather than a specific harvest limit. Although turkey and squirrel have not been analyzed for the presence of DU in tissues, there is no compelling reason to believe that DU uptake would be any greater than in deer. More importantly, I would expect that the mass of turkey meat or squirrel meat consumed per individual hunter would be less than for deer. Thus, the potential for exposure to DU, if present in tissues, would be greatest through deer consumption.

Q10. Why is no further biota sampling planned at JPG?

A10. (MLB) The Army has already collected recent samples from one of the only three receptors (deer, turkey and squirrel) that could be a potential ingestion harm to human receptors in the refuge. In addition, the receptor sampled, deer, is the most likely concern to human health via the ingestion pathway. Given the absence of DU in any of the deer tissue sampling results (SAIC 2006), there is little reason to believe that consumption of turkey or squirrel would be a concern to public health from exposure to DU. No other biota need to be sampled.

I should add that access to the DU Impact Area is restricted, so hunting does not occur there. Rather, hunters would have to capture deer and/or turkey/squirrel in hunting areas outside the DU Impact Area that were exposed to DU while in or potentially adjacent to the Impact Area. This helps to limit the exposure of hunters to deer and/or turkey/squirrel ever exposed to DU.

Q11. Are you familiar with the testimony offered by Diane Henshel in this hearing?

A11. (MLB) Yes, I have reviewed her written testimony dated July 20, 2007.

Q12. Do you agree or disagree with her opinions and conclusions regarding assessment of environmental and ecological risk?

A12. (MLB) I disagree.

Q13. What is the basis of your disagreement?

A13. (MLB) In essence, Ms. Henshel's testimony concerning biota contends that the current sampling program for biota under the FSP is deficient in meeting the eventual requirement for the Army to submit an effective decommissioning plan in 2011. At first, she relies on general sampling procedures to assert her case. While some of her recommendations would have merit if the Army were conducting an ERA or biological research study, there are no regulatory requirements in 10 Code of Federal Regulations (CFR) Part 20 et seq. to conduct the extensive biota sampling she deems is required. Her requests seem to come from a personal or professional desire to absolutely identify every potential pathway for DU to move through biota, no matter how minor, as well as a failure to understand the decommissioning process. By contrast, the Army carefully designed and carried out the work according to NRC stewardship objectives for decommissioning. The result is that there is sufficient quantity and quality of data to proceed with the necessary decisions in the decommissioning process.

Ms. Henshel, in an attempt to discredit the biota sampling plan in general and the deer sampling plan in particular, then presents an uncomplimentary critique of the quality and usefulness of the Deer Tissue Sampling Study. In brief, she suggests that the study was ill-conceived and poorly executed. Ms. Henshel's suppositions could logically follow from a poor understanding of the NRC and Army mandates and legally based stewardships for decommissioning. She has interpreted those mandates incorrectly and, therefore, the conclusions that she reaches are incorrect.

She relies on errors in facts as well as in errors in data use and interpretation. Furthermore, she implies that the Army has either withheld information or willfully avoided collecting information that could be damaging to the Army. This is just not true as my continuing testimony will show.

Interestingly, while essentially claiming the sampling in the Deer Tissue Sampling Results Report (SAIC 2006) is useless due to the numerous alleged sampling flaws to the point that deer should be re-collected, she nonetheless erroneously states that the data "prove" that DU was present in the deer, doubly reinforcing the need for the Army to re-collect deer tissue and other biota in accordance with the FSP (SAIC 2005a) and FSP Addendum (SAIC 2005b). The data show no DU in deer as I will discuss in later testimony.

Q14. Do you agree or disagree with Ms. Henshel's statements, contained in her Answer 12, concerning the basic purpose of the biological characterization activities in the FSP?

A14. (MLB) I do not agree that the biological characterization activities must provide site-specific **input** data for any risk characterization activities at JPG. First, the deer tissue samples were collected in direct response to concerns raised by NRC in a Request for Additional Information (RAI). While my Answer A31 goes into greater detail concerning this RAI, the NRC was concerned that some modest increases in uranium from deer tissues compared to background levels could be a concern to hunters. These data were never intended for use as input data into the RESRAD model. Furthermore, the design of the Army's biota sampling plan is above and beyond that required in NUREG 1757 (NRC 2006), which does not require the collection of biota. The sampling design was reviewed by NRC as required by the Army's license and regulations guiding license termination and decommissioning as specified in 10 CFR Part 20 et seq. NRC, after review of the FSP (SAIC 2005a), FSP Addendum 1 (SAIC 2005b), and Deer Tissue Sampling Results Report (SAIC 2006), did not request the collection of more deer or other biota. As a result, STV criticizes the Army in many instances for not providing data which it is not required to provide as part of the decommissioning process.

The abiotic data collected according to the FSP (SAIC 2005a) and subsequent addendum will be technically sufficient to revise the RESRAD model to determine if DU is a potential concern to public health. As a result, there is no benefit to be gained from the cost, effort, and potential schedule delays associated with collecting additional biota data.

Q15. In Ms. Henshel's Answer 14 she discusses various ways in which biological receptors transport DU. Do you have any additional comments on those pathways?

A15. (MLB) Yes, there are a number of **potential** pathways for DU to migrate from the DU Impact Area. However, how many of them are truly significant? The public is not permitted in the DU Impact Area. Thus, unless trespassing, DU has to migrate from the DU Impact Area in order for an exposure to occur. Although access is permitted in the Big Oaks NWR outside the DU Impact Area, there are restrictions and no one lives in the refuge. Thus, exposures are further limited.

How could off site exposure occur, regardless of the smallness of the exposure? There would seem to be four possibilities: via air inhalation, surface water and/or groundwater ingestion, or ingestion of wildlife. Air is not likely a significant exposure pathway as discussed in Harry Anagnostopoulos's testimony. To my knowledge, DU has not been detected in any potable wells at and nearby JPG; surface water is not used for general public consumption in this area. Lastly, deer, turkey, and squirrels are the only receptors allowed to be hunted at the refuge. We did not find evidence of DU in the deer and have no reason to suspect that turkey and squirrels would be a concern to the public either. Thus, there do not appear to be any major exposure pathways. Furthermore, the Army is collecting additional groundwater and surface water data as part of the FSP in and near the DU Impact Area (SAIC 2005a). If these data indicate the presence of DU, then samples farther from the DU Impact might be collected.

Q16. In her Answer 16, Ms. Henshel discusses the importance of "bioaccumulation" in relation to the purposes of the FSP. Do you have any additional comments to add in this regard?

A16. (MLB) Yes. The bioaccumulation potential of other metals, referenced in her answer, is of no relevance to JPG. We are concerned with DU. Ms. Henshel did not provide a reference list so we could not review all of her supporting evidence but acknowledge that DU uptake can occur in some wildlife receptors.

Q17. In your opinion, based on your experience and the information available from JPG and the surrounding area, is bioaccumulation a significant concern in this decommissioning process?

A17. (MLB) No.

Q18. What is the basis for your opinion?

A18. (MLB) For animals and plants in the DU Impact Area, there could be chronic or long-term exposure to DU. However, the focus of this decommissioning process is the protection of human health. Ms. Henshel suggests, but provides no data, that there are chronic exposures to people living south of the firing line and around JPG through exposures via air or water. Harry Anagnostopoulos will testify to the insignificance of the air pathway. The streams that flow from the DU Impact Area are not used as a potable water source near JPG. There are no chemical data to indicate that residential wells are contaminated with DU. In fact, there is no indication that there is routine or widespread DU contamination outside of the DU impact area.

Q19. Do you agree with Ms. Henshel's opinions and conclusions in her Answer 18 concerning the sources and types of biological data needed for meaningful modeling of DU fate and transport from the impact area to potential receptors?

A19. (MLB) No, I do not

Q20. What is the basis of your disagreement?

A20. (MLB) The types of biological data that Ms. Henshel suggests need to be collected would add to the body of literature on DU. However, there are no NRC requirements to conduct such an extensive sampling program. In a similar manner to Mr. Norris' testimony on the insufficiency of the hydrogeological program proposed by the Army at JPG, Ms. Henshel requests that numerous pathways, no matter their significance, be sampled. As I just discussed in A18, there is no indication that there is routine or widespread DU contamination outside of the DU impact area. In effect, the Army is being asked to trace all DU potentially leaving the DU Impact Area and then JPG. This is not required for the Army to adequately update the RESRAD model. While Ms. Henshel and STV believe that meaningful fate and transport modeling require the collection of biological data, the model inputs to RESRAD, one of the NRC-approved models that can be used in the decommissioning process, are abiotic (non biological). Furthermore, the decommissioning process criterion that the Army must meet is 25 mrem/yr to humans. The sampling plan broadly defined in the FSP (SAIC 2005a) meets this objective.

The time frame to collect all of the biological data Ms. Henshel desires but are not required for decommissioning would be at least 3 to 4 years from October 2007, at a minimum. Most of Year 1 would be occupied with planning and approval acceptance, especially for such a large study. Year 2 might focus on identifying the species of biota that inhabit the DU Impact Area, the migratory patterns of these biota in the DU Impact Area, and the food web relationships among these biota both in and outside the DU Impact Area. Year 3 would focus on collecting uptake, bioaccumulation, and effects data. Year 4 would focus on data interpretation and report writing. This also assumes no complicating factors in collecting data, which is certainly not the case at the DU Impact Area because of Unexploded Ordnance (UXO). There would be significant health and safety hurdles to collect data that would not be directly used in the RESRAD model. Furthermore, completion of such an extensive study would interfere with the Army's legal requirement to submit an effective decommissioning plan in 2011.

Q21. Do you agree or disagree with the opinions stated by Ms. Henshel in her Answers 20 and 21 concerning the sufficiency and adequacy of the biological characterization as contained in the FSP?

A21. (MLB) I disagree. The deer data were collected in response to NRC concerns about human health exposure to deer, as stated in Section 6.3 of the FSP (SAIC 2005a). Other biota would have been collected if DU was detected above background levels. This did not occur, so no further biota were collected.

Other biota have been previously collected at JPG. Ms. Henshel claims that these "activities are essentially being discounted by the Army" but fails to provide technical evidence. Although DU has been detected in vegetation, the detections have been minimal (SEG 1995 (pages 4-7, 4-11 and 4-12) and 1996 (pages 4-11 and 4-12). All historical animal samples obtained from the DU affected area showed no radiological evidence of DU contamination by virtue of both the magnitude of uranium concentration and the U-238/U-234 activity ratio (Ebinger and Hansen 1996 (pages H-1 and H-2) and SEG 1996 (page 4-13)). In effect, the historical biota data support NOT collecting additional biota data because DU has been absent from historical animal (i.e., raccoon, clams, fish, turtle and deer) samples. Nonetheless, as a good steward, the Army agreed to collect other biota if DU was detected in the deer samples.

The overall purpose of the FSP is to provide better data with which to update the RESRAD model. As I have previously stated, there are no biological data inputs to this model. There also are no NRC requirements to collect more biological data. Rather, the Army collected deer in response to an NRC request. If DU had been detected at levels of concern, other biota would have been sampled.

I concur that aquatic filter feeders and terrestrial vegetation might be better indicators of DU uptake than deer. For that matter, I agree that other biota might be beneficial indicators of DU uptake. I proposed collection of other biota (plants, earthworms, fish, small birds, and small mammals) in the FSP (SAIC 2005a) **if** the deer data, in conjunction with the abiotic data (e.g., surface soil, surface water), suggested that migration and subsequent uptake could be occurring. However, as the deer data did not indicate the presence of DU in the tissues, there is no need to collect additional biota samples.

The decommissioning activities focus on potential radiological risks to humans. While clams would be a potential food source to raccoons and other wildlife, their use as a human food source at and near JPG is unlikely. Entrance into the DU Impact Area is restricted and fishing/clamming activities are prohibited. As a result, clam consumption is an incomplete pathway for human receptors and there is no benefit to collecting clam samples.

Ms. Henshel states that "Nonetheless, when samples from early and late in DU testing are not combined, it is evident that DU in the deer are increasing over time." However, she fails to provide quantitative support for her assertion. What data are she proposing to separate? Data from the same year? Data from different years? No DU has been detected in deer tissues collected from 1984 to 2006. Without any DU detected, one cannot conclude that DU levels are increasing. Please see A33 below for further clarification on "DU levels" in deer.

IV. SUMMARY AND CONCLUSION

As to Basis Item "n"

Q22. Please summarize your testimony with regard to Basis Item "n".

A22. (MLB) My testimony can be summarized as follows:

The collection of samples according to ecological risk guidance is neither required under the decommissioning process nor warranted at JPG. Deer, which represent the greatest potential for exposure to human receptors through the consumption of meat and other organs, were collected based upon a request by NRC according to their stewardship responsibilities (2004). No DU was detected in any of the deer tissues (SAIC 2006). I believe that we should avoid further biota sampling as specified in the work plan.

The abiotic data collected according to the FSP (SAIC 2005a) and subsequent addenda will be technically sufficient to revise the RESRAD model to determine if DU is a concern to public health. As a result, there is no benefit to be gained from the cost, effort, and potential schedule delays associated with collecting additional biota data.

V. OVERVIEW

Issues Raised By Basis Item "o" to STV Contention B-1

Q23. What is your understanding of the technical issues raised by Basis Item "o" of STV's Contention B-1?

A23. (MLB) In Basis Item "o" to its contention B-1, STV stated (in part) that:

"Although deer are not the most representative biota to sample, they are the only biota proposed for sampling by section 6.3 of the FSP. Nonetheless, when data from samples early and late in DU testing are not combined, it is evident that DU levels in even the deer are increasing. This result in deer clearly mandates sampling other, more representative biota as well. Based on what little data is available, the bioaccumulation factors (BAFs) for vegetation and the aquatic filter feeders such as crayfish (both of which are eaten by higher animals and humans) are relatively high, on the order of 10^2 to 10^3 times as high as the BAFs for persistent, bioaccumulative, and toxic chemicals (PBTs) listed as being of concern by the U.S. EPA and the Persistent Organic Pollutants (POPs) Treaty. Clearly, vegetation and aquatic filter feeders are better indicators of DU migration into the eco-food chain than are deer and they should be sampled. For example, the mean of the two clam data points, when compared to the mean of the surface water data provided in Table 2-1 indicate that the clams bioaccumulation factor (BAF) is approximately 900. This is the highest bioaccumulation rate determinable among the biota listed in Tables 2-1 and 2-2 on page 2-9 of the FSP. Since clams are also eaten by both wildlife (raccoons and wading birds, for example) and humans, clams are thus an important second species to include in the biotic sampling throughout the monitoring period. Additionally, the FSP proposes (and the Staff accepts on page 6 of the April 2006 SER) to sample other biota ONLY IF there is detectable levels of DU in the deer tissue, and will only do this in another sampling year. This proposal is directly contrary to what is

considered to be "Best Practices" for sampling biota as part of an ecological assessment. See, e.g., *G.W. Suter II,* et al., *Ecological Risk Assessment for Contaminated Sites, CRC Press [Lewis Publishers], Boca Raton, FL (2000), esp. at 77."*

Once again, STV is asserting that the collection of additional biota samples in accordance with the ecological risk suggestions found in Suter (2000) is warranted for the Army's site characterization at JPG and that the license amendment should not be approved unless the Army is required to perform additional biota sampling.

Q24. Do you agree with the assertion in STV Contention B-1, Basis Item "o", that the Army's application for an alternate decommissioning schedule should not be approved unless the Army is required to perform additional biota sampling as a condition to the approval of the license amendment?

A24. (MLB) No.

Q25. What is the basis for your disagreement?

A25. (MLB) My response to Basis Item "n" concerning the need to collect biota samples other than deer is also applicable here. The collection of samples according to ecological risk assessment suggestions (Suter 2000) is neither required by NRC nor warranted as the Army does not intend to conduct an ERA.

VI. Discussion

Ecological Sampling

Q26. Besides the Suter ERA guidance, does STV raise other technical issues in supporting it assertion that further sampling should be required?

A26. (MLB) Yes. Besides citing the same ERA guidance as in Basis Item "n", STV raises more specific technical points that they believe justify the collection of other biota at JPG. A few of these points made by STV merit further response.

Q28. Do you agree with STV that these specific technical points justify the collection of other biota samples at JPG?

A28. (MLB) No.

Q29. What is the basis for your disagreement?

A29. (MLB) First, as a point of clarification, the FSP does not state that deer are the most representative biota to sample. Rather, deer were collected in direct response to an NRC request (NRC 2004). As far as potential food ingestion pathways to humans, deer ingestion represented the greatest potential for harm due to the number of deer harvested from JPG each year. Thus, deer represented the logical first choice in a tiered-sampling design.

As the primary author of the deer sampling FSP Addendum 1 (SAIC 2005b) and Deer Tissue Sampling Results Report (SAIC 2006), I do not agree with STV's assertion that the historical data support the contention that DU levels in deer are increasing. No data are presented by STV to support the claim that "Nonetheless, when data from samples early and late in DU testing are not combined, it is evident that DU levels in even the deer are increasing."

In addition, STV does not specify from what year(s) these samples were collected from which the data should be separated. Indeed, the data presented in the recent Deer Tissue Sampling Results Report (SAIC 2006), which represents the most comprehensive deer sampling at JPG to date, do not even indicate the presence of DU in the tissues. Without any DU detections in the most recent deer sampling, there can be no increasing trend of DU levels.

I concur that aquatic filter feeders and terrestrial vegetation might be better indicators of DU uptake than deer. For that matter, I agree that other biota might be beneficial indicators of DU uptake. I proposed collection of other biota (plants, earthworms, fish, small birds, and small mammals) in the FSP (SAIC 2005a) **if** the deer data, in conjunction with the abiotic data (e.g., surface soil, surface water), suggested that migration and subsequent uptake could be occurring. However, as the deer data did not indicate the presence of DU in the tissues, there is no need to collect additional biota samples.

As noted in my response to Basis Item n, the decommissioning activities focus on potential radiological risks to humans. While clams would be a potential food source to raccoons and other wildlife, their use as a human food source at and near JPG is unlikely. Entrance into the DU Impact Area is restricted and fishing/clamming activities are prohibited. As a result, clam consumption is an incomplete pathway for human receptors and there is no benefit to collecting clam samples.

Q30. Do you agree or disagree with Ms. Henshel's opinions and conclusions regarding adequacy of the deer sampling?

A30. (MLB) I disagree.

Q31. What is the basis of your disagreement?

A31. (MLB) First, I would like to clarify some information cited by Ms. Henshel in her Answer 22. The text on page 6-24 of the FSP (SAIC 2005a) states that "Although NRC has acknowledged that DU concentrations in the most recently collected deer samples were low from a human health perspective, there were modest DU increases in kidney and bone compared to background. As a result, NRC has expressed concern that concentrations may continue to increase to levels that could affect human health." NRC's actual comment in RAI #6 is below:

> *The Army should provide additional information on the apparent trend of increasing **uranium** (emphasis added) concentration in deer kidneys and bone, and how this relates to the potential for DU in deer meat that is consumed by humans. A detailed characterization survey was conducted for the Army in 1996 (SEG, Inc. 1996). Deer showed a modest increase from background **uranium** (emphasis added) concentrations in kidneys (from 0.05 to 0.151 pCi/g) and a larger increase from background in bone (from 0.0003 to 0.416 pCi/g). From the perspective of human health protection, the levels of **uranium** (emphasis added)in deer remain low. However, it is not clear if the concentration of uranium in deer kidneys and bone will continue to increase and potentially be of concern to human health from the consumption of contaminated deer meat.*

While I regret that our reports suggest that NRC reported a trend of increasing DU levels, this is simply not the case. Furthermore, the sampling data referenced by the reviewer (SEG, Inc. 1996) actually represents samples of liver, kidney, and bone harvested from a single 4-to-5-year-old female deer killed in the DU Impact Area. Although the samples collected from this single deer specimen appear higher than other samples collected from deer samples collected prior to that time, total uranium activities are low and do not indicate an impact from DU (U.S. Army 2002).

In summary, the Army agreed to collect deer samples to alleviate concerns that an increasing trend in **uranium** tissue concentrations in ONE deer was not indicative of a potential future concern in DU concentrations to hunters. There are no historical trends of DU uptake in deer a JPG.

Q32. Do you agree or disagree with Ms. Henshel's opinion that the deer sampling study is inadequate?

A32. (MLB) I disagree with her assertion that the deer sampling is inadequate; and I disagree with her allegations about inadequacies in sampling methods and data collection, management and interpretation.

Q33. What is the basis of your disagreement with Ms. Henshel on those points?

A33. (MLB) There are two alleged inadequacies cited concerning the sampling methods: location of harvested deer and use of baiting. Only 12 of the 30 deer were collected during the fall sampling period, most likely because the deer were skittish after the hunting season, which had just ended. No deer were collected from the nearby hunting zones in the fall. Two deer were collected from background locations and the remainder were collected from the DU Impact Area. Although it is unknown whether the deer collected from the DU Impact Area spent most of their time in or near the DU Impact Area or had been displaced from nearby hunting zones, it is more likely the deer spent most of their time in the DU Impact Area. Many deer studies have suggested that deer will leave their home ranges when pursued, but will return quickly (within a day) to their home range (Sweeney et al. 1971, Downing and McGinnes 1976, Pilcher and Wampler 1982, VerCauteren and Hygnstrom 1998 as cited in D'Angelo et al. 2003, page 318). A study of deer hunting using dogs (which is the most disruptive hunting of deer) indicated that disturbed deer move an average of 0.8 km from their home range while pursued, but that all of the deer returned to the home ranges within 13 hrs after the hunting ended (D'Angelo et al. 2003, page 322). These data suggest that the JPG deer hunt that occurred one week before the deer sampling event is not likely to have had any impact on the locations of the deer that were harvested for the sampling. In other words, it is not likely that some or all of the deer collected from the DU Impact Area could have spent most of their time in the nearby hunting zones which do not contain DU.

