APPENDIX A

OE*Cert* ANALYSIS REPORT

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FORMER BENICIA ARSENAL
OE*Cert* ANALYSIS
DRAFT FINAL REPORT

For EarthTech, Inc.
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The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Corps of Engineers position, policy, or decision, unless so designated by other official documentation.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (Continued)

BENICIA ARSENAL OE*Cert* ANALYSIS

DRAFT FINAL REPORT

1.0 INTRODUCTION

QuantiTech, Inc. was contracted by EarthTech, Inc. to apply the Ordnance and Explosives Cost-Effectiveness Risk Tool (OE*Cert*) in the evaluation of risk due to ordnance and explosives (OE) at the former Benicia Arsenal in Benicia, California. OE*Cert* was developed by QuantiTech and USAESCH to assess the public risk due to ordnance at formerly used military training and defense sites. The methodology has undergone numerous peer reviews, has been the focus of several conference presentations, and has been applied at over 40 OE sites across the United States by QuantiTech.

During this risk analysis, QuantiTech utilized the standard operating procedures (SOP) for OE*Cert* developed by USAESCH to evaluate the number of exposures by members of the public to unexploded ordnance (UXO). Expected land uses and activities, expected amounts of surface ordnance, and expected amounts of subsurface ordnance are key factors in the assessment. The expected amount of surface and subsurface ordnance located at Benicia Arsenal was based on an evaluation of the sector-specific sampling data and data resulting from excavations at the site performed by Granite Management.

QuantiTech also performed a comparative risk analysis to (1) compare the expected number of annual UXO exposures calculated for Benicia Arsenal to the exposure numbers calculated for other sites, and (2) compare the expected number of injuries or deaths due to UXO incidents to those expected from everyday common sources or activities at the site. These two frames of reference provide a defensible basis for addressing the relative risk to the public at Benicia Arsenal when compared to other sites that are potentially contaminated with UXO and when compared to risk exposure from common sources or everyday activities.

This report documents both the results and parameters used in the risk analysis. Specific technical references and analysis details are provided in the appendices that include:

Appendix A - SiteStats Summary

Appendix B - Participation Data

Appendix C - OE*Cert* Estimating Description and Example

Appendix D - Risk Estimates

Appendix E - Comparative Risk Analysis for Benicia Arsenal

Appendix F - OE*Cert* Standard Operating Procedures

Appendix G - Benicia Arsenal Bibliography.

2.0 APPLICATION OF OE*Cert*

There are two general categories of sites OE*Cert* considers when estimating risk, "dispersed" sites and "localized" sites. "Dispersed" sites are defined as sites contaminated with UXO as the result of training activities, accidents, kick-outs surrounding the open burning/open detonation of ordnance, etc. The ordnance located at "dispersed" sites is generally assumed to have undergone some force (i.e., firing, burning, or attempted detonation) that should have caused the ordnance item to function. A defining characteristic regarding "dispersed" sites is that they can be broken down into sub-areas, or sectors, that contain the same expected amount of ordnance, are expected to have the same current and future land uses, and exhibit similar terrain features. SiteStats methods were used to estimate sampling requirements for each sector. Appendix A provides further information concerning the sampling and UXO density characterization methods. "Localized" sites are defined as sites contaminated with UXO as the result of depot activities, burial of ordnance, etc. Ordnance at localized sites may be found in large quantities such as stockpiles or trenches or in small quantities such as abandoned ordnance items. Generally, no assumptions are made regarding the dispersion of localized areas within a site.

OE*Cert* measures risk by quantifying how often people are exposed to UXO when participating in commonly performed activities at a site, e.g., child play, hiking, etc. A UXO exposure, as defined by OE*Cert* methodology, is based on the proximity of an individual to UXO. This proximity can also be described as the "shadow" of the individual as it crosses over a UXO item. Each OE*Cert* activity has a proximity, or shadow area, estimated based on its statistical path width. For example, hiking has a 2-foot path width or proximity measured along the distance the individual travels. The individual does not have to specifically touch or know the item is present for an exposure to occur. This methodology yields a conservative estimate of UXO exposures. It is important to note that OE*Cert* estimates exposures only, not ordnance-related accidents. The presence of ordnance exposures does not necessarily indicate that an incident or injury will occur. The comparative risk analysis methodology translates the accumulated UXO exposures into the chance of a UXO-related injury or death.

The risk of being exposed to UXO is driven by the amount of surface coverage and subsurface intrusion associated with various site activities. For example, child play is an activity that includes surface coverage (the child roaming the area) and a small amount of subsurface intrusion (digging or playing near loose soil). Hiking is an example of an OE*Cert* activity that only has a surface component. The rationale for allocating surface area and subsurface area for each activity is thoroughly documented in Version E of the Ordnance and Explosives Cost-Effectiveness Risk Tool, dated 31 August 1995.

The number of participants in activities is based on a detailed review of the site land use along with the demographics of the surrounding community. The land use review and demographic data collection is specifically tailored to the site under analysis. If it is known how many participants will access a site, then the specific number of participants can be substituted for demographic data. The OE*Cert* methodology incorporates detailed parameters for recreational activity and age group participation based on factors extracted from the American Sports Analysis Summary Report, 1992. This document provides participation statistics for a myriad of recreational activities broken down by age group and geographic region.

Public risk exposure to UXO occurs when individuals participate in specific activities (both recreational and occupational) within UXO-contaminated areas. The expected number of **surface** UXO exposures per participant in an area is dependent on UXO density, the proportion of UXO on the surface of the ground, and the activity participant's exposure area (the area traversed by an individual while performing an activity). The expected number of **subsurface** UXO exposures per participant in an area is dependent on the UXO density, the proportion of UXO beneath the surface of the ground, the ordnance depth distribution of the subsurface UXO, and the associated area in which an activity is performed.

The calculation of the total expected number of UXO exposures at a site follows a step-by-step process. First, for each area, the expected number of exposures for a single individual participating in each activity is calculated. Second, the number of individuals that are expected to participate annually in that activity on the site is quantified based on the demographics (e.g., population) surrounding the site and activity participation data. It is important to note that each time a person is identified as an activity participant, the overall number of participants is increased by one (i.e., if an individual hikes through a site 25 times in a year, then that individual accounts for 25 entrants to the site, not just one). The individual exposure number and the number of participants are then multiplied as shown in the following relationship yielding the total annual number of exposures expected to occur for participants in the activity that was identified:

$$E[\text{Activity Exposures}] = E[\text{exposures for single participant}] \bullet E[\text{annual participants}].$$

These calculations are then performed for each activity occurring at the site. The values for the expected number of exposures resulting from participation in each activity are summed to yield the overall risk value for the site as follows:

$$E\left[\text{Total Exposures}\right] = \sum^{\text{all activities}} E\left[\text{Activity Exposures}\right].$$

3.0 CHARACTERIZATION OF BENICIA ARSENAL, CALIFORNIA

Sufficient characterization is the cornerstone of a credible risk analysis for sites potentially contaminated with UXO. Site characterization includes (1) an archive search, (2) an estimate of the residual UXO, (3) an assessment of both current and future land usage, and (4) an assessment of public access. The first step in the characterization process is to compose a site history by reviewing archives and other pertinent information to determine former military usages. This site history facilitates the identification of potential areas within the site that are likely to have residual UXO based on former land usage. The second step is to perform both surface and subsurface sampling of magnetic anomalies in each area or sector to obtain an estimate of residual UXO. Third, an assessment of the current and future land usage determines the activities that can be expected to occur within each sector. Finally, the participants in the expected activities, along with an assessment of public access (either restricted or unrestricted), comprise the pool of potential exposures to residual UXO.

3.1 SITE HISTORY

Benicia Arsenal was created on August 25, 1851, and during November of that year it was made the principal depot for ordnance and ordnance stores for the Division of the Pacific. Benicia Arsenal furnished ordnance supplies to all troops west of the Rockies during World War I. By 1920 it was a manufacturing arsenal and proving ground. Between World War I and World War II, Benicia Arsenal was used to reship ordnance supplies to Hawaii, the Philippines, Cuba, and Alaska. Benicia Arsenal was used extensively as a trans-shipment point for chemical warfare material and conventional ordnance during the World War II period. Benicia Arsenal existed from 1851 until it was declared excess in 1962. Activity at Benicia Arsenal ended in 1964.

3.2 UNEXPLODED ORDNANCE ASSESSMENT

To estimate residual levels of UXO, surface UXO were identified and subsurface UXO were sampled during field investigations. Prior to field sampling, Benicia Arsenal was divided into six distinct investigation areas or sectors. These sectors were individually delineated based on historical ordnance information and discoveries, geographic features, and detailed military uses as documented in the Benicia Arsenal Archive Search Report. Sampling grids were randomly placed throughout each sector where rights of entry were granted. Sampling was limited in Sector 2 at Benicia Arsenal because no rights of entry were granted. The UXO density applied in the Sector 2 risk assessment was derived via analogy to the UXO density estimated for the southern portion of Sector 3. This analogy is considered appropriate due to the similar historical land uses and the geographic proximity of Sectors 2 and 3. Samples were taken in the remaining sectors at Benicia Arsenal to allow potential residual UXO contamination to be statistically estimated as required by the OE*Cert* risk methodology. Excavation activities were conducted by Granite Management within the investigation sectors at Benicia Arsenal during February of 1997. The subsurface data collected during these excavations was incorporated in the statistical density estimation process.

All sectors were determined to be homogeneous by the application of SiteStats with the exception of Sector 3. Analysis of site sampling data resulted in three OE cluster areas being identified within Sector 3: 1) a central area where both UXO and OE-related items were found;

2) a southern area where both UXO and OE-related items were found; and 3) a northern portion of Sector 3 where no OE-related items were found. These cluster areas of Sector 3 were evaluated individually for residual density estimation (annotated as 1, 2, and 3). These cluster OE density areas are referenced in Table 3.2-1 and are incorporated in the risk evaluations for Sector 3a and 3b. Sectors 3a and 3b were reevaluated by SiteStats and were confirmed to be individually homogeneous. Sector 3c is evaluated as homogeneous by qualitative assessment as no OE items were found in any of the sampled grids.

Subsurface anomalies were investigated to a depth of four feet during the field sampling activities at Benicia Arsenal. A total of 23 UXO items (1 surface and 22 subsurface) were found during field investigation and during the Granite Management excavations. These UXO items were located in Sectors 3a, 3b, and 5. Appendix A provides details of the individual sector characterization methods and results. Sampling results provided data to statistically estimate residual UXO densities and depth distributions to a depth of four feet.

Statistical methods were used to estimate surface and subsurface ordnance contamination levels at Benicia Arsenal. Both in sectors where UXO was found and also in sectors where no UXO was found, an analysis using the USAESCH UXO Calculator Tool was used. This statistical analysis yields a probabilistic UXO density estimate based on sector area, sampled area, and the number of UXO items found. In the case with no UXO found, the CEHNC UXO Calculator Minimum Discrimination Level assessment provides a density limit (i.e., total number of surface or subsurface UXO items "x" in the sector) at which there is a 90% probability that, given the amount of sampling that occurred in the sector, at least one UXO item would have been found. For example, 4.20 acres were sampled in Sector 4 and no UXO items were found. The result for this sector yielded a probabilistic density estimate of 0.53 UXO per acre or 29 total UXO over 54 acres (See Table 3.2-1). If the actual number of UXO items in Sector 4 were greater than 29 (0.53/acre), then 90% of the time at least one UXO item should have been found during sampling of 4.20 acres. This calculated probabilistic density estimate for each sector was used as the maximum density input for OE*Cert* exposure calculations. It follows that there is 90% confidence in the assertion that the exposures calculated by OE*Cert* based on this density range are representative of the upper limit on exposures that can be expected in the sector due to either surface or subsurface UXO.

The assessment of surface and subsurface density in sectors where UXO was found is based on a confidence interval approach. The CEHNC UXO Calculator Variance Module was applied to provide a minimum and maximum UXO density at a 90% test probability. This estimate is interpreted as being 90% confident that the density for a sector is between the maximum and minimum numbers of UXO given by the Variance Module. For example, in Sector 5 where 15 UXO items were found, the 90% confidence interval estimates that between 129 and 241 residual UXO items may be present based on the sampling of 3.05 acres. The UXO densities associated with the 90% confidence interval results were input to the OE*Cert* to determine a range of expected exposures. Table 3.2-1 shows the resulting UXO density estimates calculated and applied in the OE*Cert* exposure calculations.

Table 3.2-1. Preliminary Sector Characterization for Estimated Remaining UXO

Sector	Estimated Area (Acres)	Effective Sampled Area (Acres)	Sampled Grids (100' x 100')	OE Scrap Found (Number of Items)	Number of UXO Items Found* During Sampling	Estimated UXO per Acre (90% Upper Confidence)
1 - Revetment Area	68	4.41	24	No	0	No Evidence of OE
2 - Artillery Test Area**	15	N/A	N/A	N/A	N/A	2.09 - 5.55
3a - Tourtelot Property(1)	131	12.50	55	Yes (98)	2	2.11 - 4.31
3b - Tourtelot Property(2)	47	1.88	12	Yes (269)	6	2.09 - 5.55
3c - Tourtelot Property(3)	34	1.83	8	No	0	No Evidence of OE
4 - Demolition Site on Exxon Property	54	4.20	20	Yes (48)	0	0 - 0.53
5 - Camel Barn Area	35	3.05	20	Yes (84)	15 (1 surface)	3.69 - 6.89
OT01 - Overturned Truck Area	0.23	None***	None	-	-	-
Total	**384.23**	**27.87**	**139**	**499**	**23**	**N/A**

* All are subsurface UXO except as noted.

** Density estimation made by analogy to Sector 3b.

*** No sampling due to rights of entry restrictions.

(1) Cluster Area 1

(2) Cluster Area 2

(3) Cluster Area 3

An OE depth distribution was developed based solely on the results of the site investigation sampling. Depth data was not available for the Granite Management excavations, therefore the ordnance depth distribution estimated for this risk analysis did not include any UXO or OE-related material discovered as a result of these activities. Approximately 516 ordnance-related items were found during sampling including 17 individual UXO items. These ordnance-related items (including UXO and OE scrap) were located in four of the sampled sectors. Actual UXO items were located during sampling in Sectors 3b and 5. Table 3.2-2 presents the depth distributions applied in the risk analysis across the sectors at Benicia Arsenal. An expected ordnance depth analysis would show that OE items have the potential to be found at depths even beyond the 4-foot sampling investigation depths. However, based on the extensive sampling evidence, the percentage of OE items at depths beyond four feet is likely to be very small. Additionally, the primary site activities are assumed to be intrusive to 1-foot depths or less, so that the sampling data provides a sufficient data set for the OE*Cert* risk assessment.

Major construction is anticipated in all sectors except Sector 4. Construction activity is assumed to be intrusive to a depth of 10 feet. However, construction activities in Sectors 3a and 3b will be preceded by some form of ordnance risk remediation. In these sectors, either the soil

will be removed until the bedrock layer is reached prior to construction or a 10-foot layer of clean soil will be placed on top of the existing surface area prior to construction.