However, whether some, none, or all of the deer collected from the DU Impact Area spent the majority of their time in the nearby hunting zones is not germane to the purpose of the Deer Tissue Sampling Study.

Three geographic groups of deer were selected for sampling: background, nearby adjacent hunting areas, and the DU Impact Area. Hunting is not permitted in the DU Impact Area. Samples were collected there because those are the deer most likely to exhibit DU because their exposure would be greater than the nearby adjacent hunting areas. No DU was detected in ANY of the deer samples, so even if the deer collected from the DU Impact Area were from nearby hunting areas, this provides further evidence that hunters are not at risk from exposure to DU through ingestion of deer meat. The public is safe in consuming deer tissue from JPG as it relates to DU. The sampling design satisfied the objectives of the Deer Tissue Sampling Results Report (SAIC 2006).

Ms. Henshel states that the "Deer Sampling Study observes that the uranium content of wildlife reflects an animal's recent diet." If true, the use of DU-free bait could affect the tissue concentrations in the deer, perhaps to the extent that DU would not be detected. However, the text in the Deer Tissue Report (SAIC 2006) on page 1-6 actually states that "exposure of wildlife to DU can be highly variable depending on animal behavior and recent diet...." There is a difference between exposure and uranium content in wildlife. Although uptake into tissues cannot occur without exposure, the existence of exposure does not always mean that uptake has occurred.

Bait stations were used as a means to attract the deer to areas on or near roads for harvesting. However, not all deer were harvested at the bait stations. Furthermore, very little if any bait was used in the fall sampling event when all of the deer from the DU Impact Area were collected. Without stomach analyses the amount of ingested corn is unknown. Nonetheless, the Deer Tissue Sampling Results Report (SAIC 2006) as well as Ms. Henshel provide evidence that some bioaccumulation of uranium has been observed in plants and animals. Foraging on corn for a few days or few weeks would seem unlikely to appreciably affect tissue concentrations of DU.

Q34. Do you have additional bases for your disagreement?

A34. (MLB) Yes. I disagree with Ms. Henshel's allegations that there are a significant number of inadequacies in the collection, management, and interpretation of the data collected in the Deer Tissue Sampling Study.

First, I do not agree that the data presented in the Deer Tissue Sampling Results Report (SAIC 2006) are indicative of DU in deer collected from the Nearby Hunting Zones and the DU Impact Area. While Mr. Norris provides some qualitative discussion on DU ratios, he does not provide any specific discussion on other DU ratios that might be expected from nonmetallic DU media. No quantitative data are presented by Mr. Norris to support Ms. Henshel's contention that an average isotope activity ratio of 0.61 "is consistent with the deer consuming groundwater from the area around the impact area, base flow from streams around the impact area, and vegetation that relies upon those same waters." In fact, he suggests further study is needed (starting on the bottom of page 78 of the Norris testimony) in this area rather than provide hard evidence as suggested by Ms. Henshel. As he states on page 79 of his testimony "...fractionation during weathering of projectiles within soils and migration of weathered DU through the soils may alter isotope ratios for mobile and residual DU from the ratios of the metallic uranium in the projectiles." In A075, Mr. Norris states that in order to correct the alleged deficiencies (including fractionation) that "the tasks of studying any effects of fractionation should be added." While not contradictory, Mr. Norris, in recommending further fractionation study, does not support Ms. Henshel's assertion that the deer data are indicative of DU uptake.

Second, ERM program data for groundwater show that the U-238/U-234 ratio is about 0.5. This is normal, expected, well documented, and reflects the presence of natural U, not DU. If DU were present, the ratio would be greater than 1 and around 6, not less than one. The effect of fractionation only brings into question a result with a ratio that is in excess of 1, not one that is less than one. Please see Harry Anagnostopolous's testimony for specific details on the ratios associated with DU.

Q34. Do you agree or disagree with Ms. Henshel's claim, in her Answer 28, that the Army has failed to meet the accuracy data quality objective in the laboratory analysis?

A34. (MLB) I disagree.

Ms. Henshel claims that the Army failed to meet the accuracy data quality objective (DOQ) in the laboratory analysis. Specifically, STV provides a long listing of discrepancies for the requirement for a relative percent difference (RPD) of less than 50 percent between all duplicate samples. After discussing Ms. Henshel's contention with the technical staff, I have determined that she has confused accuracy with precision. Field duplicate samples are collected and analyzed to measure precision. STV is correct in stating that the goal for precision in biota samples is an RPD of less than 50 percent. Unfortunately, Ms. Henshel may not have read FSP (SAIC 2005a), Appendix A.3.2.2., which states, "The relative percent difference (RPD) between two positive results will be calculated and used as a QC indication of the field procedures, matrix effects, and precision of the analyses conducted."

The Deer Tissue Sampling Results Report (SAIC 2006) did not calculate RPD values for the field duplicate samples because there were no positive duplicate results that could be compared and calculated. It is not clear why Ms. Henshel performed a calculation when no calculation was warranted or feasible.

The Quality Control Summary Report provided in the Deer Tissue Sampling Results Report (SAIC 2006) is correct as stated.

Furthermore, and as noted previously in the *Army Response To Amend Motion of Save The Valley, Inc., To Admit For Hearing Additional Contention B-2 and Supporting Bases A through G* on March 15, 2007, mislabeling of sample duplicates did not occur in the field. Rather, a duplicate kidney sample was collected from a different deer than the duplicate liver, bone, and muscle samples. There is no requirement to do so, nor does the collection of the duplicate kidney from another deer affect the validity of the results. It would have been perfectly acceptable to collect each tissue duplicate (muscle, liver, kidney, and bone) from a different deer

Q35. In your opinion, is Ms. Henshel correct in her assertion that the deer sampling failed to properly and consistently collect information on the deer samples as they were conducted?

A35. (MLB) No. The basis for my opinion is as follows.

There are valid reasons as to why the Army did not collect certain measurements in some areas during the deer tissue sampling. As noted previously in the *Army Response To Amend Motion of Save The Valley, Inc., To Admit For Hearing Additional Contention B-2 and Supporting Bases A through G* on March 15, 2007, ovary data were collected during the February 2006 sampling period at the request of USFWS, which wanted the ovary data for a research project being conducted by a student at Hanover College. There are no ovary data in the field logbooks for the DU Impact Area because USFWS did not request any ovary data in the fall of 2005. The Deer Tissue Sampling Results Report (SAIC 2006) did not discuss any of the ovary results because these data were not collected for the purposes of the Army's study nor were any of the ovaries analyzed for DU.

Ms. Henshel notes the lack of "spot radiation readings," which probably refers to dose-rate measurements taken on the deer samples in the field. These readings were documented in the field logbook for many samples, although these readings were not required in the field sampling procedure for the deer tissue study. The readings were taken with a dose-rate meter and such readings generally reflect the background radiation level of the surrounding area and add very little information about the tissue being sampled.

Spot radiation readings were not recorded for deer from the DU Impact Area. The reason is unknown and cannot be determined, since the employee no longer works for SAIC. Since we sampled the deer tissues for the presence of DU, the absence of spot readings does not affect the overall conclusions of the deer tissue sampling study.

Q36. In your opinion, is Ms. Henshel correct in her assertion that the deer sampling was inadequate for failure to fully collect, preserve and analyze information about the deer sampled so that a more accurate assessment of potential ecological impacts could be made?

A36. (MLB) In my opinion, she is not correct.

The purpose of the study was to collect deer tissue samples and analyze them for DU. This was specifically discussed in the FSP (SAIC 2005a) and FSP Addendum (SAIC 2005b) and agreed to by NRC. There was no intent to collect data for use in evaluating the health of the deer population. Furthermore, Ms. Henshel continues to suggest, yet not directly state, that certain important pieces of information were not collected from the DU Impact Area, constituting willful omission by the Army. This is just not true.

As noted previously in the *Army Response To Amend Motion of Save The Valley, Inc., To Admit For Hearing Additional Contention B-2 and Supporting Bases A through G* on March 15, 2007, ovary data were collected during the February sampling period at the request of the USFWS, which wanted the ovary data for a research project being conducted by a student at Hanover College. There are no ovary data in the field logbooks for the DU Impact Area because USFWS did not request any ovary data in the fall. Why did USFWS only request ovaries in February and not in November/December? Ms. Joseph Robb, USFWS, indicated to me at the time that there were few data on ovaries during

February. I surmise this is because February is out of hunting season. The Deer Tissue Sampling Results Report (SAIC 2006) did not discuss any of the ovary results because these data were not collected for the purposes of the Army's study nor were any of the ovaries analyzed for DU.

Given all the alleged deficiencies in the deer tissue sampling report and the "meager" sample size, Ms. Henshel certainly uses the results to make specific conclusions about the health of the deer population at JPG. This is a very important point. She is using a study intended to measure DU in tissues, not the health of the population, and makes numerous claims about the insufficiency of the study and the sample size, yet she makes a number of assertions about the health of the population. Based on the above, her assertions are speculation.

For example, she claims that the fecundity data indicate 0 percent in the DU Impact Area. This is incorrect. Although four females were collected in the DU Impact Area, their ovaries were not examined to determine if they were or were not pregnant. There are no data with which to state that fecundity in the DU Impact Area samples is zero. In the end, this is not a failure of the deer tissue study to test a hypothesis of DU uptake by deer (the stated objective of the study), but a failure to study the potential effects of DU on the deer population as deemed necessary by Ms. Henshel.

While stating that the Army's sample size of **30** deer is "meager", she does not specify what might be acceptable. If DU had been detected in the deer then another round of sampling might have occurred. Due to funding constraints the Army cannot just collect 100 or 1000 deer and sample their tissues. The tiered approach is cost-effective and reasonable from a scientific approach. Target certain areas of deer and review the results. If no DU was detected in any of the 30 deer collected at JPG, there is no sense in collecting additional deer. More than likely, the sample size is "meager" because it does not suit the purposes of Ms. Henshel's desire for an extensive DU research program. I note that in a similar deer study at the future Rocky Flats National Wildlife Refuge, which was formerly used as a nuclear weapons research, development, and production facility, USFWS collected **26** total deer to investigate tissue concentrations of the isotopes of americium, plutonium, and uranium (Todd and Sattelberg 2005). These deer were collected to determine if hunting could be a future recreational use at the Refuge.

Q37. In your opinion, is Ms. Henshel correct that the deer sampling data is deficient in not assessing bioaccumulation?

A37. (MLB) In my opinion she is not correct.

Q38. What is the basis for your opinion?

A38. (MLB) Bioaccumulation analysis was not part of the study objective as outlined in the FSP (SAIC 2005a) and FSP Addendum (SAIC 2005b). Moreover, no DU was detected in the deer tissue samples. Without the detection of DU, there is no benefit to bioaccumulation analysis. Furthermore, bioaccumulation rates are not needed to revise RESRAD.

Q39. In your opinion, has projectile-derived uranium moved into the JPG deer population, as asserted by Ms. Henshel in her Answer 32?

A39. (MLB) In my opinion, based on the data available, projectile-derived uranium has not moved into the JPG deer population.

Q40. What is the basis for your opinion?

A40. (MLB) As discussed in my Answer 34, the Army maintains that no DU was observed in the deer tissues (SAIC 2006). As I have noted above, there are no significant deficiencies in the deer tissue study based on the Army's objectives. To the contrary, the Army corrected some deficiencies in the previously collected deer samples at JPG in other studies. First, muscle tissue, although not as likely to accumulate DU but most likely to be consumed in the greatest quantities by humans, was sampled for the first time at JPG. In addition, liver, kidney, and bone, three other tissues more likely to show uptake, were sampled as they had been previously. Second, the Army collected 30 deer. The previous yearly high was 16 deer in 1987. Third, deer were collected from all areas of JPG, including those most likely impacted by DU. This study was designed to detect DU if it was present in the deer and determine if hunters were at risk. The study met these objectives.

Given all the alleged deficiencies she finds in the Deer Tissue Sampling Results Report (SAIC 2006), I question the definitive nature with which Ms. Henshel claims that the study proved the presence of DU. At best, if the study is as flawed as she claims, then no definitive conclusions could be made and this would be the reason to collect another round of deer samples. She fails to provide quantitative support for why certain ratios might be indicative of DU.

In the larger context of her argument, she claims other biota should be sampled. First, there is no regulatory requirement by NRC for such sampling. The Army is not conducting an ERA nor biological research program. With the FSP (SAIC 2005a) as configured, adequate data will be collected to revise the RESRAD model.

VII. SUMMARY AND CONCLUSION

As to Basis Item "o"

Q41. Please summarize your testimony with regard to Basis Item "o".

A41. (MLB) I disagree with the basis that ERA sampling principles need to be followed because they are not required by NRC guidance nor warranted at JPG, as previously noted in my response to Basis Item "n". The abiotic data collected according to the FSP (SAIC 2005a) and FSP Addendum (SAIC 2005b) will be technically sufficient to revise the RESRAD model to determine if DU is a potential concern to public health.

The specific points raised by STV to support other biota sampling either are not supported by data or represent incomplete exposure pathways to human receptors. As a result, they do not support the need for additional biota sampling.

VIII. REFERENCES

Q42. In your testimony you referred to several documents. Would you specifically identify those documents?

A42. (MLB) Yes.

1. D'Angelo, Gino, J., John C. Kilgo, Christopher E. Comer, Cory D. Drennan, David A. Osborn, and Karl V. Miller. 2003. Effects of controlled dog hunting on movements of female white-tailed deer. In: Proceedings of the Annual Conference Southeast. Association of Fish and Wildlife Agencies. 57:317-325. Attached as Exhibit MLB #2.

2. Ebinger, M. and W. Hansen. 1996. JPG Data Summary and Risk Assessment. Submitted to the U.S. Army Test and Evaluation Command by Los Alamos National Laboratory, New Mexico. Attached as Exhibit MLB #3.

3. NRC. 2006. Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria. NUREG-1757, Vol. 2, Rev. 1. Final Report. Division of Waste Management and Environmental Protection, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

4. Science Applications International Corporation (SAIC). 2005a. Field Sampling Plan, Site Characterization of the Depleted Uranium Impact Area. Final. May.

5. SAIC. 2005b. Field Sampling Plan Addendum 1, Site Characterization of the Depleted Uranium Impact Area. Final. November.

6. SAIC 2006. Deer Tissue Sampling Results Report, Depleted Uranium Impact Area Site Characterization, Jefferson Proving Ground. Final. August.

7. SEG (Scientific Ecology Group). 1995. JPG Depleted Uranium Impact Area, Scoping Survey Report. Volumes 1-3. March., Florida. Attached as Exhibit MLB #4.

8. SEG. 1996. Jefferson Proving Ground Depleted Uranium Impact Area Characterization Survey Report. Volume 1. Oak Ridge, Tennessee. February. Attached as Exhibit MLB #5.

9. Todd, A.S., and Sattelberg, M. 2005. Actinides in Deer Tissues at the Rocky Flats Environmental Technology Site. Integrated Environmental Assessment and Management 1(4):391-396. Attached as Exhibit MLB # 6.

Q43. Does that conclude your testimony?

A43. (MLB) Yes, it does.

BARTA TESTIMONY

EXHIBIT MLB #1

Résumé

MICHAEL L. BARTA

EDUCATION:

M.S., Zoology, Ohio State University, 1992
B.A. and B.S., Zoology, Miami University, 1989

ADDITIONAL TRAINING:

40-Hour OSHA Hazardous Materials Training
8-Hour OSHA Hazardous Materials Supervisor Training

SECURITY CLEARANCE: None

EXPERIENCE SUMMARY:

Mr. Barta has 15 years of experience as an ecological risk assessor. He manages and provides technical support on ecological risk assessments (ERAs) conducted for Remedial Investigations/Feasibility Studies (RI/FSs) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFIs). These assessments typically focus on hazardous waste sites. His primary responsibility is evaluating potential adverse effects to aquatic receptors and terrestrial wildlife posed by these waste sites. He is currently the ecological lead at Army installations in Arkansas, Illinois, and Indiana and at an Air Force installation in New Jersey. Mr. Barta also serves as the deputy project manager on range condition assessments at U.S. Navy installations in Virginia and California. Prior to joining SAIC, Mr. Barta spent 7 years with ICF Kaiser Engineers as an ecological risk assessor. He was the lead scientist on 21 ERAs and provided technical support on an additional 21 ERAs. These assessments most often occurred in Florida, Maryland, New Jersey, and South Carolina.

In addition, Mr. Barta has designed field sampling plans, collected environmental samples, and conducted environmental audits. His academic background encompasses environmental toxicology, biophysical ecology, and physiology. He has practical experience related to hazardous waste site investigations concerning the collection and evaluation of surface water, sediment, soil, groundwater, and biological samples.

PROFESSIONAL EXPERIENCE:

Ecological Risk Assessment

Lead Ecological Risk Assessor, U.S. Army Corps of Engineers, Louisville District, Savanna Army Depot, Savanna, Illinois. Currently evaluating potential ecological risks associated with past activities at over 100 sites at Savanna Army Depot. Risks have been calculated for exposures to surface soil, surface water, sediment, biota, and air. More than 50 screening-level ERAs and 7 baseline ecological risk assessments (BERAs) have been completed. Designed ecological sampling work plans that included surface water, sediment, and surface soil bioassays, benthic community assessments, and fish tissue studies.

Lead Ecological Risk Assessor, DOE, Pantex Plant, Amarillo, Texas. Conducted 15 Tier 2 screening-level ecological risk assessments (SLERAs) at solid waste management units (SWMUs) at Pantex Plant following the Texas Commission on Environmental Quality (TCEQ) guidance. A cumulative Site-wide ERA also was conducted and focused on risks to wide-ranging receptors from exposures to contaminants at multiple playas (basins that periodically contain water). Developed a unique quantitative approach for evaluating the Texas Horned Lizard, a state-threatened species. Ten of the Tier 2 SLERAs went from draft final to final with no revisions. The limited number of regulatory comments were resolved either through comment responses or based on changes incorporated into the final five Tier 2 SLERAs and the Site-wide ERA. Less than 10 regulatory comments received on the 2,500 page Site-wide ERA.

Lead Ecological Risk Assessor, U.S. Army Corps of Engineers, Baltimore District, Picatinny Arsenal, Dover, New Jersey. Managed an ERA for 57 sites at Picatinny Arsenal. Designed the ecological sampling work plan that included surface water, sediment, and surface soil bioassays, benthic and fish community assessments earthworm and fish tissue bioaccumulation studies, and terrestrial habitat surveys. Work plan incorporated data for each sample location on GIS plots. Coordinated sampling efforts and personally collected over 90% of the biological data. Responsible for writing work plan, responding to Army and regulatory comments, evaluating subcontracting bids, tracking subcontractor costs, evaluating data, oversight of GIS staff (both external and internal), and report preparation. Investigated whether a large number of explosives compounds (e.g., RDX, HMX, 2,4,6-TNT, and nitroglycerin) in Picatinny Lake were adversely affecting benthic macroinvertebrates. Also evaluated potential risks to the endangered Indiana bat through potential food-chain consumption of mercury, PCBs, and pesticides. Extensive negotiations with USFWS, USEPA Region II, and NJ Department of Environmental Protection resulted in the collection of insects for tissue analysis. The results were used in the food-chain model to provide a more accurate estimate of the potential risk to Indiana bats.

Lead Ecological Risk Assessor, U.S. Army Corps of Engineers, Louisville District, Newport Chemical Depot, Newport, Indiana. Evaluated potential ecological risks associated with past activities at nine SWMUs at Newport Chemical Depot. Risks were calculated for exposures to surface soil, surface water, and sediment. Chemical data from surface water suggested the potential for adverse effects to aquatic receptors in Little Raccoon Creek. As a result, a semi-quantitative benthic survey was conducted in Little Raccoon Creek to aid in the decision-making process. Successfully negotiated with USFWS concerning soil clean-up levels for lead and mercury at two SWMUs.

Lead Ecological Risk Assessor, Program Manager for Chemical Demilitarization (PMCD), Pine Bluff Chemical Disposal Facility (PBCDF), Pine Bluff, Arkansas. Leading SAIC's ecological risk team in providing risk-based decision support tools for evaluating human health and ecological health risk related to the emissions from PBCDF, an incinerator that will be used to dispose of U.S. chemical agent stockpile and related iteDr. SAIC has developed a custom-built database-driven tool for rapid assessment of human health and ecological scenarios that uses advanced fate and transport modeling to assess the incinerator stack emissions. Evaluated the ecological risks predicted based on different operational scenarios in the baseline risk assessment. Currently waiting on trial burn data in order to revise risks.

Lead Ecological Risk Assessor, U. S. Army Environmental Command (USAEC), Fort Dix, New Jersey. Evaluated potential ecological risks associated with past activities at nine areas requiring environmental evaluation (AREEs) at Fort Dix. Risks were calculated for exposures to surface soil, surface water, and sediment. The AREE of greatest concern was the PDO Landfill, which was directly upgradient of a wetland. Chemical data from surface water and sediment suggested the potential for adverse effects to aquatic receptors. However, the results of surface water and sediment bioassays in conjunction with a qualitative benthic survey suggested that adverse effects would be limited in this stream. In order to determine if long-term monitoring was a viable option in the Alternatives Analysis, additional chemical (surface water and sediment) and biological (sediment bioassays) analyses were conducted.