Table 3.2-2. Benicia Arsenal OE Sampling Depth Distribution

Sector	Number of OE Items Found on Surface (Percent)	Number of OE Items from 0-1 Foot (Percent)	Number of OE Items from 1-2 Feet (Percent)	Number of OE Items from 2-3 Feet (Percent)	Number of OE Items from 3-4 Feet (Percent)
1*	N/A	N/A	N/A	N/A	N/A
2*	N/A	N/A	N/A	N/A	N/A
3a	6 (6.12)	75 (76.53)	17 (17.35)	0 (0)	0 (0)
3b	23 (8.55)	195 (72.49)	44 (16.36)	6 (2.23)	1 (0.37)
3c*	N/A	N/A	N/A	N/A	N/A
4	3 (6.25)	41 (85.42)	4 (8.33)	0 (0)	0 (0)
5	8 (9.52)	66 (78.57)	4 (4.76)	6 (7.14)	0 (0)
Total	**40 (8.02)**	**377 (75.55)**	**69 (13.83)**	**12 (2.40)**	**1 (0.20)**

* No OE Items found during sampling.

In Sectors 3a and 3b, the average depth distribution of the two sectors was used. This depth distribution was also applied via analogy to Sector 2. In Sector 4 and Sector 5, the actual sampled depth distributions were used.

3.3 SITE LAND USE AND ACTIVITIES

The expected number of UXO exposures calculated for a site potentially contaminated with ordnance depends greatly on the activities that are expected to occur and draw members of the public to the site. The majority of the sectors at Benicia Arsenal consist of residential or industrial land use.

One of the sectors at Benicia Arsenal (Sector 3b) will be left as open space and was assumed to be used primarily for activities that were more residential and recreational in nature. The occupational activity of construction was also identified as expected land use in all sectors (excluding Sector 4). Table 3.3-1 presents the OE*Cert* activities that were applied in the Benicia Arsenal risk assessment based on the current and future land uses described for the site.

Table 3.3-1. Benicia Arsenal OE*Cert* Activities

Sector	Current Land Use						Future Land Use				
	Hiking	Mountain Biking	Short Cuts	Fire Control	Child Play	Construction	Hiking	Mountain Biking	Picnicking	Short Cuts	Fire Control
2			✓			✓				✓	
3a			✓		✓	✓			✓	✓	
3b	✓	✓			✓	✓	✓	✓	✓		
4	✓			✓			✓				✓
5	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓

OT-2761-J-042199

Estimates for the number of participants expected in each activity were based on the population of the city of Benicia and standard OE*Cert* participant estimating methodology. The Benicia Arsenal Archive Search Report states that Benicia City has a population of 24,437, and that Benicia Industrial Park employs over 7,000 people. These numbers of participants were divided between the expected activities at Benicia Arsenal based on the standard OE*Cert* methodology. Tables showing the total expected number of participants in each activity at Benicia Arsenal are provided in Appendix B.

4.0 RISK ASSESSMENT PROCESS

The dispersed OE*Cert* methodology is applicable and was used at Benicia Arsenal as prescribed in the OE*Cert* standard operating procedures. An example of the dispersed risk estimating methodology is provided in Appendix C.

4.1 UXO EXPOSURE RESULTS

OE*Cert* integrates residual UXO density, site activities, and public participation to calculate the number of expected UXO exposures. Exposure calculations are based on an individual person participating in each specific activity in a defined risk sector. An assessment of these results provides insight into which activities are the primary contributors to UXO exposure. Appendix D provides a summary of the exposure results.

The following tables (4.1-1a and 4.1-1b) summarize the range of expected annual UXO exposures. OE*Cert* was used to evaluate five risk sectors at Benicia Arsenal for current and future land uses. Tables 4.1-1a and 4.1-1b present a general summary of expected annual UXO exposures for current and future land use categorized into exposures resulting from occupational and recreational land uses. Sectors 1 and 3c were not included in the risk analysis because neither historical evidence nor sampling results indicated that any OE or OE-related scrap was present in either sector. The exposure results are presented in this manner to highlight the fact that the majority of expected UXO exposures estimated for Benicia Arsenal result from public participation in recreational activities (i.e., mountain biking, child play). The "no action" removal option shown in Tables 4.1-1a and 4.1-1b represent the "status quo"; therefore, there is

no expectation of a reduced number of potential UXO items. The number of UXO exposures associated with the other removal options (surface and clearance to depth) indicate reductions in UXO exposures due to the removal of potential UXO items associated with each option. In the Tourtelot Property Sectors (Sectors 3a and 3b), a clearance and clean-up removal option will be performed prior to any construction occurring. In this clearance and clean-up, the sectors will either be cleared down to bedrock or be covered by 10 feet of clean soil. The results of this clearance and clean-up are shown in Tables 4.1-1a and 4.1-1b.

Table 4.1-1a. Expected Annual UXO Exposures at Benicia Arsenal: Current Land Use

Sector	Recreational Activities			Occupational Activities		
	No Action	Surface Removal	Clearance to Depth	No Action	Surface Removal	Clearance to Depth
2	24 - 64	0 - 1	0 - 1	N/A	N/A	N/A
3a	71 - 145	1 - 2	1 - 2	N/A	N/A	N/A
3b	975 - 2,587	10 - 27	10 - 27	N/A	N/A	N/A
4	0 - 17	0 - 1	0 - 1	0	0	0
5	1,544 - 2,882	16 - 30	16 - 30	0 - 1	0 - 1	0
Total	**2,614 - 5,695**	**27 - 61**	**27 - 61**	**0 - 1**	**0 - 1**	**0**

Table 4.1-1b. Expected Annual UXO Exposures at Benicia Arsenal: Future Land Use

Sector	Recreational Activities			Occupational Activities		
	No Action	Surface Removal	Clearance to Depth	No Action	Surface Removal	Clearance to Depth
2	24 - 64	0 - 1	0 - 1	27 - 84	25 - 77	1 - 2
3a	3,484 - 7,117	36 - 72	36 - 72	277 - 565	255 - 521	5 - 10
3b	2,188 - 5,808	23 - 60	23 - 60	99 - 261	91 - 241	2 - 5
4	0 - 17	0 - 1	0 - 1	0	0	0
5	3,487 - 6,509	36 - 67	36 - 67	130 - 243	117 - 220	3 - 6
Total	**9,183 - 19,515**	**95 - 201**	**95 - 201**	**533 - 1,153**	**488 - 1,059**	**11 - 23**

Tables 4.1-2a and 4.1-2b present the range of expected UXO exposures for current and future land use across the five risk sectors at Benicia Arsenal categorized by activity for each of the removal options. Analyzing Tables 4.1-1a and 4.1-2a together, it becomes apparent that mountain biking (recreational activity) is the activity that accumulates by far the largest number of potential exposures to UXO for current land use, and therefore, the most risk to the public. Also by analyzing Tables 4.1-1b and 4.1-2b together, it is apparent that child play (recreational activity) is the activity that accumulates the largest number of potential exposures to UXO for future land use, and therefore, the most risk to the public.

Table 4.1-2a. Total Expected Annual Exposures at Benicia Arsenal: Current Land Use Activity Summary

Activity	No Action	After Surface Removal	After Clearance to Depth
Recreational Activities			
Hiking	749 - 1,642	8 - 18	8 - 18
Mountain Biking	1,770 - 3,884	18 - 40	18 - 40
Short-cutting	95 - 209	1 - 3	1 - 3
Occupational Activities			
Site Management (Fire Control)	0 - 1	0 - 1	0
Total Activities	**2,614 - 5,696**	**27 - 62**	**27 - 61**

Table 4.1-2b. Total Expected Annual Exposures at Benicia Arsenal: Future Land Use Activity Summary

Activity	No Action	After Surface Removal	After Clearance to Depth
Recreational Activities			
Child Play	6,544 - 13,772	68 - 139	68 - 139
Hiking	749 - 1,642	8 - 18	8 - 18
Mountain Biking	1,770 - 3,844	18 - 40	18 - 40
Picnicking	4 - 9	0	0
Short-cutting	116 - 248	1 - 4	1 - 4
Occupational Activities			
Construction	533 - 1,152	488 - 1,058	11 - 23
Site Management (Fire Control)	0 - 1	0 - 1	0
Total Activities	**9,716 - 20,668**	**583 - 1,260**	**106 - 224**

The residual UXO densities used in this risk assessment were based on sampling results and were estimated using a 90% upper confidence level to address uncertainty. Activity levels and activity participation were conservatively estimated through the data collection and OE*Cert* risk assessment process to minimize their uncertainty. Estimation of UXO depth distributions, sweep efficiencies, and other risk parameters were developed from both site data and CEHNC engineering studies. Uncertainty in values for these parameters is accounted for by using the most conservative estimate for each parameter that can be justified based on site-specific conditions.