Ecological Risk Assessor – Technical Support, Defense National Stockpile Center (DNSC), Mercury Management Environmental Impact Statement (MM EIS). The DNSC of the Defense Logistics Agency maintains stockpiles of 65 essential industrial commodities. The mercury stockpile consists of 4,890 tons of pure elemental mercury sealed in steel flasks in four warehouses. The warehouses are located at the Somerville Depot near Somerville, New Jersey; the Casad Depot near New Haven, Indiana; the Warren Depot near Warren, Ohio; and the DOE's Y-12 National Nuclear Security Complex in Oak Ridge, Tennessee. The ERA provided an evaluation of potential releases, exposures, and ecological consequences related to activities involved in managing the mercury stockpile, including potential accidents associated with those activities. The results were used in the MM EIS to facilitate comparisons between several alternatives for disposition of the mercury stockpile. The ERA evaluated plants, soil invertebrates, short-tailed shrew, American robin, red-tailed hawk, great blue heron, aquatic biota, and sediment-dwelling biota.

Lead Ecological Risk Assessor, AEC, Cornhusker Army Ammunition Plant, Grand Island, Nebraska. Evaluated ecological risks at Cornhusker Army Ammunition Plant (CAAP), Grand Island, Nebraska. Assessment primarily focused on surface soil contamination as there were limited surface water bodies at CAAP. Although potential for adverse effects existed, the areas with contamination were generally considered to have poor quality habitat due to past and present uses (e.g., industrial operations) and/or an abundance of manmade structures. As a result of the poor quality habitat, extensive use of these areas by terrestrial receptors was not expected. In addition, terrestrial receptors would more likely occur in areas adjacent to sites, such as cropland or shelterbelt areas, where the habitat quality was better, food was more plentiful, and chemical contamination was expected to be minimal or nonexistent. As a result, ERA results were not a risk driver in the FS.

Lead Ecological Risk Assessor, USEPA Region IV, Lake Hartwell, South Carolina. Assessed potential ecological impacts to aquatic and terrestrial receptors associated with a PCB-contaminated lake and watershed. Site-specific biological investigations including bioindicator analyses, fish health assessment indices, and family-level macroinvertebrate bioassessments were the primary basis for evaluating potential adverse impacts to aquatic receptors. Terrestrial wildlife that may consume PCB-contaminated fish (i.e., mink and green-backed heron) also were evaluated.

Ecological Risk Assessor – Technical Support, DOE, Savannah River Site and Idaho National Engineering Laboratory (INEL). Completed a qualitative evaluation of current and future ecological risks posed by existing conditions at two DOE weapons installations, the Savannah River Site and the Idaho National Engineering Laboratory. Results of this investigation, which included reviews of existing ecological risk assessments, current environmental monitoring data, and supporting documentation, as well as interviews with site personnel, were supplied to DOE for their 1995 Report to Congress. At Savannah, ecological units were delineated based upon a watershed approach. At INEL, the analysis focused on subsurface soil, surface soil, and surface water. Radionuclides received the most evaluation as previous INEL studies focused on these contaminants.

Lead Ecological Risk Assessor, U.S. Army Corps of Engineers, Baltimore District, Green Pond Brook & Bear Swamp Brook Feasibility Study Data Gap Work Plan, Picatinny Arsenal, Dover, New Jersey. Primary author of data gap work plan in which 39 sediment samples, 14 surface water samples, and a limited number of geotechnical samples were planned for collection in the winter of 1999. There are few potential exposures to humans in the study area so the FS was driven by ecological concerns. Data from field investigations in 1993 to 1997 were used to create extensive GIS plots in order to assess data gaps. Responsible for writing work plan, responding to Army and regulatory comments, oversight of GIS staff, and coordination with engineering staff.

Lead Ecological Risk Assessor, Private Client, Bayonne, New Jersey. Evaluated potential ecological impacts associated with emissions from an operating chemical waste incinerator. Assessment focused on food-chain exposures to aquatic and terrestrial wildlife species and surface water exposures to aquatic species.

Lead Ecological Risk Assessor, USEPA Region IV, Leeds, Alabama. Estimated potential ecological impacts to terrestrial and aquatic receptors at a former lead smelter site for USEPA Region IV. Although comparisons of surface water and sediment concentrations to toxicity reference values suggested that aquatic receptors might be adversely affected by lead, site-specific biological testing (benthic macroinvertebrate surveys and toxicity tests) indicated that no significant observable adverse effects seemed to be occurring.

Lead Ecological Risk Assessor, AEC, Aberdeen Proving Ground, Maryland. Estimated potential adverse effects to terrestrial plants, soil invertebrates, shrews, robins, and aquatic receptors for five separate ERAs in the Edgewood Area and 1 ERA in the Aberdeen Area, Aberdeen Proving Ground, Maryland. Southern Bush River Area, Northern Bush River Area, Lauderick Creek Area, Western Boundary Area, Cluster 3, and Cluster 4 each were evaluated and submitted as separate reports. These ERAs relied primarily on abiotic chemical data to estimate hazards to plants and wildlife.

Ecological Risk Assessor – Technical Support, Private Client, Louisiana. Provided technical support on a SLERAt for a private client proposing to burn sulfuric acid in an incinerator. Risks from exposure to emissions were calculated for terrestrial plants, earthworms, aquatic receptors, raccoon, American woodcock, and great blue heron.

Ecological Risk Assessor – Technical Support, USEPA Region II. Reviewed several ERA and sampling plans under the ARCS II contract (Passaic River Site, Jones Sanitation Site, Rosen Brothers Site, and General Motors Powertrain Site). The risk assessment reviews focused on data evaluation, selection of chemicals of potential concern (copcs), and an evaluation of exposure pathways. The ecological sampling plan reviews focused on sampling rationale, strategies, and endpoints.

Chemical Research and Assessment

Ecological Risk Assessor – Technical Support, USEPA. Evaluated the ecological effects of trichloroacetic acid (TCAA) in the environment. This review paper included methods for quantifying TCAA in aqueous and solid samples, possible routes of formation through natural processes, as well as summaries of concentrations in various environmental media. Concentrations of TCAA found to be toxic to aquatic and terrestrial organisms in laboratory and field studies were compiled. This report was ultimately submitted and accepted for publication in *Environment International*.

Lead Ecological Risk Assessor, USEPA Region IV, North Miami Beach, Florida. Assessed the potential for adverse effects to aquatic receptors from exposure to ammonia in a mangrove preserve located adjacent to a municipal landfill. Site-specific ambient water quality criteria (AWQC) were modified based on ph, salinity, and temperature data and compared to measured concentrations of total ammonia. Toxicity test data for inland silverside minnow and microalgae were also evaluated. Presented results of the study for USEPA Region IV at three public meetings.

Ecological Risk Assessor – Technical Support, Private Client, Alabama. Evaluated DDTR residues in wildlife and subsequent toxic effects at a Superfund site located in southern bottomland wetland habitat. More than 300 scientific articles were reviewed to evaluate potential food-chain impacts to crustaceans, fish, amphibians, reptiles, birds, and mammals.

Ecological Risk Assessor – Technical Support, USDOI, Alaska. Assessed the potential short- and long-term impacts of the Exxon *Valdez* oil spill on subsistence fish (Chinook salmon and Pacific cod) and shellfish (Spot shrimp) used by native Alaskan groups. After identification as important subsistence species, the habitats and ecological characteristics of each species then were described. Characterization of habitat and impact relied heavily upon the results of Natural Resource Damage Assessment (NRDA) studies. Toxicity data from the literature were used to augment the results of the NRDA studies.

Modeling

Lead Ecological Risk Assessor, USEPA Region IV, Lake Hartwell, South Carolina. Developed an aquatic food web that was used in the USEPA's Fish Gill Exchange of Toxic Substances (FGETS) model to assess the bioaccumulation of PCBs at a Superfund site. After determining the appropriate food web, morphometric, physiologic, and trophic parameters were selected from the literature if site-specific data were unavailable.

Ecological Risk Assessor – Technical Support, Private Client, Illinois. Reviewed ERA in support of litigation. Project focused on food-chain impacts to red-winged blackbird and mink. Revised sections of the ERA based on regulatory comments. Stochastic uncertainty analysis was used to clarify the deterministic results.

Range Condition Assessments

Technical Support, U.S. Navy, San Clemente Island, California. Assisted with the preparation of a work plan, field sampling plan, quality assurance project plan, and health and safety plan in support of a 5-year Range Condition Assessment review. Due to the potential for off-range migration, sampling for explosives constituents will occur in tributaries throughout a bombing range.

Technical Support, U.S. Navy, Naval Surface Warfare Center Dahlgren, Dahlgren, Virginia. Assisted with the preparation of a work plan in support of an initial Range Condition Assessment. Prepared the compliance assessment for natural resources. Assessed the potential for off-range migration through the development of operational range site models (ORSMs).

Human Health Risk Assessment

Human Health Risk Assessor, U.S. Army Corps of Engineers, Louisville District, Jefferson Proving Ground, Madison, Indiana. Developed a work plan to investigate depleted uranium (DU) concentrations in deer muscle, kidney, liver, and bone. In a collaborative effort with USFWS, 10 deer each were collected in a DU testing area, adjacent hunting zones, and background hunting zones. DU was not detected in any tissue samples. In addition, total uranium levels were not elevated in the samples collected from the DU testing area, the area where the greatest potential for exposures occurred.

Human Health Risk Assessor – Technical Support, DOE, Savannah River Site, Brookhaven National Laboratory, and Argonne National Laboratory-East. Developed Conceptual Site Models (CSMs) for three DOE facilities that were used by Pacific Northwest Laboratories (PNL) in their Baseline Environmental Management Report (BEMR). Analyzed data from the Savannah River Site, Brookhaven National Laboratory, and Argonne National Laboratory-East for information concerning waste types, release mechanisms, source locations, receptor pathways, and contaminants of interest. Information in the CSMs was input into the MEPAS program by PNL to develop unit risk factors (URFs) for these sites.

Environmental Audits

Environmental Auditor and Manager – Texas Commerce Bank, Houston, Texas. From 1993 to 1997, conducted a review of 38 environmental audit questionnaires of gasoline stations as part of a loan application process. This work involved researching past, current, and future environmental compliance issues regarding the underground storage tanks (USTs) on-sites, as well as other on-site activities and evaluating potential environmental liabilities. Research also involved Federal and state UST regulations and applicability of state UST Trust Funds. From 1995 to 1998, performed day-to-day oversight activities of the program, including selecting auditors, responding to client questions and needs, training new auditors, and preparing technical memoranda. From

1998-1999 acted as the co-Program Manager in charge of trouble shooting, qualifying properties, training auditors, cost estimating with the client, and internal marketing.

Environmental Auditor, GTE, Michigan, Indiana, Illinois, and Georgia. Conducted an environmental audit of 240 telephone company properties for GTE in Michigan, Indiana, Illinois, and Georgia by telephone. County health and local fire officials were interviewed about site information concerning chemical spills, leaking USTs, groundwater contamination, and groundwater depth.

Environmental Auditor, Lederle Labs, Pearl River, New York. Performed an air emissions audit at a chemical and pharmaceutical company in Pearl River, New York. Responsible for verifying old permits, writing new permits, and inspecting emissions sources and points.

MISCELLANEOUS TRAINING:

Rapid Bioassessment Protocols. 1998. Virginia Commonwealth University.

A Way of Seeing: The Study of Birds. 1997. Fairfax (VA) Audubon Society.

Society of Environmental Toxicology and Chemistry (SETAC) Shortcourses:
Sediment Toxicity Testing: Methods to Achieve Strong Data Sets and Interpret Results (2004);
Evaluation of Ecological Effects in Surface Water-Ground Water Transition Zones (2000);
Soil Toxicity Evaluation: Current Practice and Applications (1999);
Responses to Common Questions Regarding Data Analysis and Interpretation of Toxicity Tests (1998);
Practical GIS for the Non-GIS Professional (1997);
Interspecies Toxicity Extrapolations for Terrestrial Systems (1996);
Ecological Risk Assessment at Contaminated Sites (1995);
Environmental Fate Data, Estimates, and Assessments (1994);
and The Principles of Radioecology: Studying the Fate and Effects of Radioactive Contaminants in the Environment (1993).
Research and Teaching Associate, Ohio State University Department of Zoology, 1989-1992.
CPR Training
First-Aid Training

CUSTOMERS:
Air Force Center for Environmental Excellence (AFCEE)
U.S. Army Corps of Engineers, Louisville and Baltimore Districts
U.S. Department of Energy (DOE)
U.S. Army Environmental Center (AEC)

U.S. EPA Region IV
U.S. Navy
BWXT Pantex

AFFILIATIONS:

SETAC
Sigma Xi

PUBLICATIONS:

Cornaby, B.W., C. T. Hadden, and M. L. Barta. 2004. Cases histories from the ecological risk assessment world. Society for Risk Analysis meeting. December 5-8, Palm Springs, CA.

Lewis, T.E., Wolfinger, T.F., and Barta, M.L. 2004. The Ecological Effects of Trichloroacetic Acid in the Environment. Review Article. Environment International 30:1119-1150.

Barta, M. 2000. Benefits of the Triad Approach at Picatinny Lake, Picatinny Arsenal, New Jersey. Presented at the 21st annual SETAC meeting.

Barta, M., and J. Mitchell. 1997. Ammonia Toxicity from Landfill Leachate in a Mangrove Preserve. Presented at the 18th annual SETAC meeting.

Barta, M., and Mayernik, J. 1995. Lead hazard quotients in contradiction with site-specific biological results. Presented at the 16th annual SETAC meeting.

Barta, M., and M. Woolfolk. 1994. Calculating Sediment Clean-Up Criteria by using USEPA's Food and Gill Exchange of Toxic Substances (FGETS) Modeling Program. Presented at the 67th Annual Conference Exposition of the Water Environment Federation.

Barta, M., and G. Drendel. 1994. Ecological Risk Assessment of PCB-Contaminated Lake Hartwell, SC. Presented at the 15th annual SETAC meeting.

Barta, M., and Woolfolk, M. 1994. Biologically-Based Target Sediment Concentrations for a Southeastern Lake. Presented at the 15th annual SETAC meeting.

Woolfolk, M., Barta, M., and Drendel, G. 1994. Modeling the Accumulation of PCBs in Largemouth Bass from Lake Hartwell, SC. Presented at the 15th annual SETAC meeting.

WORK HISTORY:

2003 to present, Senior Ecological Risk Assessor, SAIC, Memphis, Tennessee
2001 to 2003, Risk Assessment and Data Validation Section Manager, SAIC, Reston, Virginia
1999 to 2003, Ecological Risk Assessor, SAIC, Reston, Virginia
1992 to 1999, Ecological Risk Assessor, ICF Kaiser Engineers, Fairfax, Virginia

Exhibit MLB #2

D'Angelo, Gino, J., John C. Kilgo, Christopher E. Comer, Cory D. Drennan, David A. Osborn, and Karl V. Miller. 2003. Effects of controlled dog hunting on movements of female white-tailed deer. In: Proceedings of the Annual Conference Southeast. Association of Fish and Wildlife Agencies. 57:317-325.

Michael L. Barta Testimony

Exhibits MLB #2, MLB #3, MLB #4, MLB #5, and MLB #6 contain copywrite information and were not placed in ADAMS.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before Administrative Judges:

Alan S. Rosenthal, Chair
Dr. Paul B. Abramson
Dr. Richard F. Cole

In the Matter of	)	Docket No. 40-8838-MLA
	)	
U.S. ARMY	)	ASLBP No. 00-776-04-MLA
	)	
(Jefferson Proving Ground Site)	)	August 15, 2007
	)	

TESTIMONY OF HAROLD W. ANAGNOSTOPOULOS ON STV CONTENTION B-1, BASIS ITEM "m" AND ON CERTAIN TESTIMONY OF HENSHEL AND NORRIS

Subjects: Air Sampling; Sample Collection and Analysis

I. WITNESS BACKGROUND

Harold W. Anagnostopoulos ("HWA")

Q1. Please state your full name.

A1. (HWA) My name is Harold W. Anagnostopoulos.

Q2. By whom are you employed and what is your position?

A2. (HWA) As of August 13, 2007, I work as a Senior Health Physicist with the S.M. Stoller Corporation. Previously, I worked at Science Applications International Corporation (SAIC) in their St. Louis office. SAIC acts as the Army's technical consultant and expert on selected tasks related to the planned decommissioning of the U.S. Nuclear Regulatory Commission (NRC) materials license at the Jefferson Proving Ground (JPG).

Q3. Please summarize your professional and educational qualifications.

A3. (HWA) My professional and educational experience is summarized in the résumé attached to this testimony as HWA Exhibit #1. Briefly summarized, I am certified by the American Academy of Health Physics as a Board Certified Health Physicist. I have been practicing health physics for approximately 21 years and I have been certified for 11 years. I also was registered as a Radiation Protection Technologist (RPT) in 1993. I have experience in the operation and maintenance of nuclear power reactors, the decommissioning of nuclear facilities, and emergency response. Most recently, I have served as a task manager and technical expert for the post-remediation verification of radiologically contaminated soils under a U.S. Army Corps of Engineers (USACE) Formerly Used Remedial Action Program (FUSRAP) project.

Q4. Please summarize the nature of your professional involvement with JPG.

A4. (HWA) I have been providing technical support to the Army's JPG facility since early 2004. I have visited JPG on several occasions, participated in field work, toured the Depleted Uranium (DU) Impact Area, and personally examined a DU penetrator embedded in soils in the DU Impact Area.

Q5. What is the purpose of your testimony?

A5. (HWA) The purpose of my testimony is to address, on behalf of the Army, radiological issues at JPG as raised by Save The Valley (STV) as part of its Contention B-1 in these proceedings. Specifically, my testimony will provide evidence and expert opinion refuting evidence offered by STV in support of its Basis Item "m" and evidence offered by STV concerning the adequacies of the radiological aspects of the Army's sampling program.

II. OVERVIEW

Issues Raised By Basis Item "m" to STV Contention B-1

Q6. What is your understanding of the technical issues raised by Basis Item "m" of STV's Contention B-1?

A6. (HWA) In Basis Item "m" to its contention B-1, STV asserts that the air pathway is a significant exposure pathway at JPG and that the license amendment for an alternate decommissioning schedule should not be approved unless the Army is required to perform air sampling and analysis specifically related to the controlled burns at JPG.

Q7. Do you agree with the assertion that the Army should be required to perform air sampling and analysis specifically related to the controlled burns at JPG?

A7. (HWA) No.

III. DISCUSSION

Air sampling

Q8. What is the basis for your disagreement?

A8. (HWA) First let me say that the air pathway is nearly always a potential pathway for nearly any contaminant and situation. The question is whether the air pathway is a significant pathway at JPG and whether special monitoring is required. Section 4.2.2.1 of the Army's Health and Safety Plan (HASP) does not set any requirements for air sampling for field workers. This section of the HASP clearly states that airborne radioactive contamination is unlikely and reminds the Radiation Protection Manager (RPM) to assess the need for personnel air sampling and/or respiratory protection as site conditions warrant. One objective of personnel air sampling is to assess potential exposures. Such sampling often is conducted solely for the purposes of collecting negative data (that is, to prove that no exposure occurred). A reminder note in a HASP does not constitute evidence that airborne distribution of uranium contamination is a significant pathway.

I strongly disagree with STV's statement that, because of controlled burns at JPG, "*...conditions are prime for enhancing migration of soil-bound DU into the* air." STV has not identified these prime conditions at JPG nor given evidence that they exist and are significant.

The first (and later, the second) Los Alamos National Laboratory (LANL) study cited by STV (reference 12) also does not support the assertion that the air pathway is significant. To begin, the calculations provided in the study involved numerous assumptions. Some of the more significant assumptions include:

- Tree thinning at LANL with 20 percent bare soil in thinned areas.
- Average soil uranium concentration of 6 pCi/g with a high-end average concentration of 3,000 pCi/g at the firing line.
- Assumption of five times more uranium in the airborne dust than the soil.
- Exposed workers spend their entire work year outdoors and near the burned areas.
- Per an e-mail from Mr. J.J. Whicker to Mr. P. Cloud (Exhibit HWA #2), the area at LANL in which the study data were collected contained aerosolized DU, which is not present at JPG.

The study did indeed estimate that potential doses to occupational workers at LANL increased by 38 percent. It is important to note that 38 percent was calculated using the upper bound of the airborne particulate estimates and applied only to the severely burned areas. This represented an absolute worst-case scenario at LANL and includes the assumptions provided in the bulleted list above. It is also unfortunate that the use of percentage values from the LANL study in STV's contention does not place the significance or impact of the increase into their proper perspective.

Q9. In your opinion, based on your education and experience, what is the proper perspective for evaluating the significance or impact of the increase in percentage found in the LANL study relied upon by STV.

A9. (HWA) The 38 percent increase at LANL means that the calculated dose rose from 10.2 to 14.0 mrem per year. The average annual exposure to the general population from natural and man-made sources of radiation in the United

States is approximately 360 mrem (reference 19). The calculated increase in dose at LANL from the severely burned areas is approximately 1 percent of what is received from natural and man-made sources of radiation each year and is insignificant.

The upper bound, however, should not necessarily be used for decision making as it does not represent the most likely condition. The "mean plus two standard deviations" values also were cited in the LANL study for the severely burned areas. Using these more likely estimates of the true values for airborne contamination, the increase in calculated dose rose from 0.044 to 0.06 mrem per year. This most likely calculated dose from the severely burned areas at LANL is approximately 0.004 percent of what is received from natural and man-made sources of radiation and is very insignificant.

Now both of these calculated increases include the assumptions from the bulleted list already mentioned. Unfortunately, the assumptions do not hold true for JPG because:

- There has been no systematic tree thinning and virtually no bare soil at JPG.
- The average soil concentration at JPG is most likely approximately 3 times lower than that estimated at LANL (reference 6) and high-end average concentrations of DU at JPG will be seen only at or under DU penetrators. This is because only soft targets were used at JPG.
- There is no known reason to assume that there is more uranium in airborne dust than in soil at JPG.
- It is unreasonable to assume that anyone will spend an entire working year in or near the controlled burn areas at JPG. In fact, the area is quite remote and access is limited.
- Finally, the land around LANL is markedly different in geological setting and flora than JPG. Comparisons to Aberdeen Proving Ground might be more reasonable for JPG.

Q10. In your opinion, based on your education and experience, what is the real issue with respect to STV's assertions of the need for air sampling of the controlled burns at JPG?

A10. (HWA) In my opinion, it seems that the real issue at hand is not the estimated increase in dose, but rather the idea that controlled burns will spread a notable amount of radioactive contamination outside the DU Impact Area. Data from the LANL study can be used to make estimates here as well.

The estimated air concentration (again, mean plus two standard deviations) in the severely burned areas at LANL was 4.2×10^{-6} Bq/m^3 (or 1.14×10^{-16} μCi/mL). This value is approximately 0.2 percent of the NRC limit on effluent concentrations in air from a radiological facility for the worst-case Class "Y" compounds of U-238. The NRC limit assumes that the emission is occurring continuously over an entire year; clearly that would not be the case for controlled burns at JPG.

Controlled burning (where DU might be present) probably occupies no more than 2 weeks of cumulative annual burn time (rather than the 50 weeks per year assumed in the NRC limit), so one can see that the 0.2 percent value for airborne emissions estimated earlier is in actuality much lower for JPG. Since airborne emissions at the NRC limit do not cause widespread contamination of the surrounding land area, airborne emissions that are a small fraction of the NRC limit and for only 4 percent of a year also will not cause widespread land contamination.

In order to obtain another estimate of the potential impact from controlled burns, the "Hotspot" health physics code was used to estimate the potential ground deposition from controlled burns at JPG. Assuming that the <u>entire DU Impact Area was burning</u> at one time and assuming meteorological conditions that would <u>maximize ground deposition</u> (i.e., 1 meter/second wind speed, Class F stability), the amount of uranium involved in the fire was varied until a time-integrated air concentration closest to the release point was roughly equal to the concentration seen in the estimates at LANL (i.e., 1.14×10^{-16} μCi/mL). The resulting estimated maximum ground surface deposition was 1.3 × 10^{-5} dpm/100 cm^2. This value is several orders of magnitude lower than can be detected with field instrumentation. The estimate using the "Hotspot" code is imprecise. Use of the FIREPLUME code would yield better results; however, the effort is clearly unwarranted.

Q11. Are you familiar with the testimony offered by Ms. Diane Henshel in this hearing?

A11. (HWA) Yes, I have reviewed her written testimony dated July 20, 2007.

Q12. Do you agree or disagree with her opinions and conclusions regarding the need for air sampling as a component of the characterization activities?

A12. (HWA) I disagree.

Q13. Starting with her Answer 34, in which she states her understanding of why there is no air sampling component in the FSP, do you agree with her comments there?

A13. (HWA) No. Ms. Henshel's testimony suggests that the Army's position (that the air exposure pathway is not significant) is based upon a single study (reference 3). That is an error in fact. In addition to that study, the Army's position is also based upon information from Gutierrez-Palmember, Inc. 1996 as cited in Section 5.16 of reference 3, and is based upon reference 4 and reference 5, which documents the results of air samples that were collected at JPG during controlled burns within the DU Impact Area. Most significantly, the determination that the air exposure pathway is not significant is documented in detail in a technical memorandum "Airborne Transport of Depleted Uranium (DU) and Site Characterization Needs," dated January 13, 2005 (reference 15). This technical memorandum pre-dates the FSP.

Q14. In Ms. Henshel's Answer 35, she states that the data that Army used to support its position that no air sampling is needed are outdated and that a more recent study done at LANL shows the need for such air sampling. Do you agree with her conclusions and reasoning?

A14. (HWA) No.

Q15. Please state the basis for your disagreement.

A15. (HWA) The data that were used by the Army (to determine that the air exposure pathway is not significant) are not outdated. The second LANL study cited by STV (reference 16) does not render the previous information invalid. In fact, the new information supports the assertion that the air exposure pathway is not significant at JPG. That is because the conditions at LANL represent a worst-case, bounding condition for airborne suspension of DU soil contamination (as compared to JPG), and the increase in dose from the airborne pathway at LANL, as described in the second study, was also insignificant. Ms. Henshel's testimony reflects an error in data use and interpretation.

Again, LANL represents a worst-case bounding condition as compared to JPG because:

1. The terrain and soil types at LANL are significantly different than at JPG. LANL is a dusty, arid environment, which optimizes the potential for airborne suspension of DU-contaminated dust.
2. The LANL fire was large. The burned area was approximately 30 million m^2 at LANL. The area of the entire DU Impact Area is 8.4 million m^2 (or 28 percent of LANL). The amount of burned area that is exposed to wind has a direct relationship with the amount soil dust that can go airborne. In addition controlled burns do not encompass the entire DU Impact Area in a single event.
3. Post-fire thinning of vegetation was performed at LANL, which exposed additional soils to the effects of wind erosion. This has not been done at JPG.
4. The nature of the DU contamination in the soil at LANL is different from JPG, since JPG did not use hard targets during ballistics testing.

The phrase "U-238 concentrations...have increased significantly...by about 10% since the Cerro Grande Fire" is a quote from the cited LANL report (reference 16, emphasis added). That quote might not have been presented in its proper context by Ms. Henshel. The significance that is being referred-to in the quotation is the statistical significance of the magnitude of the increase in airborne DU concentration, and not an evaluation of the magnitude of the impact of that increase on human health or the environment.

To add the missing perspective, the increase in airborne DU at LANL was insignificant from an exposure standpoint because:

1. The stated 14 percent estimated dose increase to the public from the airborne DU activity at LANL equates to a dose of 0.1 millirem. Again, the average annual dose to a member of the public in the U.S. from all sources of radiation is approximately 360 millirem (reference 19). The estimated increase at LANL from airborne DU in dust is approximately 0.03 percent of the average annual dose to a member of the public from all sources and is very insignificant. In comparison, a single commercial flight from New York to Los Angeles will result in a dose of about 3.5 millirem to a passenger (FAA CARI-6 program). The dose from the commercial flight is 3,500% higher than the dose added from airborne DU activity at LANL.
2. As a point of perspective as to potentially significant pathways for uranium exposure, the typical value for uranium in rock in the natural environment is 1.8 parts per million (ppm). The ores used to produce phosphate fertilizers contain uranium in the range of 8 to 400 ppm (reference 1, page 172). It is estimated that continued use of phosphate fertilizers could eventually double the radium and uranium content of farmlands (reference 1, page 174)! The direct application pathway for uranium in fertilizers is clearly more significant than a supposed (and disproved) airborne deposition pathway for uranium from fires at JPG in the DU Impact Area. If Ms. Henshel holds onto her beliefs about a build-up of uranium in human systems, it is troubling that she has not expressed concern about the "significant and toxicologically effective concentrations of uranium in

sensitive tissues of the body" that could occur from the widespread use of fertilizers on farmlands.

Q16. In Ms. Henshel's Answer 36, she maintains that the increase of DU dust in the LANL study was both measurable and significant. Do you agree?

A16. (HWA) No.

Q17. What is the basis for your disagreement?

A17. (HWA) Ms. Henshel's use of the phrase "not high enough by themselves to produce clearly significant adverse health effects" (emphasis added) is correct, but represents an error in data use and interpretation. It overstates the potential risk.

The increase in dose is 1/50,000th of the dose that can be safely received by an occupational radiation worker in the U.S in 1 year. This dose is 1/1,000th of that allowed in 1 year to a member of the general public under Federal Regulations (i.e., 10 CFR 20). The dose is so low as to be difficult to impossible to even measure with reasonable certainty.

The "Dust to Dose" paper (reference 16) documented that the amount of airborne DU in dust increased in a statistically significant way at LANL, following a major fire that was followed by tree thinning activities, which exposed soils to wind erosion. As already stated, the conditions at LANL have little bearing on those at JPG, with the exception of providing a worst-case bounding condition for comparison purposes. The increase from the additional airborne DU dust had no significance to dose.

Q18. Do you, then, agree or disagree with the opinion that Ms. Henshel expresses in her Answer 37 that the LANL study supports the need for air sampling at JPG?

A18. (HWA) I disagree.

Q19. Would you please state the basis for your disagreement?

A19. (HWA) Yes. A simple inspection of maps of the JPG area show that the fenced and controlled area for the JPG range begins at least 0.75 miles away from the nearest edge of the DU Impact Area. The residents mentioned by Ms. Henshel are well in excess of 2 miles away from the DU Impact Area, which is contained within a 55,000-acre facility, for which access is strictly controlled, and is surrounded by 48 miles of fence. The lands surrounding JPG are predominantly farmlands and woodlands (reference 6).

As stated in reference 15:

> *"Airborne transport of uranium involves particles. Vaporization is not a significant transport route because uranium metal has a boiling point of 3818°C. Powdered uranium metal may burn spontaneously in air, but larger pieces of metal, such as penetrators, require a heat source ranging from 700°C to 1000°C to produce ignition. A DU projectile creates very fine particles of uranium oxides (typically 75 percent U_3O_8 and 25 percent UO_2) upon impact or burning. These particles settle according to Stokes Law. The larger particles [> 5 micron] settle rapidly and travel only short distances through air because they are so dense (specific gravities of 8.3 and 10.96, respectively)."*

In addition, the airborne concentration will generally decrease with increasing distance from the source following a general inverse-square relationship. Ms. Henshel's testimony reflects an error in data use and interpretation.

Even assuming that chronic, low-level emissions of DU from the DU Impact Area via the air pathway are as postulated by Ms. Henshel, she has not established how that might cause someone to exceed 25 millirem per year, let alone how those exposures might be of a magnitude to cause adverse health effects. She has provided no evidence or estimate to show that the decommissioning criterion will be exceeded.

Contrary to Ms. Henshel's testimony, the Army can say with good assurance that the increased dose (if any) would be insignificant. This is based upon a combination of calculations, experience at other sites, <u>and actual air</u>

sampling that has already been conducted at the JPG site during controlled burns within the DU Impact Area (reference 4 and reference 5).

Most importantly, if Ms. Henshel is concerned with chronic low-level bioaccumulation of uranium in the local population, she might consider comparing the potential uranium exposure from the DU Impact Area (2 miles away) to the very real and somewhat significant human exposures that routinely occur due to the presence of natural uranium in well water, natural uranium in phosphate fertilizers, natural uranium from the fallout of coal fly ash, and natural uranium in foodstuffs. These routes of uranium exposure are likely to far outweigh the potential additional uranium burden from an airborne pathway from the DU Impact Area.

Considering that an average 1 square mile of earth that is 1 foot deep contains approximately 4 tons of natural uranium (reference 17), it seems logical that a natural source of uranium that is very close to the human receptor will cause more intake than an unnatural source of uranium (DU) that is physically quite remote from the receptor. Such uranium exposures from natural sources have been occurring over the entire age of man.

IV. SUMMARY AND CONCLUSION

As to Basis Item "m"

Q20. Please summarize your testimony with regard to Basis Item "m".

A20. (HWA) My testimony as to STV's Basis Item "m" can be summarized as follows:

Theoretical calculations and analysis of real data from a large-scale fire at LANL have suggested that the air pathway is not a significant exposure pathway at LANL or at JPG. More importantly, air sampling has been conducted during historical controlled burns within the DU Impact Area and little or no uranium was detected in the samples. Refer to references 3, 5, 6, 7, 8, and 11 for supporting information. These data have demonstrated that the air pathway is not significant.

V. OVERVIEW

Sample collection and analysis

Q21. Are you familiar with the testimony offered by Mr. Charles Norris in this hearing?

A21. (HWA) Yes, I have reviewed his written testimony dated July 13, 2007.

Q22. Do you agree or disagree with his opinions and conclusions regarding the inadequacy of the sample collection and analysis methods found in the Army's FSP?

A22. (HWA) I disagree, with two minor exceptions. Mr. Norris did identify a typographical error in the Field Sampling Plan (FSP), and he did correctly note that 1-gallon water samples are not being collected as described in the standard operating procedure (SOP) for the Environmental Radiation Monitoring Program. The significance and impact of these two issues will be described in my testimony.

Q23. Starting with his Answer 71, in which he states his opinion as to the inadequacies in the analysis of the samples, do you agree with his comments there?

A23. (HWA) No.

VI. DISCUSSION

Q24. Please state the basis for your disagreement.

A24. (HWA) Mr. Norris testifies that some samples are to be analyzed for gross gamma activity and uses sediment sample sites as an example. Mr. Norris may not fully understand this element of the FSP. A gamma sensitive sodium-iodide detector will be used to scan the stream beds and banks to look for areas of increased counting-rates, such as may occur with a deposit of DU in the sediments. These areas, if found, may be selected for biased sediment sampling. The actual analysis of a sample will be a laboratory analysis and will not involve gross gamma activity. The selection of the gamma scanning action level, in excess of background, is documented in Appendix C to the FSP and is based upon many years of experience in the detection of uranium contamination in soils and sediments.

Mr. Norris then testifies that the FSP is deficient in that the sample sizes are too small to provide an "unambiguous identification" of DU at low levels of contamination. He then cites a "reduced sample size" as the source of large reporting limit objectives.

First, the "unambiguous identification of DU at low levels" is not a stated objective of the FSP and is not necessary to characterize the DU Impact Area and surroundings. This "unambiguous identification" goal was asserted by STV and has not been accepted by the Army. In fact, such unambiguous identification of DU at levels that are near that which are expected in the natural background for natural uranium (and in the presence of natural uranium) presents several challenges, as will be explained later in my testimony.

Second, Mr. Norris has not stated what value of low-level contamination must be detected in order to have an acceptable characterization plan. Natural uranium can be present in rock at values of about 0.4 to 41 pCi/g (reference 1, page 140). The FSP Table A.3-1 specifies that a reporting limit of 2 pCi/g be met and, in general, lower levels are routinely met. This reporting limit is well within the range of the values expected for natural uranium in rocks and sediments and can therefore detect the condition where DU is contaminating the environment, causing a rise in the total uranium concentration.

Third, I object to Mr. Norris's defacto assumption that DU contamination is present at JPG in areas outside of the DU Impact Area. To date, there is no indication that there is routine or widespread DU contamination outside of the DU Impact Area.

Next, Mr. Norris states that the FSP specifies a "reduced sample size" but provides no standard for comparison. Reduced in relation to what? There has been no reduction in sample sizes; sample sizes are based upon the analytical technique, laboratory needs, and project data quality objectives (DQOs), and are specific to the project and the activity.

Finally, Mr. Norris may not fully understand how field sample size can affect the reporting limit (Note: for radiological analysis, the minimum detectable concentration [MDC] is a more appropriate term and the "MDC" will be used in my testimony). For example, Table A.4-2 of the FSP specifies that 8 ounces of soil or sediment be collected as a field sample. When that sample is processed in the analytical laboratory, an aliquot of approximately 1 to 3 grams is removed and used in the laboratory method (in this case, alpha spectroscopy). It is the actual sample aliquot size that is used in the determination of the MDC for that method. Increasing the field sample size, in this case, has no impact on the MDC (reporting limit) for the alpha spectroscopy of soils or sediments. The use of larger sample aliquots in the laboratory analysis could theoretically lower the MDC, but presents problems in the processing and counting of the sample and could actually raise the MDC due to self-absorption effects in the sample matrix.

A similar situation exists for water samples, with one exception, 1L of sample usually is collected, but the water is processed through a precipitation step and all of the field sample is used. Again, a larger sample size could theoretically lower the MDC, but the amount of total dissolved solids in the sample could have a significant negative effect on the analytical results as already mentioned for the soils and sediments.

Most importantly, lowering the MDC to levels that are below that expected in the natural background, by increasing the sample size (which may not be feasible) or increasing the counting time (expensive and quickly reaches a point of little added benefit) may yield more precise information, but still not provide "unambiguous identification of DU" due to the effect of fractionation of U-234 in water, which will be discussed later in this testimony.

Q25. Do you agree or disagree with the opinions stated by Mr. Norris in his Answer 72 as to the necessity of identifying the presence of DU and its concentrations at low levels?

A25. (HWA) No, I do not agree.

Q26. Please state the basis for your disagreement.

A26. (HWA) Mr. Norris asserts that the objective of the FSP is to provide site-specific data that would allow a fate and transport model to realistically and reliably predict the future movement and concentrations of DU. He then asserts that the Army must be able to see DU at extremely low levels in order to achieve this objective. This is inaccurate on both points.

First, it is not an objective of the FSP to support a fate and transport model. The objective of the FSP is to gather additional information that is necessary, as part of a characterization, to support a decommissioning plan. The decommissioning plan will include a conceptual site model (CSM), but numerical fate and transport modeling and estimates of future offsite concentrations are not currently required.

Second, significant information can be gathered simply by looking at the total uranium values in environmental samples. DU penetrators present concentrated point sources of uranium. If a DU penetrator corrodes and the corrosion products move through the environment, high values for total uranium should be seen (and have been seen in the DU Impact Area, and in one stream at a location immediately downstream from a DU penetrator that was discovered in the stream).

A key factor in any decision to terminate the JPG radioactive materials license will be an evaluation as to whether the dose to a critical receptor from the DU in the DU Impact Area will be less than 25 millirems in a year. The RESidual RADioactivity (RESRAD) software program will be used to make that evaluation. The most sensitive input parameters to the RESRAD model at JPG are; the uranium soil concentration, the depth of the contaminated zone, the value for the Kd, and the corrosion rate of the penetrators. The characterization efforts, as described in the FSP, are primarily designed to refine these four key RESRAD parameters.

The RESRAD model accepts, as an input value, the exposure point concentration of the contaminant in soil. Since DU is not more hazardous than natural uranium and since the dose conversion factors for U-234, U-235, and U-

238 are essentially equal, the presence or absence of DU has little bearing on the results of the RESRAD modeling.

In his testimony, Mr. Norris has made several references to the "calibration" of a model. Mr. Norris does not explain what this "calibration" is, and how such a "calibration" would be performed. Mr. Norris uses ambiguous terms such as "very low detection threshold" and "high detection threshold," which do not lend themselves to a technical evaluation and rebuttal. Due to the lack of specificity in these areas, I cannot comment on their veracity.

Q27. Do you agree or disagree with the comments Mr. Norris makes in his Answer 73 pertaining to the effects of small sampling size on the ability to identify DU and establish its concentration?

A27. (HWA) I disagree.

Q28. Please state the basis of your disagreement.

A28. (HWA) Mr. Norris may not be fully familiar with the counting statistics associated with measurements of radioactivity. The counting rates are proportional to the total number of radioactive atoms that are present in a sample. The total number is a function of both the concentration of radioactive material in the sample and the mass or volume of the sample.

The SOP for the JPG Environmental Radiation Monitoring (ERM) program, OHP 40-2, does specify that 1 gallon of field sample be collected for surface water and ground water. That procedure also specifies that the water be analyzed fluorometrically for total dissolved uranium. The procedure cannot be followed as written because fluorometic analysis for total uranium is not now readily available on a commercial basis. The analytical technique was changed to alpha spectroscopy after the April 2004 ERM program sampling event. With the change in analytical technique also came a change in the total volume of sample to be collected for the alpha spectroscopy analysis, which is 1 L, using bottles supplied by the offsite analytical laboratory.

If the 1-gallon sample were to be collected (as specified in the SOP), the entire contents would not normally be analyzed by either flourometric methods or alpha spectroscopy. Mr. Norris's numerical argument breaks down at this critical point, since his sample volume comparisons to 1 gallon are not valid; 1 gallon of sample would simply not be analyzed.

For alpha spectroscopy, this is because the total sample volume to be analyzed cannot be increased without bound. At some point, the amount of solids that are precipitated onto a filter or planchette for analysis by alpha spectroscopy become so great as to adversely impact the MDC for the analysis. 1 L or 500 mL are standard sample volumes for this method and are dependant on the total amount of solids that are present in the water sample.

Mr. Norris's argument breaks down at a second important point. Mr. Norris alleges that the 500 mL sample size for surface water in the April 2006 ERM sampling event caused "uncertainties" and allowed the Army to reject the indication of DU in two samples. Mr. Norris provides no calculation or technical evaluation to show that this is the case. (Note also that, Mr. Norris may be mixing the concepts of the "minimum detectable concentration" [MDC] with the "total propagated uncertainty". The distinction will be clarified here in my testimony).

I did an evaluation in August 2006 where I performed some back-calculations and built a mathematical model to evaluate how varying the counting time and sample size will affect the MDC of the alpha spectroscopy analysis, and the total propagated uncertainty (TPU) of the U-238:U-234 ratio calculation. This was done for sample SW-DU-002 as part of an evaluation into how we could improve the uncertainty in the estimate of the U-238:U-234 ratio.

In way of explanation, the MDC is defined as the net concentration that has a specified chance of being detected. It is an estimate of the detection capability of a measuring protocol and is calculated before measurements are taken. The detection limit is the lowest net response level, in counts, that you expect to be seen with a fixed level of certainty (customarily 95 percent). The

MDC is the detection limit expressed as an activity concentration (e.g., pCi/L). If the activity concentration in a sample is equal to the MDC, there is a 95 percent chance that radioactive material in the sample will be detected.