4.2 COMPARATIVE RISK

The comparative risk process has two components: (1) comparing the expected number of annual UXO exposures calculated for that site to the exposure numbers calculated for other sites, and (2) comparing the expected number of annual injuries or deaths due from UXO incidents to everyday common sources of risks at the site. These two frames of reference provide a defensible basis for addressing the relative risk of Benicia Arsenal when compared to other sites that are potentially contaminated with UXO and when compared to risk exposure from common sources or activities at the site.

Table 4.2-1 presents the expected number of annual UXO exposures for the "no action" or status quo option for each site which has undergone an OE*Cert* risk analysis. This ascending rank order groups the sites according to their expected number of exposures into ranges of very low (0-500), low (501-15,000), medium (15,001-300,00), and high (>300,000). This table clearly addresses the common question of "how risky is this site when compared to other sites contaminated with OE?". The upper 90% probabilistic UXO density estimate was used to calculate the expected number of exposures for each site, therefore the "worst" case or highest number is presented in the table. Specific details for each of the other sites can be found in their associated OE*Cert* report. Table 4.2-1 places Benicia Arsenal in the low range of expected number of UXO exposures for the "worst case" current land use with 5,696 UXO exposures per year. Benicia Arsenal is in the medium range of expected number of UXO exposures for the "worst case" future land use with 20,668 exposures per year.

Table 4.2-1. Site Comparison of Expected Annual UXO Exposures for the "No Action" Option

EXPOSURE RANGE	SITE (ANNUAL EXPECTED EXPOSURES)	
Very Low 0 – 500	Adak, AK	(3)
	Duck Target Facility, Currituck Sound, NC	(7)
	Jefferson Barracks, MO	(10)
	Salton Sea Test Base, CA	(25)
	Camp Greene, NC	(26)
	Camp Grant, IL	(41)
	Nansemond Army Depot, VA	(49)
	Diamond Springs Road Area, MN	(49)
	Pantex Ordnance Plant, TX	(60)
	Waikoloa Maneuver Area, HI	(76)
	Dutch Harbor, AK	(90)
	Camp Croft OOU6, SC	(105)
	Baywood Park, CA	(143)
	Illinois Ordnance Plant, IL	(310)
	Fort Monroe, VA	(356)
	Hancock Range, MS	(433)
Low: 501 - 15,000	Fort Ord EE/CA Phase I Sites, CA	(723)
	Camp McCain, MS	(1,276)
	Attu, AK	(2,007)
	Pole Mountain, WY	(3,424)
	Raritan Arsenal, NJ	(3,598)
	Benicia Arsenal, CA (Current Land Use)	**(5,696)**
	Duck Target Facility, NC	(6,563)
	Buckley Field, CO	(13,447)
	Umatilla, OR	(14,004)
	Motlow Range, TN	(14,277)
Medium: 15,001 - 300,000	McGregor Range, NM	(16,417)
	Camp Bonneville, WA	(16,664)
	Fort Ritchie, MD	(18,332)
	Benicia Arsenal, CA (Future Land Use)	**(20,668)**
	Camp Maxey, TX	(21,992)
	Castner Range, TX	(79,053)
	Fort Hancock, NJ	(86,940)
	Dolly Sods, WV	(90,859)
	Camp Howze, TX	(85,005)
	Culebra Island NWR, PR	(117,930)
	Camp Claiborne, LA	(286,396)
High: > 300,000	Southwest Proving Ground, AR	(449,906)
	Tierrasanta, CA	(774,811)
	Sioux Army Depot, NE	(2,125,955)

The second component of the comparative risk analysis rank orders the expected number of injuries or deaths due to UXO exposures to those expected from common everyday sources of exposure over a one-year period. Figure 4.2-1 presents, in descending order, sources that may cause injury or death in everyday life in the city of Benicia. The number of injuries or deaths for each common source was calculated using accident rate data from the National Safety Council, Accidents Facts, 1996 and multiplying it by the population base in the Benicia Arsenal area (Benicia City). Accident data from 18 sites was employed to develop a probability or risk of UXO accidents given the estimated number of UXO exposures at Benicia Arsenal assuming No Removal action occurs. The comparative risk methodology is documented in the Comparative Ordnance and Explosive Risk Final Report, dated 24 October 1997 available through CEHNC. Figure 4.2-1 depicts the rank ordering of common risk sources according to the expected number of injuries or deaths. From this figure, at Benicia Arsenal, there are 689 annual projected injuries or deaths caused by activities in the home, 379 caused by motor vehicle accidents, and significantly less than one caused by exposure to UXO. By comparison, it is much more hazardous for an individual at Benicia Arsenal to perform common activities in their home or ride in a motor vehicle than to be exposed to UXO.