The MDC goal to be met for the ERM program water sampling is 1 pCi/L. Using a 500 mL sample for SW-DU-002 (as cited by Mr. Norris), the MDC for U-238 was reported by the laboratory as 0.066 pCi/L and for U-234 it was 0.07 pCi/L. We can see that, even using what Mr. Norris alleges as the "reduced" sample size, the MDC that was achieved by the analytical laboratory was well below the program goal of 1 pCi/L. I estimate that increasing the sample aliquot size to the full 1 L would result in an MDC for U-238 of approximately 0.033 pCi/L and for U-234 it would be approximately 0.035 pCi/L. This is a marginal improvement in the MDC.

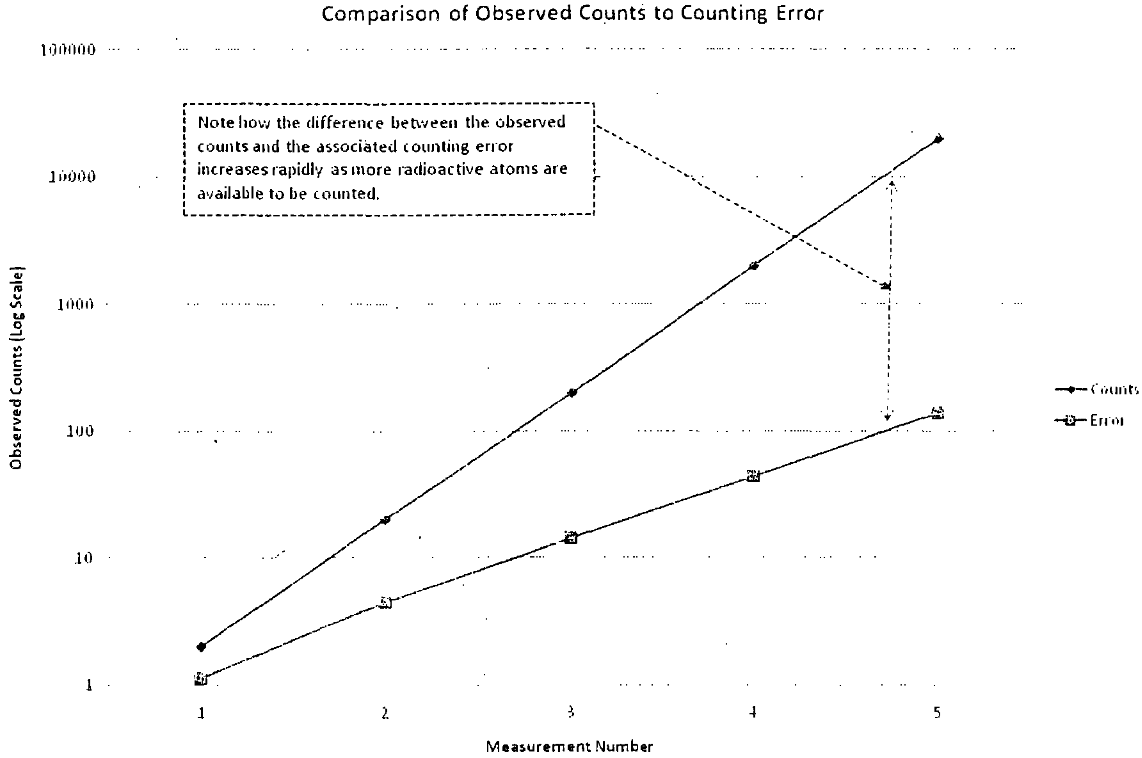
The real technical issue here, as explained by me to STV during negotiations in the summer of 2006, is the uncertainty in the U-238 measurement, in the U-234 measurement, and the propagation of those uncertainties into the calculation of the U-238:U-234 ratio.

Because radioactive decay is a random process, for radioactive counting statistics, the uncertainty in any estimate of the observed activity of a sample is equal to the square root of the total observed counts during the observation period. If the total observed counts is low, the square root of the total observed counts is fairly high in relation to the observed value. If the total observed counts is high, the square root of that number is higher, but much less so in relation to the observed counts. Refer to Table 1 and Figure 1 for an example.

Table 1. Comparison of Observed Counts to the Related Counting Error

Observed Counts	Counting Error
2	1.14
20	4.47
200	14.14
2,000	44.72
20,000	141.42

Figure 1. Graphical Representation of the Relationship of Counts to Counting Error



One can easily see that as the total observed counts increases, the value of the distance between the total observed counts and the counting error increases rapidly. That means that the uncertainty, in relation to the observed value, decreases rapidly. In other words, as more radioactive material is present to be detected, we achieve more confidence in the estimate of the activity that is present.

For sample SW-DU-002 in the April 2006 ERM program report, the value of the U-238:U-234 ratio was 3.75 ± 3.7. That means that the true value of the ratio could vary from 0.05 to 7.45. Clearly, the TPU for this sample is very high and the results cannot be used for decision making. The primary reason for the high uncertainty is the very low level of total uranium detected in the sample. This is supported by the fact that the U-234 value for SW-DU-002 was flagged with a "J" code during data validation. A "J" code indicates that the measured value is an estimate and may not be reliable. Other factors also come into play.

Now Mr. Norris testifies that the reason for this high "uncertainty" (e.g., ± 3.7) is a "reduced sample size." Returning to the mathematical model that I developed in September of 2006, I increased the sample size to a full 1 L. This does not change the concentration of uranium in the sample, but it does provide more uranium atoms to be counted. Assuming that doubling the sample size doubles the number of uranium atoms to be counted, the new estimate of the U-238:U-234 ratio would be 3.75 ± 2.6. That means that the true value could vary from 1.15 to 6.35. Again, the uncertainty is high and the results cannot be used for decision making.

The "reduced" sample size had no significant impact on the "uncertainty" in this sample, and the Army's handling of the two results cited by Mr. Norris was appropriate.

I have consistently and repeatedly stated to STV in their negotiations with the Army that STV is asking for a capability that may not be technically feasible in regard to alpha spectroscopy. The issue of U-234 fractionation, again raised by me to STV and discussed later in my testimony, further supports this case. Now, when DU is clearly present in a sample such that the total uranium concentration is elevated in regard to that expected in the natural environment, alpha spectroscopy is capable of reliably identifying the presence of DU. This was seen in the characterization of the DU Impact Area by another Army contractor several years ago.

Another analytical method, inductively coupled plasma - mass spectroscopy (ICP-MS), is a possible alternative to alpha spectroscopy for the evaluation of characterization samples at JPG. This method was suggested by me to STV in the negotiations in the summer 2006. This method examines the isotopic mass of the uranium radionuclides in a sample, rather than the isotopic activity. The mass of U-235 is measured directly, and the mass percentage of U-235 is used as an indication of the presence of DU in a sample.

As with any method, there are technological limitations. A normal ICP-MS sample receives a 10-times dilution before being introduced into the analytical device. This is necessary to protect the device from contamination and it aids in the resolution of the method. Such a dilution raises the uncertainty in the results to a point where the presence of DU (if any) cannot be reliably determined. During a test on groundwater sampling location MW-DU-006 during the April 2006 ERM program sampling, it was determined that using a diluted sample was unacceptable, but use of an undiluted sample would provide usable results. The ability to analyze an undiluted sample is dependent on the level of total dissolved solids that are present in the sample. Because of this, we cannot assure that all samples for the characterization efforts at JPG will be able to be analyzed via an undiluted ICP-MS method. I also believe that STV has not made the case, to the Army's satisfaction, that such an effort is warranted or that failing to utilize such a technique causes the current characterization plans to be inadequate.

Mr. Norris is correct in that the FSP requires groundwater and surface water samples of 100 mL in volume. That is an obvious typographical error, which will be corrected in the next revision to the FSP and clarified in the planned FSP Addendum 5. The correct value is, of course, 1,000 mL.

Returning back to alpha spectroscopy methods, the allegation of low field sample volumes is not similar for soil and sediment samples. For solid samples, only a small aliquot of the field sample is analyzed. This is generally 1 to 3 grams of sample. The aliquot sample size is limited by the amount of material that is deposited on the alpha spectroscopy planchete, which is an important factor affecting the sensitivity and resolution in alpha spectroscopy. The sample volume specified in the FSP is not important to the laboratory MDC, provided that more than 3 grams of sample are collected.

Q29. Do you agree or disagree with Mr. Norris's listing of deficiencies specific to particular media sampling methods found in his Answer 74?

A29. I disagree.

Q30. What is the basis of your disagreement?

A30. (HWA) DQOs for the FSP Addendum 5 have been drafted and they do specify that water samples will not be filtered. It is important to note that Mr. Norris is indicting the FSP water sampling methods when they have not yet been initiated.

An apparent inconsistency in the FSP does not render the site characterization efforts inadequate. In fact, there was no inconsistency. Section 6.2.9 applies to groundwater and begins with "If filtered samples are required, the following procedures will be followed..." (emphasis added). Section 6.4.5 applies to surface water and does state that water samples will not be filtered. There is no contradiction.

Also, the Army is taking a phased approach to characterization. Sediment samples are first being collected from locations that are most likely to be contaminated with DU. The Army may elect to collect additional sediment samples, as necessary, from other locations based upon the results of the initial sediment samples.

This is a prudent, cost-effective approach. If DU contamination is not found at significant levels in sediments within the DU Impact Area, it is unreasonable to assume that all of the DU is actually suspended in water and leaving the area. If DU is migrating to streams, there should be local deposition of the DU.

It is not an objective of the FSP to estimate the load of DU being transported via suspended sediments in water. It is not reasonable to expend a limited budget on such a concern without first finding indications that such a transport is occurring.

In regard to sediment sampling locations, Mr. Norris is again indicting the Army and the FSP for an activity that has not yet occurred. Is there any evidence that sediment samples have been collected on the wrong bank of a creek or stream? Section 6.6 of the FSP clearly states that samples will be collected where "deposition is most likely." In addition, gamma radiation instruments will be used to look for locations where DU might have been deposited, and biased samples will be collected at some of these locations.

Mr. Norris's testimony is dominated with comments on karst topography and postulated karst conduits through bedrock at JPG. Such pathways are possible and are being evaluated. It is unreasonable, however, to assume that sediment transport via karst conduits is the only mechanism that is moving DU contaminated sediments and that this only occurs through a conduit that discharges at a location that is outside the JPG boundary. Again, a phased-approach to the investigation of sediments is more prudent. First, we must know if sediments are being impacted. Next, we must understand any karst networks and how they move water. After that, we may find it necessary to examine sediments being moved by such a network. Sediments are sampled as a part of the FSP. If sediment contamination with DU is found, the CSM may be modified and additional investigation may be warranted. No DU transport mechanisms have been "eliminated."

Mr. Norris's testimony in regard to the potential for fractionation of U-234 is interesting, because I personally raised this issue with Mr. Norris in negotiations with STV during the summer 2006. Unfortunately, Mr. Norris might not have fully comprehended what I taught him about the mechanisms of fractionation, or the paper that he references in his testimony.

At the time, STV was alleging that there was a source of enriched uranium (EU) at JPG. They were basing this allegation on the low U-238:U-234 ratios being observed in groundwater and surface waters in the ERM program reports at JPG. This type of allegation has become fairly common amongst environmental activist groups who do not fully understand radiochemistry and radioactive equilibrium in environmental systems.

In way of a short explanation of U-234 fractionation, U-234, U-235, and U-238 are all present in natural uranium and DU. U-234 exhibits a specific activity that is several orders of magnitude higher than U-235 and U-238. Because of this, U-234 is decaying at a rate that is many times higher than the surrounding U-235 and U-238 (on an atomic scale). Uranium decays via the emission of an alpha particle. Since the alpha particle is fairly massive, the uranium atom exhibits a recoil impulse. This impulse can fracture the uranium crystalline structure, causing some uranium to become more mobile in relation to other uranium. Since U-234 has such a high specific activity, this effect is more pronounced for the U-234 atom. Since some U-234 is now free from the metallic uranium crystal, it is more mobile and also exhibits less self-absorption effects. This makes the U-234 easier to detect and alters the observed U-238:U-234 ratio. This effect is seen primarily in water systems. The ERM program data at JPG clearly show U-238:U-234 ratios of approximately 0.5 in water systems, and the expected (non-fractionated) ratio of approximately 1.0 in soils and sediments.

The U-238:U-234 ratio for DU should be on the order of 6.0 to 8.0. This ratio was clearly seen during characterization activities for soils and vegetation within the DU Impact Area by another contractor. If fractionation of U-234 in DU were to occur, then the amount of U-234 that is available to be detected would rise, as already discussed. A rise in U-234 increases the value of the denominator in the U-238:U-234 ratio and effectively lowers the ratio by some amount. One might then conclude that fractionation would then take a sample containing DU and make it look like it only contained natural uranium. That would be an incorrect oversimplification, however. DU is depleted in U-234, so there is less U-234 present in DU. That means that as the amount of DU that is present rises, the amount of U-234 that is available to fractionate is greatly reduced.

The fractionation study that is suggested by Mr. Norris is not an objective of the current FSP, is not required, and will not be helpful to the understanding of the CSM at JPG. First, available literature suggests that the magnitude of the fractionation of U-234 can be highly variable. Next, fractionation is primarily observed in water and not in soils or biota. Finally, issues relative to the total propagated uncertainty (as already discussed for alpha spectroscopy methods) will still be present.

If the Army determines that the characterization program must be able to detect the presence of DU in environmental samples where the total uranium concentration is near the levels expected in the natural environment, the alpha spectroscopy method may not be capable of meeting the associated DQOs. I have conducted a literature search, have contacted technical experts at two other locations that work with DU, and have conducted a test of the use of ICP-MS to directly measure the U-235 mass in an environmental sample. This method is still being evaluated and it exhibits its own set of technical limitations, but it shows some promise (as already discussed).

Q31. Do you have any comment to the corrective actions recommended by Mr. Norris, in his Answer 75, to the deficiencies he perceives in the sampling and analysis?

A31. (HWA) Yes. Mr. Norris testified to the need for a DQO whereby DU can be detected if it constitutes 25 percent of the total uranium in a sample. Mr. Norris does not provide a technical basis for this objective. Due to a lack of specificity, I cannot render an opinion on this objective. It has already been established that increasing the sample size, or the count time, or both will not achieve this objective for alpha spectroscopy. In addition, the fractionation of U-234 would likely prevent the achievement of this objective for alpha spectroscopy.

VII. SUMMARY AND CONCLUSION

As to Norris Testimony

Q32. Please summarize your testimony with regard to Mr. Norris Testimony.

A32. (HWA) Mr. Norris has indicted the FSP in numerous areas. He has testified that the FSP is inadequate because it does not provide for certain capabilities that are not stated objectives of the JPG characterization effort. He has not demonstrated, to my satisfaction, how those capabilities would be used, how they could be justified in terms of cost and risk to site workers, and how a lack of these capabilities renders the current characterization plans inadequate. Mr. Norris seems to be focused on a single potential DU transport mechanism (one for which he is a specialist) while ignoring the significant information to be gleaned by the existing FSP in regards to the other (and more likely) DU transport mechanisms. Mr. Norris has made claims in regards to sample sizes and detection limits which do not hold up to scientific scrutiny. Mr. Norris attempts to indict the FSP for activities that have not even been initiated yet, and he establishes a new Data Quality Objective for the JPG decommissioning efforts with no scientific basis.

In my opinion, the current FSP is designed to gather the additional information that is necessary to better understand the four most sensitive RESRAD input parameters, and that should be the focus of the characterization efforts. The FSP will also gather additional information that will support the Conceptual Site Model, which is an important element of the decommissioning plan. Mr. Norris has not provided a sound technical argument to establish that the characterization of the JPG DU impact area and surroundings will be inadequate.

VIII. REFERENCES

Q33. In your testimony you referred to several documents. Would you specifically identify those documents?

A33. (HWA) Yes.

1. *Environmental Radioactivity Form Natural, Industrial, and Military Sources,* Fourth Edition, Esenbud and Gesell, Academic Press, 1997, ISBN 0-12-235154-1. *Attached as Exhibit HWA # 3.*
2. *Radiological Assessment*, NUREG/CR-3332, Till & Meyer, U.S. NRC, 1983.
3. *Long-Term Fate of Depleted Uranium at Aberdeen and Yuma Proving Grounds, Phase II: Human Health and Ecological Risk Assessments*, LA-13156-MS, LANL National Laboratory, 1996. (Section 3.6.3, page 35) *Attached as Exhibit HWA # 4.*
4. *Review of the Environmental Quality Aspects of the TECOM DU Program at Jefferson Proving Ground, Indiana*, Abbott, et. al., Monsanto Research Corp., 1988. (section 2.1.4.2, page 2-25 and section 4.4.2.2, page 4-28) *Attached as Exhibit HWA # 5.*

5. *A Review of the Radiological Environmental Monitoring Data at U.S. Army Jefferson Proving Ground, Madison, Indiana*, Abbott, EG&G Mound Applied Technologies, Inc., 1988. *Not attached due to length (75 Pages).*

6. *Decommissioning Plan for License SUB-1435, Jefferson Proving Ground, Madison, Indiana,* Final, U.S. Department of the Army Soldier and Biological Chemical Command, June 2002. (section 4.3.7.1) *ADAMS ML021930415.*

7. *Environmental Report, Jefferson Proving Ground, Madison, Indiana*, Final, U.S. Department of the Army Soldier and Biological Chemical Command, June, 2002. (Section 3.1.4). *ADAMS ML021960089.*

8. *Potential Health Impacts from Range Fires at Aberdeen Proving Ground, Maryland*, ANL/EAD/TM-79, Prepared for the U.S. Army, Directorate of Safety, Health, and Environment, for APG by Argonne National Laboratory, Williams et al., March 1998. Not attached because of length (101 pages).

9. *Environmental Assessment for Testing Uranium Penetrator Munitions at U.S. Army Combat Systems Test Activity, Aberdeen Proving Ground, Maryland*. Davis, 1990. Not attached because of length (43 pages).

10. *Environmental Radiation Monitoring Program Plan for License SUB-1435, Jefferson Proving Ground*, Final, U.S. Army Soldier and Biological Chemical Command, September, 2003. (Section 3.3.5) ADAMS 032731017.

11. *Health and Environmental Consequences of Depleted Uranium Use in the U.S. Army: Technical Report*, U.S. Army Environmental Policy Institute, June 1995. (Section 7.1.1) *Attached as Exhibit HWA # 6.*

12. *Updated Calculation of the Inhalation Dose from the Cerro Grande Fire Based on Final Air Data*, LA-UR-01-1132, Kraig, et al., Los Alamos National Laboratory, February 2001. *Attached as Exhibit HWA # 7.*

13. *Health Risk Assessment Consultation No. 26-MF-7555-00D, Depleted Uranium - Human Exposure Assessment and Health Risk Characterization in Support of the Environmental Exposure Report*

"Depleted Uranium in the Gulf" of the Office of the Special Assistant to the Secretary of Defense for Gulf War Illnesses, Medical Readiness and Military Deployments (OSWAGI), U.S. Army Center for Health Promotion and Preventative Medicine, September 15, 2000. (Section 5.2, Camp Doha) *Attached as Exhibit HWA # 8.*

14. *Depleted Uranium in Kosovo, Post-Conflict Environmental Assessment*, United Nations Environment Programme, Nairobi, Kenya, 2001. (section 2.2, page 15) *Attached as Exhibit HWA # 9.*

15. Airborne Transport of Depleted Uranium (DU) and Site Characterization Needs", memorandum from Ms. Corrine Shia to Mr. Paul Cloud, January 13, 2005, Science Applications International Corporation. ADAMS ML 070090201

16. "From dust to dose: Effects of forest disturbance on increased inhalation exposure", Jeffery J. Whicker, et. al., Science of the Total Environment, March 2006. *Attached as Exhibit HWA # 10.*

17. "Public Health Statement for Uranium", Agency for Toxic Substances and Disease Registry, CAS# 7440-61-1, September 1999. *Attached as Exhibit HWA # 11.*

18. Examination and Analysis of Three Fired Depleted Uranium Penetrators, QINETIQ/FST/SMC/CR021209, QinetiQ Ltd., March, 2002. (item 4.5, 4,6, and Appendix A) *Attached as Exhibit HWA # 12.*

19. *Health Effects of Exposure to Low Levels of Ionizing Radiation*, BEIR V Report, National Research Council, National Academy Press, Washington, D.C., ISBN 0-309-03997-5, page 18,,1990. Attached as Exhibit HWA # 13.

Q34. Does that conclude your testimony?

A34. (HWA) Yes, it does.

EXHIBIT HWA #1

Résumé for

Harold W. Anagnostopoulos, CHP

Work Summary:

- Certified Health Physicist, ABHP
- Certified Radiation Protection Technologist, NRRPT
- Manager-level Supervisory Experience
- ALARA Planning and Radiological Engineering
- Quality Verification Auditor (NQA-1, 1989)
- Root Cause Expert Qualified & Certified Human Error Reduction Instructor

Professional Experience:

Stoller-Navarro Joint Venture, 08/07 – Present, Senior Health Physicist.

SAIC, 10/05 – 08/07, Radiation Safety Officer, Technical Group Leader, & FUSRAP Task Manager, St. Louis, MO. Technical group leader for Health Physics and Data Management personnel. Task manager for information technology services with a budget of approximately $500K. Managed a team of 7 professional staff. Radiation Safety Officer for the St. Louis office operations.

SAIC, 08/04 – 10/05, On-Site Radiation Safety Officer, LVI Services & Westinghouse Electric Corp, Hematite, MO. On-site RSO and Health Physics Supervisor for equipment removal and facility decontamination at a former nuclear fuel production facility. Nuclear criticality safety controls were required for all work. Supervised 1 Radiological Engineer, 1 Lead HP Technician, 6 Sr. HPTs and 4 Jr. HPTs. Responsible for license and permit required surveillances and environmental monitoring. Developed and presented basic nuclear criticality safety training to site personnel. Developed site technical basis documents in support of the decommissioning efforts.