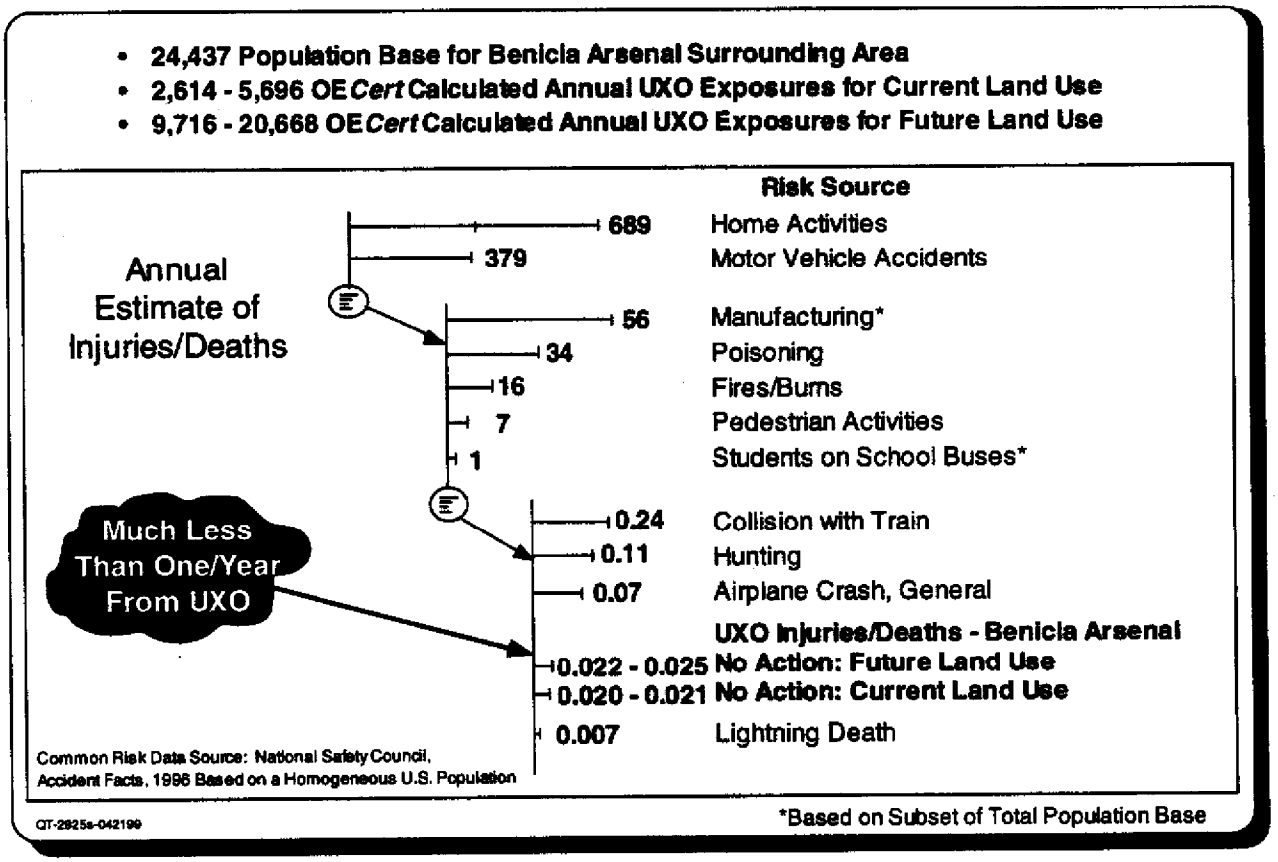

Figure 4.2-1. Benicia Arsenal Comparative Annual Risk Estimate – Injuries and Deaths

5.0 CONCLUSION

The results of the Benicia Arsenal OE*Cert* risk analysis indicate that at most 5,696 UXO exposures can be expected per year due to public participation in current land use activities and at most 20,668 UXO exposures can be expected per year due to public participation in future land use activities. These exposure estimates are based on the expected number of visitors to the site, the expected land uses and activities, and the residual ordnance density. Both the OE*Cert* assessment and the comparative risk analysis utilized conservative population and activity assumptions and confidence level UXO density estimates. It is important to note that OE*Cert* estimates UXO exposures only and not ordnance-related accidents. Exposure to UXO does not necessarily imply that an accident or injury will occur. Historically, UXO-related accidents result from the inappropriate handling of UXO items and involve some application of force or motion.

Compared to other sites that have undergone OE*Cert* analysis, Benicia Arsenal is in the low range of expected annual exposures resulting from current land uses with an estimated 2,614 - 5,696 annual UXO exposures and is in the medium range of expected annual exposures resulting from future land uses with an estimated 9,716 - 20,668 annual UXO exposures. Comparison of the number of expected injuries or deaths resulting from common sources to those from UXO exposure indicates that significantly less than one injury or death is expected at Benicia Arsenal related to UXO exposure annually. This comparison is based on the "no removal action" option for both current and future land uses. The analysis further shows that the chance of an injury or death attributable to UXO occurring at Benicia Arsenal is comparable to the chance of an individual living in the Benicia Arsenal area being killed by a lightning strike.

APPENDIX A

SITESTATS SUMMARY

APPENDIX A

SITESTATS SUMMARY

Under a contract task order from EarthTech, Inc., QuantiTech provided SiteStats/GridStats support during the Benicia Arsenal intrusive OE investigation and sampling. The field investigation contractor for EarthTech, Inc. was USA Environmental.

Area Sampling Plan and Characterization Approach

The Benicia Arsenal OE investigation areas were delineated based on historical records of military use, Archive Search Report site investigation reports, and current land use information. The purpose of sampling in the field investigation areas was to provide information to confirm the possible presence of OE materials, and if necessary, to make a distinction between OE and UXO areas.

Sector Characterization

Data collected from intrusive sampling was used to establish a basis for both site and sector characterization. Table A-1 summarizes the number of grids sampled during the intrusive investigation along with the findings of OE related items and UXO. UXO items were found during sampling in Sectors 3b and 5. OE related items (scrap/frag) were found in 3 of the 6 sectors during sampling. Sampling in Sector 2 was limited and sampling in the Overturned Truck Area was not performed due to rights of entry restrictions. Additional UXO were discovered independently by Granite Management during clearance activities in Sectors 3a and 3b. These UXO items were incorporated into the sampling data for density estimation purposes.

All sectors were determined to be homogeneous by the application of SiteStats with the exception of Sector 3. Sectors 3a and 3b were reevaluated by SiteStats and were confirmed to be individually homogeneous. Sector 3c is evaluated as homogeneous by qualitative assessment as no OE items were found in any of the sampled grids. Incorporation of site sampling data resulted in three OE cluster areas being identified within Sector 3: 1) a central area where both UXO and OE-related items were found; 2) a southern area where both UXO and OE-related items were found; and 3) a northern portion of Sector 3 where no OE-related items were found. These cluster areas of Sector 3 were evaluated individually for residual density estimation (annotated as 1, 2, and 3). These cluster OE density areas are referenced in Table A-1 and are incorporated in the risk evaluations for Sector 3a and 3b. Risk analysis was not performed in Sector 3c because there was no historical evidence of ordnance contamination in the area and no ordnance or ordnance-related scrap was found in the sector during sampling. Risk analysis was not performed in Sector 1 for the same reason.

Using the sampled area and the number of UXO items found during each investigation, a preliminary statistical estimate of the remaining UXO items was made by applying UXO Calculator methods. In those sectors where no UXO items were found, a UXO residual statistical estimate was made based on the probability of finding no UXO in the sampled area. In

sectors where UXO was found during sampling, a confidence interval was computed based on the number of UXO items found. The Overturned Truck Area had no sampling performed. It was not included in the OE*Cert* risk assessment. Sector 2 has insufficient sampling as a result of rights of entry restrictions. A risk analysis of Sector 2 was based on a density analogy drawn from Sector 3b.

Table A-1. Preliminary Sector Characterization for Estimated Remaining UXO

Sector	Estimated Area (Acres)	Effective Sampled Area (Acres)	Sampled Grids (100' x 100')	OE Scrap Found (Number of Items)	Number of UXO Items Found* During Sampling	Estimated UXO per Acre (90% Upper Confidence)
1 - Revetment Area	68	4.41	24	No	0	No Evidence of OE
2 - Artillery Test Area**	15	N/A	N/A	N/A	N/A	2.09 - 5.55
3a - Tourtelot Property(1)	131	12.50	55	Yes (98)	2	2.11 - 4.31
3b - Tourtelot Property(2)	47	1.88	12	Yes (269)	6	2.09 - 5.55
3c - Tourtelot Property(3)	34	1.83	8	No	0	No Evidence of OE
4 - Demolition Site on Exxon Property	54	4.20	20	Yes (48)	0	0 - 0.53
5 - Camel Barn Area	35	3.05	20	Yes (84)	15 (1 surface)	3.69 - 6.89
OT01 - Overturned Truck Area	0.23	None***	None	-	-	-
Total	**384.23**	**27.87**	**139**	**499**	**23**	**N/A**

* All are subsurface UXO except as noted.

** Density estimation made by analogy to Sector 3b.

*** No sampling due to rights of entry restrictions.

(1) Cluster Area 1

(2) Cluster Area 2

(3) Cluster Area 3

APPENDIX B

PARTICIPATION DATA

APPENDIX B

PARTICIPATION DATA

Activity participation parameters for Benicia Arsenal were developed by evaluating land uses and demographic data. The demographic data for Benicia City, California, documented in the Benicia Arsenal Archive Search Report, was used as the basis for the number of participants. The Benicia Arsenal Archive Search Report states that Benicia City has a population of 24,437 and that Benicia Industrial Park employs over 7,000 people. These population numbers were extrapolated across the entire Benicia Arsenal site area to estimate the total number of people that were eligible to participate in activities at the site. These participants were then divided into the various activities expected to occur at Benicia Arsenal using standard OE*Cert* methodology. Ordnance exposures for the construction activity are calculated based on the participation of a single individual. Since construction is a team activity consisting of multiple participants, it is appropriate to multiply the number of ordnance exposures due to construction by the number of construction crew members on-site when this number becomes known. Since construction crew size is currently not known, a participation value of one individual was used in risk calculations. Table B-1 shows the number of participants expected annually for each current activity in each sector at Benicia Arsenal. Table B-2 shows the number of participants expected annually for each future activity in each sector at Benicia Arsenal.

A times-per-year factor was applied to address individuals participating in the same activity at Benicia Arsenal numerous times during a year. The number of expected annual participants shown in Tables B-1 and B-2 was multiplied by the times-per-year factor to provide an estimate of the total number of participants expected for each activity at Benicia Arsenal annually. The times-per-year factor applied in OE*Cert* is based on statistical sources including the American Sport Analysis Summary Report published by American Sports Data, Inc. Escalating the number of participants in this manner is also part of the standard OE*Cert* methodology. Tables B-3 and B-4 show the escalated participation data that was applied in the OE*Cert* analysis of Benicia Arsenal.

Table B-1. Current Land Use Annual Participation Data: Benicia Arsenal

Sector	Area (Acres)	Hiking	Mountain Biking	Short Cuts	Site Management (Fire Control)	Comments
Sector 2	15.0			3,482		Industrial Park
Sector 3a	131.0			3,435		Residential
Sector 3b	47.0	1,452	1,254			Open Space
Sector 4	54.0	417			1	Guarded and Fenced
Sector 5	35.0	1,081	934		1	Recreational and Industrial
Total	**384.00**	**2,996**	**3,095**	**22,702**	**2**	

Table B-2. Future Land Use Annual Participation Data: Benicia Arsenal

Sector	Area (Acres)	Child Play	Construc-tion	Hiking	Mountain Biking	Picnicking	Short Cuts	Site Mgt (Fire Control)	Comments
Sector 2	15.0		1				3,482		Industrial Park
Sector 3a	131.0	11,304	1			172	3,435		Residential
Sector 3b	47.0	4,056	1	1,452	1,254	62			Open Space
Sector 4	54.0			417				1	Guarded and Fenced
Sector 5	35.0	3,020	1	1,081	934	46	918	1	Recreational and Industrial
Total	**384.00**	**21,314**	**6**	**2,996**	**3,095**	**325**	**23,620**	**2**	

Table B-3. Current Land Use Escalated Participation Data: Benicia Arsenal

Sector	Area (Acres)	Hiking	Mountain Biking	Short Cuts	Site Management (Fire Control)	Comments
Sector 2	15.0			33		Industrial Park
Sector 3a	131.0			33		Residential
Sector 3b	47.0	108	33			Open Space
Sector 4	54.0	31			1	Guarded and Fenced
Sector 5	35.0	81	24		1	Recreational and Industrial
Times per Year		**13.4**	**38.5**	**104**	**1**	

Table B-4. Future Land Use Escalated Participation Data: Benicia Arsenal

Sector	Area (Acres)	Child Play	Construction	Hiking	Mountain Biking	Picnicking	Short Cuts	Site Management (Fire Control)	Comments
Sector 2	15.0		1				33		Industrial Park
Sector 3a	131.0	42	1			29	33		Residential
Sector 3b	47.0	15	1	108	33	10			Open Space
Sector 4	54.0			31				1	Guarded and Fenced
Sector 5	35.0	11	1	81	24	8	9	1	Recreational and Industrial
Times per Year		**272**	**1**	**13.4**	**38.5**	**6**	**104**	**1**	

APPENDIX C

OE*Cert* EXPOSURE ESTIMATING DESCRIPTION AND EXAMPLE

APPENDIX C

OE*Cert* EXPOSURE ESTIMATING DESCRIPTION AND EXAMPLE

C.1 OE*Cert* EXPOSURE ESTIMATING DESCRIPTION

The public exposures result from individuals performing specific activities (both recreational and occupational) within UXO-contaminated areas. The expected number of surface UXO exposures per participant in a sector is dependent on UXO density, the proportion of UXO on the surface of the ground, and the activity participant's exposure area (the area traversed by an individual while performing an activity). The expected number of subsurface UXO exposures per participant in a sector is dependent on the UXO density, the proportion of UXO beneath the surface of the ground, the density distribution of the subsurface UXO, and the intrusive area associated with an activity performed in the sector.

The calculation of the total expected number of exposures to UXO at a site follows a step-by-step process. This process is explained in detail in Version E of the Ordnance and Explosives Cost-Effectiveness Risk Tool (OE*Cert*) Final Report, dated 31 August 1995. First, for each sector, the expected number of exposures for a single individual participating in a specific activity is calculated. Second, the number of individuals that are expected to participate annually in that activity on the site is determined based on the demographics (e.g., population) surrounding the site and activity participation data. The two values are combined as shown in the following relationship to give the total annual number of exposures expected to occur for participants in the activity that was identified.

$$E[\text{Activity Exposures}] = E[\text{exposures for single participant}] \bullet E[\text{annual participants}]$$

These calculations are then performed for each activity occurring at the Formerly Used Defense Sites (FUDS). The values for the expected number of exposures resulting from participation in each activity are summed to yield the overall exposure value for the site.

$$E[\text{Total Exposures}] = \sum_{\text{all activities}} E[\text{Activity Exposures}].$$

C.2 OE*Cert* EXAMPLE

Calculating Exposures for Benicia Arsenal (Sector 5, Upper Density Estimate)

The exposures associated with short cutting at Benicia Arsenal involve the calculation of surface exposures. The number of exposures to ordnance for a single individual short cutting in Sector 5 is calculated by multiplying the UXO density by the effective area. The effective area is defined as the minimum of the sector area and the area that an individual covers while short cutting. The resulting value for a single individual exposure is called mu (μ).

To find mu for a density of 6.89 UXO/acre, first find the overall density per square foot for all depths:

density/acre = *6.89* UXO/*acre*

density/sq ft = *6.89/43,560 sq ft*

= *0.0001582* UXO/*sq ft*

Then find the density on the surface by multiplying the overall density by 9.52%, which is the proportion of the ordnance within the surface area for short cutting as calculated from the sampling data:

surface density = *0.0001582* UXO/*sq ft* • *0.0952*

= *0.00001506* UXO/*sq ft*

Finally, calculate mu by multiplying the surface density by the surface effective area (2,787 ft^2).

μ = *0.00001506* UXO/*sq ft* • *2,787 sq ft*

μ = *0.041972*

The expected number of exposures for short cutting is found by multiplying the mu value by the total number of annual participants. The expected number of exposures for a clearance to depth removal action are the same as the expected number of exposures for surface removal because short cutting is a surface only activity (i.e., it is non-intrusive).

The mu value is also used to calculate the probability of an exposure for a single individual. This is done by substituting the mu value into the following equation for calculating probability:

$p(Exp) = 1 - e^{-\mu}$

$p(Exp) = 1 - e^{-0.041972}$

$p(Exp) = 1 - 0.958897$

$p(Exp) = 0.041103$

The expected annual exposures while short cutting are shown in Table C-1. The following assumptions were made: density equals 6.89 UXO/acre and there are 918 annual participants in short cutting. Note that these exposures are calculated from the upper UXO density expected in Sector 5 and are shown only to illustrate the mathematical calculations. Complete exposure calculation results are provided in Appendix D.

Table C-1. Expected Exposures for All Short Cutting Participants in Sector 5 Annually

Removal Option	Expected Exposures
No Removal Action	39
Surface Removal	1
Clearance to Depth Removal	1

APPENDIX D

RISK ESTIMATES

APPENDIX D

RISK ESTIMATES

The estimates provided in this analysis include expected annual exposures to UXO by members of the public participating in various activities. An expected annual exposure is defined by the OE*Cert* methodology as a participant in an activity being in the proximity of ordnance, with or without knowledge of the presence of ordnance.