SAIC, 06/04 – 08/04, Senior Health Physicist & Subject Matter Expert, Guardian Program, U.S. Department of Defense, St. Louis MO & Abingdon MD. Subject matter expert for radiological detection for the Guardian program which will augment the CBRN capabilities of 200+ military installations. Responsible for developing specifications for the procurement of radiation detection portal monitors and hand-held emergency response detectors. Responsible for the evaluation and selection of said detectors. Lead for the resolution of radioactive materials licensing issues related to Guardian equipment.

SAIC, 07/02 – 08/04, Senior Health Physicist & Radiation Protection Manager, FUSRAP, U.S. Army Corps of Engineers, St. Louis MO. Lead the Final Status Survey and Verification effort. Developed and implemented highly automated computer spreadsheets for the calculation of MARSSIM statistics. Developed and implemented a database to quickly manipulate and inspect laboratory results. This reduced the backfill authorization report lead-time from several hours to one hour or less, and eliminated several sources of potential error. Authored survey plans for piles of material, consolidated materials, and structures. Authored post remedial action reports for several FUSRAP survey efforts. Task Manger for FUSRAP documents and associated technical reviews.

SAIC, 11/03 – 01/04, Senior Health Physicist, Gulf States Steel Decommissioning Project, Highland Technical Services, Gadsden AL Consultant responsible for the disposal of 14 radioactive gauge sources and the termination of a state radioactive materials license at a bankrupt steel mill facility. Reviewed license documents and inspected the facility to ensure regulatory compliance. Interfaced with regulators. Researched the history of the 14 radioactive gauge sources and evaluated disposal options. Authored a "Phase-1" summary report in clear language for use by the bankruptcy lawyer.

SAIC, 07/02 – 10/02, Senior Health Physicist, Nucor Yamato Steel Corp, Blytheville AR. Team member on an site assist project to assess license compliance, observe operations, assess vulnerabilities, and develop a Radioactive Source Melt Prevention Plan and a Radioactive Source Melt Response Plan for a large steel recycling mill. Served as the author and architect for those plans.

Duratek Inc., 01/02 – 07/02, Senior Radiological Engineer, Oak Ridge TN. Project Manager for emergency response, source recovery, and system restoration following a ruptured radiography source at the nation's sixth largest oil refinery. Responsible for 24 hour operations and the coordination of three separate radiological control companies in the recovery effort. Duties included the development of Technical Basis Documents, MARSSIM survey plan(s), management of waste, and removal of source material. Project is estimated at $1.5M.

Duratek Inc., 03/01 – 01/02, Senior Radiological Engineer, Oak Ridge, TN. Project Manager and Site Health & Safety Manager for decommissioning of a nuclear laundry facility license in Vicksburg, MS. Supervised the conduct of 5 Sr. HP Technicians and a crew of 5 laborers. Duties include developing technical approaches, supervision of Final Status Surveys, audits, and management of a budget in excess of $1.6M.

Duratek Inc., 08/00 – 03/01, Senior Radiological Engineer, Oak Ridge, TN. Supervisor of Radiological Operations for the decommissioning of the TR-2 reactor license at the Waltz Mill site. Supervised the conduct of 1 Supervisor, 9 Senior, and 4 Junior Radiation Protection Technicians. Work included the remediation of Hot Cells, Fuel Transfer Canals, Reactor Containment, and piping tunnels.

Mound Laboratory (DOE), 09/99 – 08/00, Radiological Engineer, Dayton, OH. Responsible for development and implementation of a DAC hour tracking program. Accountable for development of a MARSSIM based survey program for D&D of Mound facilities. Involved in the development of a technical basis document for Stable Metal Tritides. Team Leader for 10 CFR 835 compliance effort in radioactive material labeling and control.

Clinton Power Station, 09/98 – 07/99, Radiation Protection Manager - Acting, Clinton, IL. Accountable for radiological safety and administration of licensed nuclear materials at a power generation facility. Managed a radiation protection staff which included: 2 health physicists, 2 certified health physicists, 18 other management, and 36 union personnel. Improved overall staff performance culminating in an *Event-Free* plant restart following a 2-1/2 year shutdown.

Clinton Power Station, 03/98 – 09/98, Supervisor – Radiological Operations, Clinton, IL. Responsible for the day to day radiation protection activities at a power generation facility. This included a staff of 7 supervisors, 25 radiation protection technicians, and 22 technician contractors providing around the clock coverage of plant activities. Improved staff morale, ownership of radiological activities, industrial and radiological safety focus, customer service, and regulatory margin as evidenced by INPO, quality assurance, Nuclear Review and Assessment Group, and NRC reports.

Dresden Power Station, 06/97 – 03/98, Corrective Actions Process Supervisor, Morris, IL. Responsible for all aspects of the station's prevention, detection, and correction strategies including site lessons learned This included root cause analysis, commitment management, problem reporting, self-assessments, trending, reporting, and human error reduction at the station. Lead 7 management and 3 clerical personnel. Site program is recognized as a top performer within the corporation and has been benchmarked by other utilities.

Dresden Power Station, 04/96 – 06/97, Site Quality Verification Auditor, Morris, IL. Served as the plant support (SALP Area) auditor. Drove performance improvement in survey map quality, RAM tagging, High Radiation Area controls, and plant postings via audits and implementation of a field monitoring program.

Dresden Power Station, 08/95 – 04/96, Radiological Assessment Manager, Morris, IL. Assessment of RP activities, performance indicator monitoring, plant tours and data review to predict and prevent radiological events. Team leader for a Reactor Water Clean Up Surge Tank contamination event root cause investigation, including N.R.C, interface and briefings. The intrusiveness and aggressive actions taken obviated any further NRC involvement or action.

Dresden Power Station, 08/94 – 08/95, Radiation Protection Unit Supervisor, Morris, IL. Served as the RP Supervisor responsible for Unit-I (SAFESTOR Decommissioning) and Unit-2. Supervised the conduct of radiation protection technicians and field activities. Initiated technical improvements by developing an air sample calculation nomograph, density thickness measurements of protective clothing materials, and installing electronic access control terminals at the Drywall access point. Received an award for determining the root cause and recovering the Unit-I Central Tool Storage Facility from a chronic contamination problem.

Dresden Power Station, 03/92 – 08/94, ALARA Engineer, Morris, IL. Acted as the ALARA Engineer for Units-1 and 2. Project Manager for the replacement of an activated nuclear detector that had been stuck in-core, in addition to other detector repairs in the Drywall at power. Acted as tour leader and liaison for the NRC during the Sphere Service Waver Leak Augmented Inspection. Served on the Boiling Water Reactor Owners Group/RP sub-committee as a Steering Committee member, 2 yr. commitment.

U.S. Navy, 11/82 – 12/91, Nuclear Propulsion Program.

Radiological Controls Shift Supervisor
Engineering Watch Supervisor
Training Manager
Leading Engineering
Lab Technician
Prototype Staff Instructor

Served in the U.S.S. VonSteuben (SSBN-632) and the U.S.S. Frank Cable (AS-40). Details of duties available upon request.

Professional Licenses and Certifications:
Certified Health Physicist, American Board of Health Physics
NRRPT Certified (inactive)

Miscellaneous:
Member, Health Physics Society
Member, American Academy of Health Physics
Assistant Editor, *The CHP Corner* of the HPS Newsletter.

EXHIBIT HWA #2

-----Original Message-----
From: Jeff Whicker [mailto:whicker_jeffrey_j@lanl.gov]
Sent: Wednesday, January 17, 2007 11:50 AM
To: Cloud, Paul D RDECOM
Subject: Re: Dust to Dose

Paul,
Thank you for your interest in our work. I cannot comment on the specifics of situation at the Jefferson Proving Ground, but I can discuss the specifics of our study at Los Alamos. To summarize, we found an increase in DU air concentrations following the Cerro Grande fire and, though not causally tested, this corresponded to increased dust flux measured in forested areas that were either burned in the fire or thinned following the fire. Though increases in dust flux and DU concentrations were found, the measured and projected concentrations of DU in air were far below regulated safety limits. Regarding your question about aerosolization, I believe that the DU in the environment at LANL was introduced through high explosives testing using DU. This testing resulted in DU aerosol and shrapnel with the highest DU soil concentrations nearest the location of the explosion.

Best regards,

Jeff Whicker

At 09:44 AM 1/11/2007, you wrote:

Jeff: Here is what the environmental group (Save the Valley) said regarding your study and their justification for asking the Army to conduct air monitoring at Jefferson Proving Ground.

"m. Basis [SUPPLEMENTED]. Air remains a potential exposure pathway as evidenced by the air sampling requirements to be implemented for the field workers (Health and Safety Plan, Section 4.2.2.1). If short-term air exposure is a concern for the workers, long-term air exposure is a concern for residents in surrounding communities, as well as for the animals living in the JPG ecosystem. Given the frequent burns that are used to clear brush at JPG, including in the DU Impact Area, con-ditions are prime for enhancing migration of soil-bound DU into the air. A recently published study provided solid evidence that fire does indeed increase the air migration pathway of soil uranium. Whicker et al studied air concentrations of uranium at the perimeter of the Los Alamos National Laboratory that were measured seasonally over a 10 year time period, including before and after fires, both wildfire and fires that were intentionally set (the equivalent of the JPG controlled burns). They found that the estimated dose due to U attached to particulate in the air at the perimeter of Los Alamos National Laboratory property increased by approximately 15% after even a "moderate" controlled burn, and this increase was greater (38%) after a more intensive wildfire. Further, the contaminated particulate matter increased seasonally, being highest during the spring months when the snow has melted, the ground is bare, winds tend to be gusty (as is true in southern Indiana), and there is little vegetation covering the ground. See JJ Whicker, et al., from Dust to Dose: Effects of Forest Disturbance on Increased Inhalation Exposure, Science of the Total Environment (2006)."

Would appreciate it if you could provide a response to the above specific to your study regarding the potential for receiving an increased does from DU as a result of a fire either during or after the fire. Also whether or not there was aeroization at LANL.

Thanks, Paul

Paul D. Cloud
JPG BEC
RSO for JPG
OSD BTC for JPG

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DSN 584-2381
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Work schedule B

Exhibit HWA # 3

Environmental Radioactivity Form Natural, Industrial, and Military Sources,
Fourth Edition, Esenbud and Gesell, Academic Press, 1997,
ISBN 0-12-235154-1.

Harry W. Anagnostopoulos Testimony

Exhibits HWA #3, HWA #4, HWA #5, HWA #6, HWA #7, HWA #8, HWA #9, HWA #10, HWA #11, HWA #12, and HWA #13 contain copywrite information and were not placed in ADAMS.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before Administrative Judges:

Alan S. Rosenthal, Chair
Dr. Paul B. Abramson
Dr. Richard F. Cole

In the Matter of	)	Docket No. 40-8838-MLA
	)	
U.S. ARMY	)	ASLBP No. 00-776-04-MLA
	)	
(Jefferson Proving Ground Site)	)	August 15, 2007
	)	

TESTIMONY OF JOSEPH N. SKIBINSKI

I. WITNESS BACKGROUND

Joseph N. Skibinski (JNS)

Q1. Please state your full name.

A1. (JNS) My name is Joseph N. Skibinski.

Q2. By whom are you employed and what is your position?

A2. (JNS) I work as an Environmental Chemist and Human Health Risk Assessor with Science Applications International Corporation (SAIC) in their Reston, Virginia office. Presently, I also serve as a Section Manager for SAIC that includes eight scientists and engineers with technical expertise including statistical analysis, human health and ecological risk assessment, and fate and transport simulation and optimization. SAIC acts as the Army's technical consultant and expert on selected tasks related to the planned decommissioning of the U.S. Nuclear Regulatory Commission (NRC) materials license at the Jefferson Proving Ground (JPG).

Q3. Please summarize your professional and educational qualifications.

A3. (JNS) My professional and educational experience is summarized in the résumé attached to this testimony as Exhibit JNS 1. As a Project Manager, Environmental Chemist, and Human Health Risk Assessor, I have provided environmental expertise over the past 18 years to the Federal Government (U.S. Department of Defense [DOD], U.S. Department of Energy [DOE], and U.S. Environmental Protection Agency [EPA]) on hazardous, toxic, and radiological waste (HTRW) and munitions and explosives of concern (MEC) projects. Among the services provided are site characterization studies under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) (site inspections to Proposed Plans/Records of Decision [PPs/RODs]), conceptual site models (CSMs), fate and transport analyses, quality assurance/quality control (QA/QC) evaluations, data validation, data management, field investigations, and environmental compliance assessments.

This experience includes calculating risks and radiation doses, developing remedial goal options (RGOs), and conducting quantitative uncertainty analysis using Monte Carlo techniques in the evaluation of exposures of different receptor groups to chemicals and radionuclides in various media and food-chain pathways for projects at the Savannah River Site and East Fork Poplar Creek (part of the Oak Ridge Reservation).

In addition, I have analyzed the fate and transport of chemicals and radionuclides in air, surface water, sediments, soils, and groundwater using various modeling tools at several sites. My experience includes using the EPA's MINTEQA2 geochemical equilibrium model for metals at three sites and evaluating the transport of metals and uranium using the U.S. Geologic Survey (USGS) PHREEQC model for the DOE, Pantex Plant in Amarillo, Texas.

As part of my support to the DOE Pantex project, I supported the planning of the partition coefficient (K_d) study conducted for uranium transport in the alluvial soil. In total, I have led or supported more than 100 environmental studies ranging from preliminary assessments to multi-media, HTRW studies in simple and complex hydrogeologic environments.

I have been providing technical support to the Army's JPG facility since 2004. I have been the Project Manager for SAIC's work at JPG since February 2006. In this role, I oversee key technical staff located in Indianapolis, Indiana; St. Louis, Missouri; Harrisburg, Pennsylvania; Memphis, Tennessee; and Reston, Virginia. In addition, I work directly with Mr. Paul Cloud and Mr. Brooks Evens (U.S. Army Corps of Engineers [USACE]) on all aspects of SAIC's support to the characterization, environmental radiation monitoring, and decommissioning activities at JPG. I have visited the JPG Depleted Uranium (DU) Impact Area on two occasions and have personally examined a DU penetrator embedded in shallow surface soil in the DU Impact Area during the electrical imaging (EI) survey.

My academic credentials include a B.S. in chemistry. In addition, I attended an Advanced Course in Modeling Groundwater Contamination in Non-aqueous Phase Liquids taught by Dr. George Pinter (University of Vermont) in January 2003 and a MINTEQA2 Workshop taught by Dr. Jerry Allison (Allison Geoscience Consultants, Inc.) in June 2003.

Q4. What is the purpose of your testimony?

A4. (JNS) The purpose of my testimony is to address, on behalf of the Army, the lack of understanding of decommissioning objectives, regulations, and process, as well as certain misconceptions, misstatements, and technical flaws found in the testimonies of Ms. Diane Henshel and Mr. Charles Norris, which have been filed herein.

Q5. Have you reviewed the testimonies of Ms. Henshel and Mr. Norris filed in support of Save the Valley's (STV's) Contention B-2?

A5. (JNS) Yes, I have reviewed the testimony of Ms. Henshel, dated July 20, 2007, and the testimony of Mr. Norris, dated July 13, 2007.

Absence of Demonstrated and Documented Understanding of Decommissioning Objectives, Regulations, and Process

Q6. Do you agree or disagree with the testimonies of Ms. Henshel and Mr. Norris in regard to their general premise that the Army is not now gathering sufficient data to adequately support the anticipated Decommissioning Plan?

A6. (JNS) I disagree.

Q7. Please state the basis of your disagreement.

A7. (JNS) The testimonies provided by Ms. Henshel and Mr. Norris demonstrate their fundamental failure to understand the NRC's decommissioning objectives, regulations, and processes. The testimonies imply and state that a complete understanding of the site is necessary to identify fate and transport of DU in the environment at JPG and to validate the CSM. However, these statements do not reflect a clear understanding of the NRC requirements for developing an acceptable Decommissioning Plan. The characterization approach described in the FSP (SAIC 2005) and addenda (SAIC 2006a, 2006b, and 2007) was developed with the primary goal of obtaining data needed to support the radiological dose assessment specified in 10 Code of Federal Regulations (CFR) § 20.1403(b) and 10 CFR § 20.1403(e). The requirement includes determining whether or not the total effective dose equivalent (TEDE) from DU exposure is below the limits of 25 mrem/year, 100 mrem/year (if institutional controls fail), or 500 mrem/year (if institutional controls fail and specific provisions are met). The TEDE is to be assessed using the NRC's RESidual RADioactivity (RESRAD) model.

It is neither necessary nor desirable to complete site characterization to the degree described by Ms. Henshel and Mr. Norris to determine if the restricted release criteria are met. DU has been reliably detected in samples collected near penetrators or fragments of penetrators and there is no indication that there is routine or widespread DU contamination outside the DU Impact Area. In addition, DU is less hazardous than natural uranium and since the dose conversion factors for U-234, U-235, and U-238 are essentially equal, the presence or absence of DU has little bearing on the results of the RESRAD modeling.

Moreover, the program described by the interveners is neither fiscally responsible nor required by NRC's regulations, and implementing several of the recommendations could jeopardize submitting a Decommissioning Plan in the required 5-year timeframe. Even for the recommendations that are feasible and safe to implement, the proposed program described by Mr. Norris and Ms. Henshel is projected to add several years to the existing program at a cost of at least double what the Army has programmed in its budget. This clearly is not a prudent strategy for the Army or a reasonable use of public funds at this site. Examples of this ill-conceived approach exceeding regulatory requirements are described by the interveners in Mr. Norris's A036, A037, and A041 and Ms. Henshel's A018 and A037.

Furthermore, the additional characterization recommended by STV (through the testimonies of Ms. Henshel and Mr. Norris) may result in "net public or environmental harm" as described in 10 CFR § 20.1403(a) due to the significant safety hazards posed by numerous unexploded ordnance (UXO) remaining throughout the DU Impact Area. The testimony of Mr. Norris in A024 (page 16, first bullet) indicates that for the Fracture Trace Analysis (FTA), all technology should be considered and the best method selected for the task and conditions. Among the technology he cites is ground penetrating radar (GPR). However, Mr. Norris has either not evaluated or does not understand the capability and limitations of this technologies in light of the site conditions at JPG, which includes an area laden with UXO. Had he evaluated GPR carefully, he would have realized this technology is not appropriate for JPG, since this active energy source could unintentionally detonate certain types of UXO. Therefore, this technology was ruled out immediately. The citation of technologies that are not applicable to the site conditions calls in question the credibility of this testimony on this subject. In fact, SAIC considered a wide range of approaches and opted for the stereo-paired aerial photographs based on such factors as safety, technology status, complexity, relevance, and cost. SAIC eliminated GPR from the candidate list very early in the evaluation process based on potential safety concerns.

The Army has already agreed to perform the most accurate, protective, and scientifically defensible analysis for collecting data needed to conduct RESRAD modeling as described in the FSP (SAIC 2005) and addenda (SAIC 2006a, 2006b, and 2007). The approach is consistent with NRC guidance and standard methods used by industry for license decommissioning projects. Most importantly, the characterization and related activities supporting the Army's Decommissioning Plan will meet all NRC requirements when it is submitted in 2011.

Misunderstanding, Misinterpretation, and Misstatements of Army's Approach

Q8. In your opinion, is the testimony of either Ms. Henshel or Mr. Norris based on an accurate understanding of the Army's approach to site characterization?

A8. (JNS) No. In my opinion, neither testimony is based on an accurate understanding of the Army's approach.

Q9. Please state the basis of your opinion.

A9. (JNS) The pre-filed testimony of Mr. Norris and Ms. Henshel reflect repeated misunderstandings and misinterpretations of the Army's approach to site characterization. Moreover, these witnesses testifying on behalf of STV have, in many cases, either misstated or misinterpreted the Army's strategy and plans. As a result, the credibility and veracity of part or all of some testimony is questionable and biases their observations, critiques, and conclusions. Examples of these misunderstandings, misinterpretations, and misstatements are provided below. Further evidence of these flaws is provided in the testimonies of Mr. Harry Anagnostopoulos, Mr. Michael Barta, Mr. Todd Eaby, and Mr. Stephen Snyder.

STV does not appear to understand the Army's phased and adaptable approach that is documented in the FSP (SAIC 2005) and addenda (SAIC 2006a, 2006b, and 2007). The FSP (SAIC 2005) clearly states that a "tiered, time-phase approach" was defined and that tasks subsequent to the first year "will be planned and detailed as addenda" to meet the NRC regulatory requirement of completing the Decommissioning Plan within the required 5-year timeframe. However, Mr. Norris spends a considerable amount of time critiquing the sediment and surface water sampling plans outlined in the FSP (SAIC 2005) without regard for the fact that these plans have not been formally defined (see Norris Q&A 062 – 075). These initial plans were defined with clear acknowledgment of the fact that the plans would be revised to reflect the "then current understanding" of the site, current technologies and methodologies, and related schedule and funding constraints. Therefore, this testimony and other testimony related to activities that have not yet been more clearly defined in FSP addenda are irrelevant to determining the adequacy of the FSP (SAIC 2005).