Each area at Benicia Arsenal has an estimated ordnance density, identified activities, and estimated public participation as described in this report and appendices. Exposure calculations consider the surface area covered during an activity and the subsurface intrusion area of the activity (if one exists). Generally, larger numbers of UXO exposures can be expected in areas with many activities and many public participants in areas where UXO has been found during sampling.

In calculating the exposures for Benicia Arsenal, standard OE*Cert* methodology was used for calculating the effective area for each of the identified activities and also for calculating the annual participants for these activities. Consistent with OE*Cert* methodology, all activities having a computed value of less than 0.1 expected exposures are reported as having zero exposures.

The following tables (D-1 and D-2) summarize the range of expected annual UXO exposures. OE*Cert* was used to evaluate five risk sectors at Benicia Arsenal for current and future land uses. Sectors 1 and 3c were not included in the risk analysis because neither historical evidence nor sampling results indicated that any OE or OE-related scrap was present in either sector. Tables D-1 and D-2 present a general summary of expected annual UXO exposures for current and future land use. The "no action" removal option shown in Tables D-1 and D-2 represents the "status quo"; therefore, there is no expectation of a reduced number of potential UXO items. The number of UXO exposures associated with the other removal options (surface and clearance to depth) indicate reductions in UXO exposures due to the removal of potential UXO items associated with each option. In Sectors 3a and 3b, either the soil will be removed until the bedrock layer is reached prior to construction or a 10-foot layer of clean soil will be placed on top of the existing surface area prior to construction. The results of this clearance and clean-up are shown in Tables D-1 and D-2.

Table D-1. Total Expected Annual UXO Exposures at Benicia Arsenal: Current Land Use

Sector	No Action	Surface Removal Action	Clearance to Depth Removal Action
2	24 - 64	0 - 1	0 - 1
3a	71 - 145	1 - 2	1 - 2
3b	975 - 2,587	10 - 27	10 - 27
4	0 - 17	0 - 1	0 - 1
5	1,544 - 2,883	16 - 31	16 - 30
Total	**2,614 - 5,696**	**27 - 62**	**27 - 61**

Table D-2. Total Expected Annual UXO Exposures at Benicia Arsenal: Future Land Use

Sector	No Action	Surface Removal Action	Clearance to Depth Removal Action
2	51 - 148	25 - 78	1 - 3
3a	3,761 - 7,682	291 - 593	41 - 82
3b	2,287 - 6,069	114 - 301	25 - 65
4	0 - 17	0 - 1	0 - 1
5	3,617 - 6,752	153 - 287	39 - 73
Total	**9,716 - 20,668**	**583 - 1,260**	**106 - 224**

Tables D-3 through D-7 show the expected annual exposures to UXO by members of the public in each sector for each removal option based on the current activities. Tables D-8 through D-12 show the expected annual exposures to UXO by members of the public in each sector for each removal option based on future activities at Benicia Arsenal. These values can be thought of as the "risk to the many" since it considers the annual visitors at Benicia Arsenal. The "no action" alternative reflects the current site conditions. Surface removal provides a surface sweep of OE items with a 99% efficiency. Appendix E provides further details about the sweep efficiencies used in the analysis.

Table D-3. Expected Annual Exposures for Sector 2: Current Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Short Cuts	24 - 64	0 - 1	0 - 1

Table D-4. Expected Annual Exposures for Sector 3a: Current Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Short Cuts	71 - 145	1 - 2	1 - 2

Table D-5. Expected Annual Exposures for Sector 3b: Current Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Hiking	290 - 769	3 - 8	3 - 8
Mountain Biking	685 - 1,818	7 - 19	7 - 19

Table D-6. Expected Annual Exposures for Sector 4: Current Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Hiking	0 - 17	0 - 1	0 - 1
Site Management (Fire Control)	0	0	0

Table D-7. Expected Annual Exposures for Sector 5: Current Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Hiking	459 - 856	5 - 9	5 - 9
Mountain Biking	1,085 - 2,026	11 - 21	11 - 21
Site Management (Fire Control)	0 - 1	0 - 1	0

Table D-8. Expected Annual Exposures for Sector 2: Future Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Construction	27 - 84	25 - 77	1 - 2
Short Cuts	24 - 64	0 - 1	0 - 1

Table D-9. Expected Annual Exposures for Sector 3a: Future Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Child Play	3,411 - 6,967	35 - 70	35 - 70
Construction	277 - 565	255 - 521	5 - 10
Picnicking	2 - 5	0	0
Short Cuts	71 - 145	1 - 2	1 - 2

Table D-10. Expected Annual Exposures for Sector 3b: Future Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Child Play	1,212 - 3,219	13 - 33	13 - 33
Construction	99 - 261	91 - 241	2 - 5
Hiking	290 - 769	3 - 8	3 - 8
Mountain Biking	685 - 1,818	7 - 19	7 - 19
Picnicking	1 - 2	0	0

Table D-11. Expected Annual Exposures for Sector 4: Future Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Hiking	0 - 17	0 - 1	0 - 1
Site Management (Fire Control)	0	0	0

Table D-12. Expected Annual Exposures for Sector 5: Future Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Child Play	1,921 - 3,586	20 - 36	20 -36
Construction	130 - 242	117 - 219	3 - 6
Hiking	459 - 856	5 - 9	5 - 9
Mountain Biking	1,085 - 2,026	11 - 21	11 - 21
Picnicking	1 - 2	0	0
Short Cuts	21 - 39	0 - 1	0 - 1
Site Management (Fire Control)	0 - 1	0 - 1	0

Tables D-13 through D-17 detail the individual probability of exposure for each current activity in each sector. Tables D-18 through D-22 detail the individual probability of exposure in each sector based on current and future activities at Benicia Arsenal. The values displayed provide the probability that an individual participating in an activity will be exposed to at least one UXO item in a single visit if the removal option (column) is implemented (e.g., 1/1 indicates that an individual is exposed once during each visit/activity; 1/15 indicates an exposure occurs only once in 15 visits/activity). This measure can be thought of as the "risk to an individual" because it considers only a single participant and not the annual participants in activities at Benicia Arsenal.

Table D-13. Probability of Individual Exposure for Sector 2: Current Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Short Cuts	1/145 - 1/55	1/14,463 - 1/5,447	1/14,463 - 1/5,447

Table D-14. Probability of Individual Exposure for Sector 3a: Current Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Short Cuts	1/49 - 1/24	1/4,848 - 1/2,374	1/4,848 - 1/2,374

Table D-15. Probability of Individual Exposure for Sector 3b: Current Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Hiking	1/6 - 1/2	1/502 - 1/190	1/502 - 1/190
Mountain Biking	1/2 - 1/1	1/184 - 1/69	1/184 - 1/69

Table D-16. Probability of Individual Exposure for Sector 4: Current Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Hiking	0 - 1/26	0 - 1/2,502	0 - 1/2,502
Site Management (Fire Control)	0 - 1/26	0 - 1/2,502	0 - 1/2,502

Table D-17. Probability of Individual Exposure for Sector 5: Current Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Hiking	1/3 - 1/2	1/236 - 1/127	1/236 - 1/127
Mountain Biking	1/1	1/87 - 1/47	1/87 - 1/47
Site Management (Fire Control)	1/5 - 1/3	1/6 - 1/3	1/481 - 1/258

Table D-18. Probability of Individual Exposure for Sector 2: Future Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Construction	1/1	1/1	1/2 - 1/1
Short Cuts	1/145 - 1/55	1/14,463 - 1/5,447	1/14,463 - 1/5,447

Table D-19. Probability of Individual Exposure for Sector 3a: Future Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Child Play	1/4 - 1/2	1/331 - 1/162	1/332 - 1/163
Construction	1/1	1/1	1/1
Picnicking	1/85- 1/42	1/7,852 - 1/3,844	1/8,436 - 1/4,130
Short Cuts	1/49 - 1/24	1/4,848 - 1/2,374	1/4,848 - 1/2,374