Ms. Henshel has misinterpreted the Army's overarching plan to generate sufficient data to support the Decommissioning Plan in 5 years. This plan includes a primary focus on data for determining if the decommissioning criteria are satisfied for potential human receptors and not for a complete biological characterization of the site. In Ms. Henshel's testimony on the biological sampling program in A012-A018, she inaccurately describes the program proposed in the FSP (SAIC 2005) and subsequent Addendum 1 (SAIC 2006a). The biota sampling program described in these two documents was designed to respond to NRC requests for deer sampling because of potential impacts to human receptors. The Army willingly included the option for additional biota sampling if there were indications of potential biological impacts. This latter data are not necessary to develop an acceptable Decommissioning Plan, but would have been collected to support further understanding of the potential biological impacts. Therefore, Ms. Henshel's assertions in A021 that a yet undefined fate and transport model requires multi-species sampling reflects a misinterpretation of the FSP (SAIC 2005) and Addendum 1 (SAIC 2006a) first and foremost, as well as the NRC's requirements for decommissioning.

Technical Flaws Demonstrated Through Errors in Data Usage and Interpretation

Q10. Did you note any technical flaws in the testimony of either Ms. Henshel or Mr. Norris.

A10. (JNS) Yes, I did.

Q11. Would you please state what you found?

A11. (JNS) Errors in the data use and interpretation of the Army's results provide a technical flaw in STV's testimonies. In A028, Ms. Henshel indicates the deer sampling report is inadequate because it failed "...to meet specified accuracy in the chemical analysis of deer samples." Unfortunately, Ms. Henshel has confused accuracy with precision. Accuracy is defined as, "a measure of the closeness of an individual measurement or the average of a number of measurements to the true value" (USEPA 1998, attached AS Exhibit JNS #2). Precision is defined as, "a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions expressed generally in terms of the standard deviation" (USEPA 1998). Field duplicate samples are collected and analyzed to measure precision.

Furthermore, Ms. Henshel has misinterpreted Appendix A of the FSP (SAIC 2005) which states, "...the relative percent differences (RPD) between two positive results will be calculated and used as quality control indication of the field procedures, matrix effects, and precision of the analyses conducted." RPDs were not calculated for the field duplicate samples because there were no positive duplicate results that could be compared and calculated. Therefore, it is not clear why Ms. Henshel performed calculations when no calculations were warranted or feasible.

Mr. Norris, in A024, stated that glacial sediments, which overlie bedrock over much of the site, are "fractured, and traces of those fractures may have no bearing on the deeper bedrock fractures of interest." His statement infers that these features would mislead a photo-geologic FTA, such as the one performed by the Army. He referenced a U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) study to lend credence to his statement. However, that referenced sentence actually reads, "*Small-scale fractures and sand lenses within the till contribute to the higher hydraulic conductivity.*" The context of his comment discusses the range of hydraulic conductivities measured in the fairly tight tills south of the firing line at JPG. Fractures of the scale discussed in the reference made by Mr. Norris (inches) are much smaller than those that would be identifiable by the photo-geologic FTA and are of secondary importance relative to the larger features that would be of interest in the analysis conducted by the Army.

In A030, Mr. Norris misinterprets a statement he extracted from Appendix B of the FSP (SAIC 2005) in which he alleges that the EI survey lines should have been oriented perpendicular to fracture traces. The statement he references actually states, "*The traverse should not be set up running parallel to subsurface utilities or other subsurface conductors.*" This statement was added to Appendix B primarily for avoiding highly conductive subsurface utilities, such as drinking water supply lines, that can complicate the interpretation of EI data. This clearly is an attempt to mislead someone who may not check references.

In summary, there has been a misinterpretation of the Army's plans and calculations performed inappropriately. The results presented in the testimony on these issues, therefore, are inaccurate and misleading to the Atomic Safety and Licensing Board Panel.

SUMMARY AND CONCLUSION

Q12. Please summarize your testimony with regard to Basis Item "q".

A12. (JNS) There is a general absence of demonstrated and documented understanding of decommissioning objectives, regulations, and process in the testimonies of both Ms. Henshel and Mr. Norris. This is compounded by their misunderstanding, misinterpretation, and misstatements pertaining to the Army's approach to site characterization. Further, technical flaws in their testimonies have been demonstrated through errors in data usage and interpretation. These defects call in question the credibility of the opinions each express in her or his testimony concerning inadequacies in the FSP (SAIC 2005).

REFERENCES

Q13. In your testimony you referred to several documents. Would you specifically identify those documents?

A13. (HWA) Yes.

1. SAIC (Science Applications International Corporation). 2005. Field Sampling Plan. DU Impact Area Site Characterization, JPG, Madison, Indiana. Final. May. ADAMS ML051520319.

2. SAIC. 2006a. Field Sampling Plan Addendum 2, Depleted Uranium Impact Area Site Characterization – Soil Verification, Jefferson Proving Ground, Madison, Indiana. Final. July. ADAMS ML061930256.

3. SAIC. 2006b. Field Sampling Plan Addendum 3, Depleted Uranium Impact Area Site Characterization – Other Monitoring Equipment Installation, Other Monitoring (Precipitation, Cave, and Stream/Cave Spring Gauges), and Electrical Imaging Survey, Jefferson Proving Ground, Madison, Indiana. Final. July.

4. SAIC. 2007. Field Sampling Plan Addendum 4, Depleted Uranium Impact Area Site Characterization: Monitoring Well Installation Jefferson Proving Ground, Madison, Indiana. Final. January. ADAMS ML070220165.

5. USEPA (U.S. Environmental Protection Agency). 1998. EPA Guidance For Quality Assurance Project Plans – EPA QA/G-5, Appendix B (Glossary Of Quality Assurance And Related Terms). EPA/600/R-98/018. Office of Research and Development, Washington, D.C. February. Attached as Exhibit JNS #2.

Q14. Does that conclude your testimony?

A14. (JNS) Yes, it does.

SKIBINSKI TESTIMONY

EXHIBIT JNS #1

Résumé

JOSEPH N. SKIBINSKI

EDUCATION:

B.S., Chemistry, Shippensburg University, 1988

SECURITY CLEARANCE:

None

WORK SUMMARY:

Mr. Skibinski is an environmental chemist with more than 17 years of experience in management and support of hazardous waste site evaluations, removal actions, and environmental compliance assessments. He manages and supports Military Munitions Response Responses (MMRPs), Remedial Investigations/Feasibility Studies (RI/FSs) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and Resource Conservation and Recovery Act (RCRA) Facility Investigations/Corrective Measures Studies (RFI/CMSs). Mr. Skibinski's experience includes human health risk assessments; environmental fate and transport assessments; quality assurance (QA) evaluations; data validation, management, and analysis; field investigations; and environmental compliance assessments. He is experienced in using and developing diverse software applications.

PROFESSIONAL EXPERIENCE:

February 2004 to present, Manager of Analysis, Automation, and Optimization Section, Division 827, Science Applications International Corporation (SAIC)

Mr. Skibinski manages a section that includes six full-time and two unscheduled professionals. The technical expertise within the section includes statistical analysis, human health and ecological risk assessment, and fate and transport modeling and optimization. The majority of the personnel are located in Reston, Virginia, but three staff are located in Augusta, Georgia; Memphis, Tennessee; and Waterbury, Vermont.

He is responsible for conducting annual performance reviews, planning and overseeing career development and mentoring, handling human resource issues, and hiring new personnel.

September 1989 to present, Environmental Chemist/Risk Assessor, SAIC

Mr. Skibinski is the Project Manager for the Jefferson Proving Ground (JPG), U.S. Nuclear Regulatory Commission (NRC) Permit Closure project. This is the first U.S. Department of Defense (DOD) request for a restricted release termination of a possession-only NRC license. This project currently includes three task orders executed under the U.S. Army Corps of Engineers (USACE), Louisville District's Hazardous, Toxic, and Radiologic Waste (HTRW) support contract cumulatively valued at $1.8M. He oversees key technical staff located in Indianapolis, Indiana; St. Louis, Missouri; Harrisburg, Pennsylvania; Memphis, Tennessee; and Reston, Virginia. In addition, he provides environmental chemistry and human health risk assessment support in analyzing the fate, transport, and effects of depleted uranium (DU). He is responsible for ensuring the development of all project deliverables such as the Field Sampling Plan (FSP) and Health and Safety Plan (HASP), which define the procedures needed to safely characterize the DU Impact Area at JPG; modify the Army's current environmental radiation monitoring (ERM) plan; and develop a defensible Decommissioning Plan.

Mr. Skibinski is the Deputy Project Manager and Technical Lead for the Range Condition Assessment (RCA) 5-Year Review at San Clemente Island, California. This project is the first 5-year RCA review performed for the Navy and includes an evaluation of the environmental condition of land-based operational ranges managed by Commander, Pacific Fleet (COMPACFLT). The project is executed under SAIC's Architect and Engineering (A-E) Services contract held with Naval Facilities Engineering Command (NAVFAC), Southwest. It includes attending meetings, preparing work plans, conducting an onsite visit and information review, sampling for munitions constituents on the operational ranges, and developing an RCA Report.

Mr. Skibinski is the Delivery Order (DO) Manager for Navy Range Sustainability and Environmental Program Management Support DO. This time and materials (T&M) DO with a capacity of $14.8M requires SAIC to provide range sustainability program management support, other Navy environmental/operational readiness support, and maritime environmental compliance support. Mr. Skibinski is responsible for reporting progress monthly, ensuring tasks are completed in accordance with SAIC policies and standards for quality, and coordinating with other SAIC organizations performing work under the DO.

Mr. Skibinski is the Project Manager and Technical Lead for the RCA at Naval Surface Warfare Center – Dahlgren Laboratory (NSWC-DL), Dahlgren, Virginia. This project is the first RCA performed for Naval Sea Systems Command (NAVSEA) ranges. It includes attending meetings, preparing work plans, conducting an on-site visit and information review, and developing an RCA Report.

Mr. Skibinski is the Project Manager for the Site Inspection (SI) conducted for a Formerly Used Defense site (FUDS) located at Lockbourne Air Force Base (AFB), Lockbourne, Ohio. SAIC is providing the support to the following tasks as a subcontractor to GEO Consultants, LLC.: (1) Data Quality Objectives (DQOs), RI Work Plan, Sampling and Analysis Plan (SAP), and HASP; (2) Sample Analyses, Data Assessment, Data Validation, and Reporting; and (3) Data Evaluation/Fate and Transport/Risk Screening.

Mr. Skibinski was the Project Manager for the Range Sustainability Environmental Program Assessment (RSEPA) supporting the U.S. Navy's Chief of Naval Operations (N45). The project included the development of Revision 1 of the RSEPA Policy Implementation Manual. He supported a multi-disciplinary Navy workgroup in developing and prototype-testing Revision 0 of the RSEPA Policy Implementation Manual. Related to this support, he was the liaison between the Range Residue and Analysis Team (RRAT) and RSEPA development teams bringing consistency to the parallel efforts in matters relating to operational range site models (ORSMs), chemical sampling and analysis, risk assessment, and decision analysis. He supported the RCAs conducted at the Virginia Capes (VACAPES), Fallon, and Southern California (SOCAL) range training complexes, which included the determination of potential impacts of environmental regulations or encroachment threats on munitions use, range management, and training operations for each Navy asset in each range complex. In addition, he was one of two SAIC scientists who developed and conducted training of Navy personnel in San Diego, California; La Plata, Maryland; and Honolulu, Hawaii. SAIC's project team was recognized by the Navy as follows, "Throughout the development of the RSEPA manual, SAIC has been very responsive to the Navy's needs. They have shown us they can develop sound engineering solutions for unique situations." Kelli A. Ackiewicz, Naval Facilities Engineering Command Headquarters.

Mr. Skibinski was the principal author of the Alabama Army Ammunition Plant (ALAAP) – Area B Soils, Surface Water, and Sediment Proposed Plan. This plan documents the decisions resulting from SAIC's work since the mid-1990s and earlier investigation and remedial actions.

Mr. Skibinski was the Project Manager for the analysis of land use controls as a component of ordnance and explosives removals at the Former Nansemond Ordnance Depot. In addition to managerial and administrative responsibilities, his role on the project included educating Federal, state, and local regulatory agencies as well as the stakeholders on the components used to develop land use controls (institutional controls, engineering controls, and educational programs); facilitating stakeholder involvement in the overall process and development of the land use controls; developing and presenting the methods and assumptions for assessing residual explosives safety risk; and presenting results during public meetings.

Mr. Skibinski implemented decision support tools for the *Economic and Environmental Analysis of Technologies to Treat Mercury and Dispose in a Waste Containment Facility* project conducted for the U.S. Environmental Protection Agency (EPA), Office of Research and Development. His role on this project included implementing the Expert Choice® (version 11) software tool to support the environmental analysis and conducting a Monte Carlo simulation using Crystal Ball® Pro (Version 4.0e) software to support the economic analysis. As a function of his role, he attended meetings with personnel from EPA and SAIC in June 2004 and January 2005 and prepared relevant sections of the draft (December 2004) and final reports (March 2005).

Mr. Skibinski was one of two trainers who conducted train-the-trainer training for Transportation Security Administration (TSA) managers in Indianapolis, Indiana (2 to 4 August 2004) and Arlington, Virginia (21 and 22 September 2004). Each class included approximately 30 students. The training addressed the TSA's requirements for handling and management of voluntarily abandoned property (VAP) for airports of various sizes located across the United States.

Mr. Skibinski was the risk assessment subject matter expert for the Operational Risk Management Analysis (ORMA) that was prepared to support the Environmental Impact Statement (EIS) for the Navy's proposed Air-To-Ground Training at Avon Park Air Force Range (APAFR). This analysis evaluated the potential for acute and chronic injuries and fatalities to humans from residual unexploded ordnance (UXO) for all 15 land use scenarios. The analysis was conducted before using Air Force Instruction (AFI) 90-901, Operational Navy Instruction (OPNAV) 3500.9, and Military Standard (MIL-STD)-882D. The analysis was conducted for two aircraft delivery platforms, three target areas, and 11 weapon safety footprints (WSFs), which include all the required munitions, run-in headings, dive angles, delivery altitudes, and air speeds.

Mr. Skibinski supported the engineering evaluation/cost analyses (EE/CAs) as subcontractor to American Technologies, Inc. at two FUDS: Former Pole Mountain Target and Maneuver Area, Laramie, Wyoming and Camp Goodnews, Sandwich, Massachusetts. He led the ordnance and explosives risk impact analysis (OERIA) and supported the technical project planning (TPP) tasks on these projects.

Mr. Skibinski participated in the peer review of two protocols developed by contractors for the U.S. Army Engineering and Support Center, Huntsville (CEHNC). These protocols include life-cycle data management and footprint reduction. He provided input to CEHNC's contractor on principles to include in these protocols, attended a meeting to discuss the draft protocols, and developed a report to SAIC's prime contractor (American Technologies, Inc.).

Mr. Skibinski supported two tasks for the U.S. Navy, Commander-In-Chief, Atlantic Fleet (CINCLANTFLT): Ranges to Readiness Study (SAIC as subcontractor to SRS Technologies) and Technical Support for the Integrated Long-Range Planning Process. His support on these tasks was limited to the few instances where expertise in conducting range responses was needed.

Mr. Skibinski supported the assessment of fate and transport and potential human health effects resulting from a hypothetical spill of up to 175,000 kg of chemical warfare materiel (CWM) from a stockpile in a west Asian theater of operation. The assessment considered potential human exposures resulting from a hypothetical spill of VX or GB. The assessment focused on the following events: evaporation of the spilled agent into the air, infiltration of agent spilled onto soil, infiltration of agent spilled onto concrete, movement of agent through an aquifer, and contamination of drinking water by agent spilled into a reservoir. Specifically, Mr. Skibinski was responsible for developing the conceptual site model (CSM) and assessing acute and short-term impacts to human health from direct and indirect exposures to VX, GB, and potential degradation products.

Mr. Skibinski was the technical lead in the development and demonstration of the Range Rule Risk Methodology (R3M)/Hazard Assessment Methods for UXO Response (HAMUR) for the U.S. Army Environmental Command (formerly U.S. Army Environmental Center). The following bullets summarize Mr. Skibinski's responsibilities on the R3M/HAMUR Project:

- The Interim R3M was developed in a collaborative effort with environmental regulators (Federal, State, and Tribal), public representatives, and representatives from other DOD agencies. Mr. Skibinski's responsibilities for this effort included writing sections of the Interim R3M, developing materials to focus discussions with the partners, preparing and making presentations for partnering meetings, and preparing minutes from partnering meetings and teleconferences.
- The Preliminary Validation consisted of simulating the decision-making process of the Interim R3M by training and testing two artificial groups. Support for this included preparing training materials, training the artificial groups, synthesizing data from range clearance operations, preparing test questions, conducting the tests, and writing parts of the Preliminary Validation Report.
- The Interim R3M was posted for public comment. Mr. Skibinski's role for this phase of the project included coordinating the development of the comment management website, tracking and responding to public comments, recommending changes to the Interim R3M, and reconciling the comments and revisions.

- Mr. Skibinski provided technical support and direction for the transformation of the Interim R3M into HAMUR, as well as the scoping and performance of the subsequent demonstration conducted using Fort Wingate Depot Activity UXO cleanup data.
- Mr. Skibinski also provided administrative support, which includes tracking schedules and budgets, writing monthly progress reports, working with subcontractors and other organizations within SAIC, and coordinating meetings.

Mr. Skibinski provided decision support using risk-based tools for the evaluation of what-if scenarios for items processed in the Pine Bluff Chemical Disposal Facility (PBCDF). PBCDF is one of seven incinerators built or planned for destroying the U.S. chemical agent stockpile and related items. Site managers used the what-if scenarios to refine a wide variety of operational parameters and procedures relating to primary and secondary items processed in the PBCDF. The what-if scenarios were conducted rapidly using a custom-built database-driven tool. The tool facilitated the use of advanced fate and transport models to assess human health and ecological health effects based on the incinerator stack emissions.

Mr. Skibinski has supported the human health risk assessment team on over 40 RI/FS and RFI/CMS projects. His involvement included the development of spreadsheet models that project potential risks and RGOs, including quantitative uncertainty analysis using Monte Carlo techniques. He used these models to evaluate exposures of different receptor groups to various chemicals and radionuclides in soil, surface water, sediment, groundwater, and food-chain pathways (including produce, beef, dairy, and fish consumption). In addition to the spreadsheet models, Mr. Skibinski used EPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model to evaluate lead exposures in children and estimate target cleanup levels in soil and groundwater. Mr. Skibinski estimated risks from the implementation of several proposed remedial alternatives. Mr. Skibinski supported risk assessments on the following projects: A-Area Burning Rubble Pits RI/RFI/Baseline Risk Assessment (BRA), Savannah River Site; Alabama Army Ammunition Plant RI/FS; Anniston Army Depot - Southeast Industrial Area RI/FS; C-Area Burning Rubble Pits RI/RFI/BRA, Savannah River Site; Central Shops Burning/Rubble Pits Scoping Package, Savannah River Site; Chemicals, Metals, and Pesticides Pit RI/RFI/BRA, Savannah River Site; Detroit Arsenal Tank Plant RI/FS; DOE Y-12 East Fork Poplar Creek RI/FS/Environmental Impact Statement (EIS); Fernald Environmental Restoration Management Corporation (FERMCO) – Operable Unit 5; Fire Department Hose Training Facility, RI/RFI/BRA, Savannah River Site; Ford Building Seepage Basin Scoping Package, Savannah River Site; Ford Building Waste Unit, RI/RFI/BRA, Savannah River Site; Fort McClellan RI/FS; Fort Benjamin Harrison Environmental Investigation; Fort Sheridan RI/FS; Fort Wayne ANGB Site Inspection (SI); Gowen Field ANGB SI; H-Area Retention Basin Focused Feasibility Study (FFS), Savannah River Site; Joe Foss Field RI; Juncos Landfill RI; Hill AFB RI; Lowry AFB RI; Toledo Express Airport SI; Miscellaneous Chemical Basin/Metals Burning Pit RI/RFI/BRA, Savannah River Site; Newport Chemical Depot – Little Raccoon Creek RFI, Newport, Indiana; L, P, and R Bingham Pump Outage Isolated Hazardous Material Units Approved Standardized Corrective Action Design (ASCAD™) Report; Savanna Army Depot Lower Post RI; Savanna Army Depot Upper Post RI; Savanna Army Depot Sites 20, 73, and 178 RI; Savanna Army Depot Plant Area RI; TNX RI/RFI/BRA, Savannah River Site; Tooele Army Depot – North Area Group B Suspected Releases Solid Waste Management Units (SWMUs) Phase II RFI; Tooele Army Depot – North Area Group C Suspected Releases SWMUs Phase II RFI; Tooele Army Depot – South Area Phase II RFI Group 3 Suspected Releases SWMUs; U.S. Coast Guard (USCG) Support Center, Kodiak Island RFI/CMS; West Valley Demonstration Project EIS; Whidbey Island-Contract Task Order 54 RI; Wright-Patterson AFB Operable Unit-3 RI; and, Whidbey Island-Contract Task Order 42 RI.

Mr. Skibinski developed materials for the Uncertainty Analysis Training Course for EPA personnel to train other EPA risk assessors and risk managers. Mr. Skibinski worked in collaboration with the EPA's and SAIC's experts on uncertainty analysis to prepare the course materials. In addition, Mr. Skibinski conducted a literature review. The information obtained from the collaborative effort as well as the information obtained from the literature review was presented on slides in Microsoft Powerpoint®.

Mr. Skibinski developed software components, provided technical support to other developers, and trained staff to support these efforts. This software includes in-house programs that are used to conduct statistical analyses, data screening, and human health and ecological risk assessment calculations for internal use and a program that performs risk assessment calculations for use by a commercial client. He used Microsoft Visual Basic for Excel® as the development platform while other developers used Microsoft FoxPro®. The system was developed to perform human health risk assessment calculations for internal use to generate tables that comply with EPA's Risk Assessment Guidance for Superfund (RAGS) Part D required formats. The other internal program provides different outputs, depending upon the requirements and needs of the project. The program developed for the commercial client supports the reporting requirements of their RCRA Subpart X Permit with the state.

For the Fort Meade UXO Survey Data Analysis – BRAC Parcel, Mr. Skibinski provided managerial and technical support. Mr. Skibinski assisted the project manager in tracking schedules and budgets, planning meetings, and writing progress reports. During the field program, he conducted QA surveillances and provided technical oversight for the subcontractor conducting the UXO survey. He also was responsible for developing and running the risk assessment spreadsheet model, which was used to determine risks associated with exposure to UXO. He was responsible for designing a second spreadsheet model that included a quantitative uncertainty analysis using Monte Carlo techniques.

For the Fort Benjamin Harrison UXO Survey/Surface Clearance, Mr. Skibinski provided technical support and oversight. He was involved in designing the UXO survey and surface clearances. In addition, he conducted QA surveillances and provided technical oversight for the subcontractor conducting the work. He was also one of the primary authors of the Explosives Safety Submittal and the report.

The majority of the data/statistical analyses Mr. Skibinski has conducted have been background comparisons using different statistical techniques (e.g., upper tolerance limit comparisons, Student's t-tests, Mann-Whitney tests). Several investigations where statistical analyses were conducted include: Fort Wayne ANGB SI; Gowen Field ANGB SI (Phases I and II); Toledo Express Airport SI; Tooele Army Depot – North Area Group B Suspected Release SWMUs Phase II RFI; and Vint Hill Farms Station SI. In addition, he was responsible for designing and developing software that completes statistical analyses and data screening required for human and ecological risk assessment and site investigations. This software was used to conduct data analyses for the Detroit Arsenal Tank Plant RI/FS, Fort Benjamin Harrison Environmental Investigation, Fort Sheridan DOD Operable Unit RI/FS, Fort McClellan RI/FS, and multiple projects still conducted at Anniston Army Depot, Savanna Army Depot, and Newport Chemical Depot.

For the CERCLA 5-Year Review conducted for Louisiana Army Ammunition Plant, Mr. Skibinski conducted a statistical trend analysis to identify groundwater contaminant concentration trends over time (1980 through 1994) and to evaluate the effectiveness of interim remedial actions on groundwater quality. This evaluation was the subject of two published papers.

Mr. Skibinski has analyzed the fate and transport of chemicals and radionuclides in air, surface water, sediments, soils, and groundwater. The primary emphasis of the assessments has been mobility and degradation in vadose and saturated zone soils to support investigation conclusions and remedial action recommendations. Mr. Skibinski has conducted fate and transport assessments for a variety of contaminants at several sites in Germany and for the Springfield ANGB SI. He also has modeled emissions and dispersion (using EPA's SCREEN2 model) of fugitive dust and volatile emissions resulting from proposed remedial actions at the U.S. Department of Energy (DOE) Y-12 Facility, East Fork Poplar Creek (EFPC), Oak Ridge, Tennessee and for the development of a RCRA Subpart X Permit for a commercial waste handler in Utah. Using MINTEQA2, Mr. Skibinski performed geochemical equilibrium modeling for the Alabama Army Ammunition Plant RI/FS, EFPC RI, and the Fort Benjamin Harrison EI. For the Newport Army Ammunition Plant RFI/CMS, Mr. Skibinski used the International Ground Water Modeling Center's Summers Model to develop soil cleanup levels with consideration of groundwater protection. For the DOE, Pantex Plant in Amarillo, Texas, Mr. Skibinski evaluated the transport of metals and uranium using the U.S. Geologic Survey (USGS) PHREEQC model and Los Alamos National Laboratory's Finite Element Heat and Mass Transfer (FEHM) Code. He developed and presented a 2-day course for the BWXT-Pantex Project Manager regarding Fate and Transport Modeling of Metals in Unsaturated Soil. The course included a basic chemistry refresher (e.g., precipitation/dissolution reactions, reduction/oxidation, ion exchange, complexation, and adsorption/desorption processes) and a tutorial describing how to use the PHREEQC and FEHM models.

Mr. Skibinski has contributed to and overseen the development of work plans, sampling plans, and QA plans, and has served as SAIC's interface with analytical laboratories. For the plans, he selected analytical methods for soil, sediment, surface water, and groundwater analyses of inorganic and organic contaminants using the EPA's Methods for Chemical Analysis of Water and Wastes and Test Methods for Evaluating Solid Waste (SW 846). He has assisted in the preparation of planning documents and cost proposals for the following contracts: USACE-Baltimore District: HTRW Branch, USAEC (Army Total Environmental Program [ATEPs] and Environmental Services Program Support [ESPS] contracts), and the Hazardous Waste Remedial Actions Program (HAZWRAP). He has assisted in the preparation of several plans and conducted laboratory audits for the USAEC program using U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) Quality Assurance Program (PAM 11-41) and Guidelines for the Implementation of ER 1110-1-263. He also is familiar with analytical methods prepared by the German Institute of Norms used for sample analyses under contract with the USACE-Europe District.

Mr. Skibinski's experience with environmental monitoring data also includes the evaluation of analytical data for nonconformance under the EPA Contract Laboratory Program (CLP) for inorganic (CLP SOW 7/88 and 3/90) and organic analyses (CLP SOW 2/88 and 3/90) and tentatively identified compound (TIC) evaluations. He has validated environmental data quality for several investigations: Buckley ANGB RI; Fort Wayne ANGB SI; General Mitchell International Airport RI; Gowen Field ANGB Site Inspection Addendum; Joe Foss Field ANGB RI; Hill AFB RI; Lowry AFB RI; Toledo Express Airport SI; Utah Testing and Training Range, Hill AFB, North Range Sites SI; and Wright-Patterson AFB Underground Storage Tank (UST) Investigation. The TIC evaluations were conducted for the Wright-Patterson AFB SI and Toledo Express Airport SI. These evaluations consisted of classifying the compounds detected as either laboratory contaminants, degradation products of source material compounds, non-target compound list compounds in source material, or as naturally occurring compounds.

Mr. Skibinski has managed environmental quality data for the following investigations: Buckley ANGB Phase II RI; Fort McClellan SI; Fort Wayne ANGB SI; General Mitchell International Airport RI; Gowen Field ANGB SI Addendum; Hill AFB RI; Joe Foss Field ANGB RI; Juncos Landfill RI, Juncos, Puerto Rico; Lowry AFB RI; Toledo Express Airport Suspected Floating Product Investigation; Toledo Express Airport SI; USCG Support Center, Kodiak Island RFI/CMS; Utah Testing and Training Range, Hill AFB, North Range Sites SI; and Wright-Patterson AFB SI. In addition, Mr. Skibinski has provided major technical direction for the creation of the sample tracking system and data/sample management activities. This system is a Microsoft® FoxPro for Windows based program to print sample labels and chain-of-custody (CoC) forms in the field, track samples through the laboratories, create data presentation tables, and statistically manipulate data for use in risk assessment and other technical evaluations.

Mr. Skibinski has written data management plans for the following USAEC investigations: Anniston Army Depot – Chemical Storage Area RI/FS; Fort McClellan RI/FS; Newport Army Ammunition Plant RFI; Louisiana Army Ammunition Plant 5-Year Review; Newport Army Ammunition Plant RFI/CMS; Tooele Army Depot – North Area Group B Suspected Release SWMUs Phase II RFI; and Tooele Army Depot – South Area Phase II RFI Group 3 Suspected Releases SWMUs.

Mr. Skibinski is an experienced field chemist and has expertise in the following areas: supervision of hollow-stem auger drilling operations, dual-wall reverse air percussion hammer drilling operations, and wire-line rock coring; subsurface soil sampling using a standard split-spoon sampler, shallow soil sampling using core-barrels with sleeves, and soil sampling from UST excavation pits; monitoring well installation, development, and purging; aquifer characterization using a rising head well test; sampling UST contents for removal actions; and UXO surveys. Mr. Skibinski has participated in the sampling of surface water, sediment, soil, and groundwater as well as sample preparation, handling, documentation, and shipping at the following sites: Fairchild AFB RI/FS; Fort George G. Meade UXO Survey Data Analysis – BRAC Parcel; Gowen Field ANGB Phase II – SI; Newport Chemical Depot – Little Raccoon Creek RFI; Seneca Army Depot UST Closure; Toledo Express Airport SI; Tooele Army Depot – North Area Group B Suspected Release SWMUs Phase II RFI; Tooele Army Depot –

North Area Group C Suspected Release SWMUs Phase II RFI; Tooele Army Depot – South Area Phase II RFI Group 3 Suspected Releases SWMUs; U.S. Coast Guard Support Center, Kodiak, Alaska RFI/CMS; and, Walter Reed Army Medical Center SI.

Mr. Skibinski has participated in environmental compliance assessments (ECAS) conducted for the USCOE. These assessments included environmental compliance assessments at Army facilities with 17 Federal regulations (e.g., Clean Water Act, Safe Drinking Water Act, CERCLA), Army Regulation (AR) 200-1, and state laws. He participated in ECAS at the following facilities: Cameron Station, Virginia; Fort Meyer, Virginia; Fort Monroe, Virginia; and United States Military Academy, West Point, New York.

COMPUTER PROFICIENCY:

Mr. Skibinski is proficient in the use of the following software programs/operating systems:

- Decisioneering Crystal Ball® Pro (version 4.0)
- Expert Choice® (version 11)
- Microsoft® Windows and Office 2003
- Pallisade @Risk (version 3.0)

MISCELLANEOUS:

- Presenter *Demonstration of a Method to Assess Explosives Safety Risk* and *Selecting And Implementing Interim Land Use Controls At The Former Nansemond Ordnance Depot* on 5 September 2002 at the UXO/Countermine 2002 Forum that was held in Orlando, Florida.
- Co-author "Using Machine Learning to Complement and Extend the Accuracy of UXO Discrimination Beyond the Best Reported Results of the Jefferson Proving Ground Technology Demonstration," Society for Modeling and Simulation International's Advanced Technology Simulation Conference, San Diego, California, April 2002. Other authors include Larry M. Deschaine (SAIC & Chalmers Univ. of Tech); Richard A. Hoover and Janardan J. Patel (SAIC); Frank

D. Francone (Chalmers Univ. of Tech. & Register Machine Learning Technologies); and M. J. Ades.

- Co-presenter of *Underlying Logic Of Developing Risk-Based Methods For UXO/Countermine Programs* at the UXO/Countermine Forum 2001 that was held in New Orleans, LA in April 2001.
- Presented *Risk Assessment, Decision Analysis, and Public Outreach: Pieces of the OE Response Puzzle* at the Severn Trent Laboratories 2nd Annual Louisville Meeting, 5 June 2001.
- One of four people on the Range Rule Risk Methodology team winning SAIC's Annual Environmental Excellence Award, 2000.
- Presenter, "Probabilistic Risk Assessment of Exposure to UXO - Fort George G. Meade, Maryland," AMEREM '96 International Conference on "The World of Electromagnetics", Albuquerque, New Mexico, 28 May 1996.
- Co-author, "Contaminated Army Site Object of Novel Analysis," National Defense Journal, 1995.
- Co-author, "Statistical Trend Analysis of Groundwater at Louisiana Army Ammunition Plant," Hazardous Materials Control Resources Institute's Superfund Conference Proceedings, 1994.

CUSTOMERS:

- Hazardous Waste Remedial Actions Program (HAZWRAP)
- U.S. Army Environmental Command (USAEC)
- U.S. Army Corps of Engineers (USACE)
- U.S. Coast Guard (USCG)
- U.S. Department of Energy (DOE)
- U.S. Navy
- Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina (WSRC)

EXHIBIT JNS #2

USEPA (U.S. Environmental Protection Agency). 1998. EPA Guidance For Quality Assurance Project Plans – EPA QA/G-5, Appendix B (Glossary Of Quality Assurance And Related Terms). EPA/600/R-98/018. Office of Research and Development, Washington, D.C. February.

United States Environmental Protection Agency | Office of Research and Development Washington, D.C. 20460 | EPA/600/R-98/018 February 1998

EPA GUIDANCE FOR QUALITY ASSURANCE PROJECT PLANS

EPA QA/G-5

APPENDIX B

GLOSSARY OF QUALITY ASSURANCE AND RELATED TERMS

Acceptance criteria — Specified limits placed on characteristics of an item, process, or service defined in requirements documents. (ASQC Definitions)

Accuracy — A measure of the closeness of an individual measurement or the average of a number of measurements to the true value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; the EPA recommends using the terms *"precision"* and *"bias"*, rather than "accuracy," to convey the information usually associated with accuracy. Refer to *Appendix D, Data Quality Indicators* for a more detailed definition.

Activity — An all-inclusive term describing a specific set of operations of related tasks to be performed, either serially or in parallel (e.g., research and development, field sampling, analytical operations, equipment fabrication), that, in total, result in a product or service.

Assessment — The evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation (PE), management systems review (MSR), peer review, inspection, or surveillance.

Audit (quality) — A systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

Audit of Data Quality (ADQ) — A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

Authenticate — The act of establishing an item as genuine, valid, or authoritative.

Bias — The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). Refer to *Appendix D, Data Quality Indicators*, for a more detailed definition.

Blank — A sample subjected to the usual analytical or measurement process to establish a zero baseline or background value. Sometimes used to adjust or correct routine analytical results. A sample that is intended to contain none of the analytes of interest. A blank is used to detect contamination during sample handling preparation and/or analysis.

Calibration — A comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments.

Calibration drift — The deviation in instrument response from a reference value over a period of time before recalibration.

Performance Evaluation (PE) — A type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst or laboratory.

Pollution prevention — An organized, comprehensive effort to systematically reduce or eliminate pollutants or contaminants prior to their generation or their release or discharge into the environment.

Precision — A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions expressed generally in terms of the standard deviation. Refer to *Appendix D, Data Quality Indicators,* for a more detailed definition.

Procedure — A specified way to perform an activity.

Process — A set of interrelated resources and activities that transforms inputs into outputs. Examples of processes include analysis, design, data collection, operation, fabrication, and calculation.

Project — An organized set of activities within a program.

Qualified data — Any data that have been modified or adjusted as part of statistical or mathematical evaluation, data validation, or data verification operations.

Qualified services — An indication that suppliers providing services have been evaluated and determined to meet the technical and quality requirements of the client as provided by approved procurement documents and demonstrated by the supplier to the client's satisfaction.

Quality — The totality of features and characteristics of a product or service that bears on its ability to meet the stated or implied needs and expectations of the user.

Quality Assurance (QA) — An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

Quality Assurance Program Description/Plan — See *quality management plan.*

Quality Assurance Project Plan (QAPP) — A formal document describing in comprehensive detail the necessary quality assurance (QA), quality control (QC), and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. The QAPP components are divided into four classes: 1) Project Management, 2) Measurement/Data Acquisition, 3) Assessment/Oversight, and 4) Data Validation and Usability. Requirements for preparing QAPPs can be found in EPA QA/R-5.

Quality Control (QC) — The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality. The system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring the results are of acceptable quality.

Quality control (QC) sample — An uncontaminated sample matrix spiked with known amounts of analytes from a source independent of the calibration standards. Generally used to establish intra-

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before Administrative Judges:

Alan S. Rosenthal, Chair
Dr. Paul B. Abramson
Dr. Richard F. Cole

In the Matter of	)	Docket No. 40-8838-MLA
	)	
U.S. ARMY	)	ASLBP No. 00-776-04-MLA
	)	
(Jefferson Proving Ground Site)	)	August 15, 2007
	)	

AFFIDAVIT OF JOSEPH N. SKIBINSKI

County of Prince William)
State of Virginia)

I, Joseph N. Skibinski, being duly sworn according to law, depose and state the following:

1. I am an Environmental Chemist and Human Health Risk Assessor with Science Applications International Corporation (SAIC) in their Reston, Virginia office. I also serve as a Section Manager for SAIC that includes eight scientists and engineers with technical expertise including statistical analysis, human health and ecological risk assessment, and fate and transport simulation and optimization. My business address is 11251 Roger Bacon Drive, Reston, Virginia 20190.

2. I am providing testimony, dated August 15, 2007, on behalf of the U.S. Army, Licensee, in the above captioned proceeding, entitled "TESTIMONY OF JOSEPH N. SKIBINSKI."

3. The factual statements and opinions I express in the cited testimony are true and correct to the best of my personal knowledge and belief.

4. I declare under penalty of perjury that the foregoing is true and correct.

Further, the affiant sayeth not.

Joseph N. Skibinski

Subscribed and sworn to before me
this 15th day of August, 2007.

Christiana Kittrell
Notary Public

My commission expires 10/31/08
NRN# 298280

CHRISTIANA KITTRELL
NOTARY PUBLIC
Commonwealth of Virginia
My Commission Expires Oct. 31, 2008

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NUCLEAR REGULATORY COMMISSION

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	)	

TESTIMONY OF PAUL D. CLOUD

I. WITNESS BACKGROUND

Paul D. Cloud ("PDC")

Q1. Please state your full name.

A1. (PDC) My name is Paul D. Cloud.

Q2. By whom are you employed and what is your position?

A2. (PDC) I am a U. S. Army civilian employee. I am the U. S. Army's Radiation Safety Officer for the Jefferson Proving Ground (JPG) site. I have been the Radiation Safety Officer for JPG since June 1, 2006. I am also the U. S. Army's Base Realignment and Closure (BRAC) Base Environmental Coordinator (BEC) responsible for the oversight, funding and management of the JPG nuclear materials license SUB-1435. I have been the BRAC BEC for JPG since January 15, 1994.

Q3. Are you familiar with the JPG Restoration Advisory Board ?

A3. (PDC) Yes. As the BRAC BEC for JPG, I was the Co-Chairman of the JPG Restoration Advisory Board (RAB) from its creation in June of 1994 until its termination in November 2006.

Q4. Are you familiar with the testimony offered by Diane S. Henshel in this hearing?

A4. (PDC) Yes, I have reviewed her written testimony dated July 20, 2007.

Q5. Are you also familiar with her service as a consultant with respect to the Army's Jefferson Proving Ground?

A5. (PDC) Yes, I am.

Q6. Do you agree with the description of her service as consultant pertaining to JPG which she gives in her Answer ?

A6. (PDC) No.

Q7. Please state the basis for your disagreement.

A7. (PDC) Ms. Henshel states that she was "technical advisor to the JPG Restoration Advisory Board (RAB) from 1999 through 2003 providing technical document review and interpretation assistance to the RAB."

In fact, Ms. Henshel was the technical advisor for the community members of the JPG RAB only and was employed in that position under the Department of Defense's (DOD) Technical Assistance Participation Program (TAPP) which was funded by the Army. It should also be noted that Ms. Henshel's involvement with the JPG RAB was restricted to the area of JPG below the firing line and was associated only with the potential environmental contamination and restoration of this portion of JPG. The portion of JPG below the firing line has no connection with these NRC proceedings. Ms. Henshel has had no official or formal involvement or participation in any JPG DU activities as an advisor to the JPG RAB under the DOD TAPP program

Q8. Does that conclude your testimony?

A8. (PDC) Yes, it does.

AFFIDAVIT OF PAUL D. CLOUD

County of Harford)
State of Maryland)

I, Paul D. Cloud, being duly sworn according to law, depose and state the following:

1. I am a Department of the Army civilian employee. I am the Army's Radiation Safety Officer for the Jefferson Proving Ground (JPG) site. I am also the U. S. Army's Base Realignment and Closure (BRAC) Base Environmental Coordinator (BEC) responsible for the oversight, funding and management of the JPG nuclear materials license SUB-1435. My business address is 5183 Blackhawk Road, Building E5183, Room 5, Aberdeen Proving Ground, Maryland 21010.

2. I am providing testimony, dated August 11, 2007, on behalf of the U.S. Army, Licensee, in the above captioned proceeding, entitled "TESTIMONY OF PAUL D. CLOUD."

3. The factual statements and opinions I express in the cited testimony are true and correct to the best of my personal knowledge and belief.

4. I declare under penalty of perjury that the foregoing is true and correct.

Further, the affiant sayeth not.

Paul D. Cloud

Paul D. Cloud

Subscribed and sworn to before me
this 11th day of August, 2007.

Colleen M McKinney

Notary Public

My commission expires 1/6/2011

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before Administrative Judges:

Alan S. Rosenthal, Chair
Dr. Paul B. Abramson
Dr. Richard F. Cole

In the Matter of	)	Docket No. 40-8838-MLA
	)	
U.S. ARMY	)	ASLBP No. 00-776-04-MLA
	)	
(Jefferson Proving Ground Site)	)	August 17, 2007
	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of:

- Army's Initial Statement of Position on Save The Valley Contention B-1, dated August 17, 2007;
- Testimony of Stephen M. Snyder on STV Contention B-1, Basis Items "a," "d," "e," and "f", dated August 15, 2007;
- Testimony of Todd D. Eaby on STV Contention B-1, Basis Items "b", "c", "g", "h" and "i", dated August 2, 2007; Testimony of Michael L. Barta on STV Contention B-1, Basis Items "n" And "o", dated August 15, 2007;
- Testimony of Harold W. Anagnostopoulos on STV Contention B-1, Basis Item "m" and on Certain Testimony of Henshel and Norris, dated August 15, 2007;
- Testimony of Joseph N. Skibinski, dated August 15, 2007; and
- Testimony of Paul D. Cloud, dated August 2, 2007;

filed on August 17, 2007 in the above-captioned proceeding have been served on the following persons by U. S. Mail, first class, and (as indicated by asterisk) by e-mail this 17th day of August, 2007:

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Dated August 17, 2007

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