Table D-20. Probability of Individual Exposure for Sector 3b: Future Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Child Play	1/4 - 1/2	1/334 - 1/126	1/335 - 1/127
Construction	1/1	1/1	1/1
Hiking	1/6 - 1/2	1/502 - 1/190	1/502 - 1/190
Mountain Biking	1/2 - 1/1	1/184 - 1/69	1/184 - 1/69
Picnicking	1/131 - 1/50	1/11,740 - 1/4,421	1/13,081 - 1/4,926

Table D-21. Probability of Individual Exposure for Sector 4: Future Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Hiking	0 - 1/26	0 - 1/2,502	0 - 1/2,502
Site Management (Fire Control)	0 - 1/26	0 - 1/2,502	0 - 1/2,502

Table D-22. Probability of Individual Exposure for Sector 5: Future Land Use

Activity	No Removal Action	Surface Removal Action	Clearance to Depth Removal Action
Child Play	1/2 - 1/1	1/157 - 1/84	1/158 - 1/85
Construction	1/1	1/1	1/1
Hiking	1/3 - 1/2	1/236 - 1/127	1/236 - 1/127
Mountain Biking	1/1	1/87 - 1/47	1/87 - 1/47
Picnicking	1/70 - 1/37	1/6,202 - 1/3,322	1/6,907 - 1/3,700
Short Cuts	1/45 - 1/24	1/4,451 - 1/2,384	1/4,451 - 1/2,384
Site Management (Fire Control)	1/5 - 1/3	1/6 - 1/3	1/481 - 1/258

APPENDIX E

COMPARATIVE RISK ASSESSMENT FOR BENICIA ARSENAL

APPENDIX E

COMPARATIVE RISK ASSESSMENT FOR

BENICIA ARSENAL

This appendix presents a comparative risk assessment of UXO risks to common risks at Benicia Arsenal. This analysis incorporates data and OE*Cert* analyses from 18 other Formerly Used Defense Sites (FUDS) and Base Realignment and Closure (BRAC) sites. The comparative risk methodology was developed primarily to address the relative UXO risk from public use of the sites as compared to selected risks from common everyday sources or activities. Common risks to the public (e.g., injuries and deaths from home accidents) were quantified from several statistical sources. UXO risks at 18 FUDS and BRAC sites were estimated from demographics, land use projections, archival accident data, and site sampling. Accident data from the 18 sites was employed to develop a statistical regression equation, or predictor, of UXO accidents given estimated UXO exposures.

Each site used in the comparative risk analysis has had a risk assessment completed by QuantiTech based on OE*Cert* methods for calculating exposure to UXO by the public. During the comparative risk assessment, as detailed in each site's Archive Search Report (ASR), the number of injuries and deaths that have been attributable to exposure to UXO were counted. The ASR period usually covers over 50 years of site history. The results of combining each site's OE*Cert* UXO exposure results and the number of injuries and deaths are shown graphically in Figure E-1 (marked as "Actual" in the legend). Of significant importance is that no injuries and deaths have been recorded at the 15 sites used in the regression where less than 100,000 OE*Cert* estimated annual UXO exposures were projected.

A curve fit to the accident data was developed using statistical regression techniques. This curve overlays the actual data shown in Figure E-1. This statistical fit to the accident data resulted in a high correlation between UXO exposures at a site and time between accidents. The values for the regression equation coefficients (a and b) along with the correlation coefficient (R) result are also shown in the figure. In the equation, x is the number of annual expected exposures to UXO while y is the projected time between accidents. Based on these results, a projection of time between accidents based on UXO exposures can be calculated.

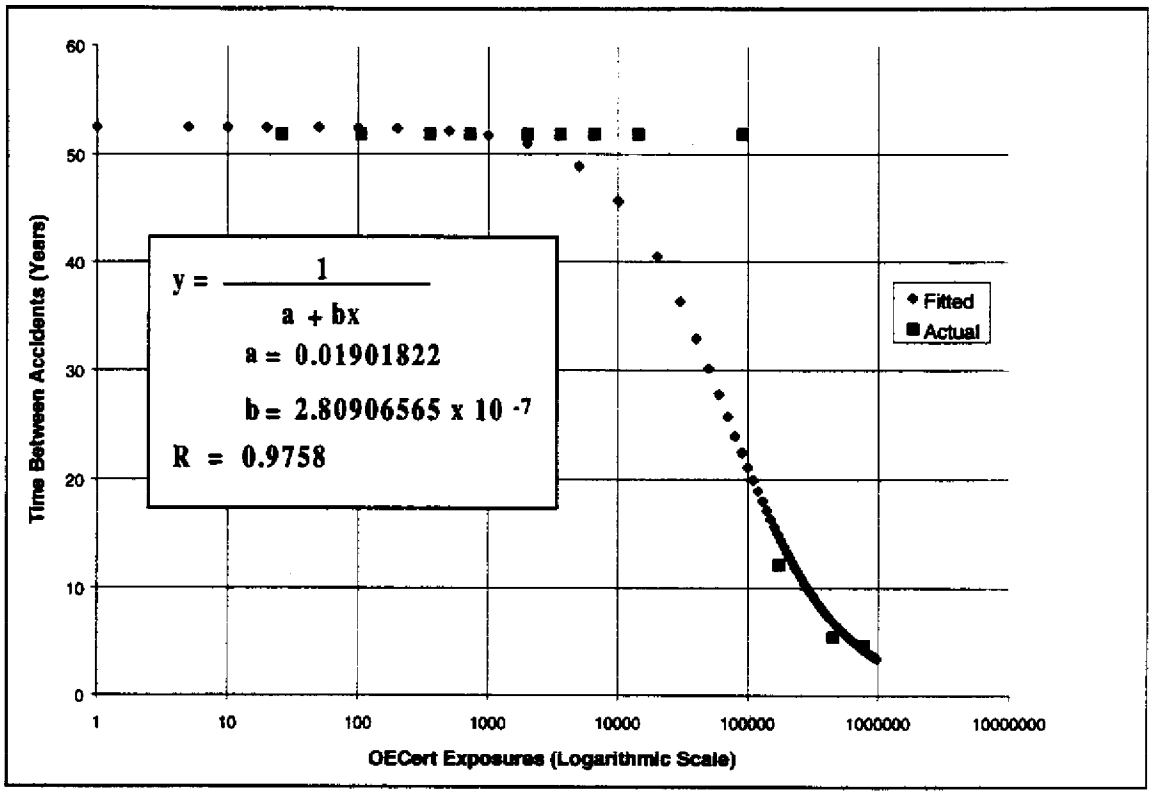

Figure E-1. Best Fit Regression – Projected Time Between Accidents with OE*Cert* Exposures

A population basis was calculated for each common risk source and activity and was used to convert the total number of injuries and deaths to a chance or probability of an individual risk. Similarly, a site's chance for injury or death due to UXO exposures was also calculated using the site's population basis with the estimated number of accidents over a one-year period. Figure E-2 provides a graphical summary of selected common risk sources and activities, three example OE sites, and Benicia Arsenal results. This graph illustrates that UXO risk is extremely low relative to everyday common risks. Note that the comparative risk value for each site is representative of the "No Action" case. This means that these comparative risk values are appropriate for these sites in the "As Is" condition with no UXO removal actions occurring.

Figure E-2 graphically compares the one-year chance of injury or death for several day-to-day activities, to which the general population can relate, to the one-year chance of injury or death due to a UXO accident in the Benicia Arsenal investigation area. The figure shows that the current one-year chance of injury or death from a UXO accident in the Benicia Arsenal investigation area (1 in 1,185,211current land use) is about 18,000 times less likely to occur than the possibility of being injured or killed in a car accident (1 in 65) over the same one-year period.

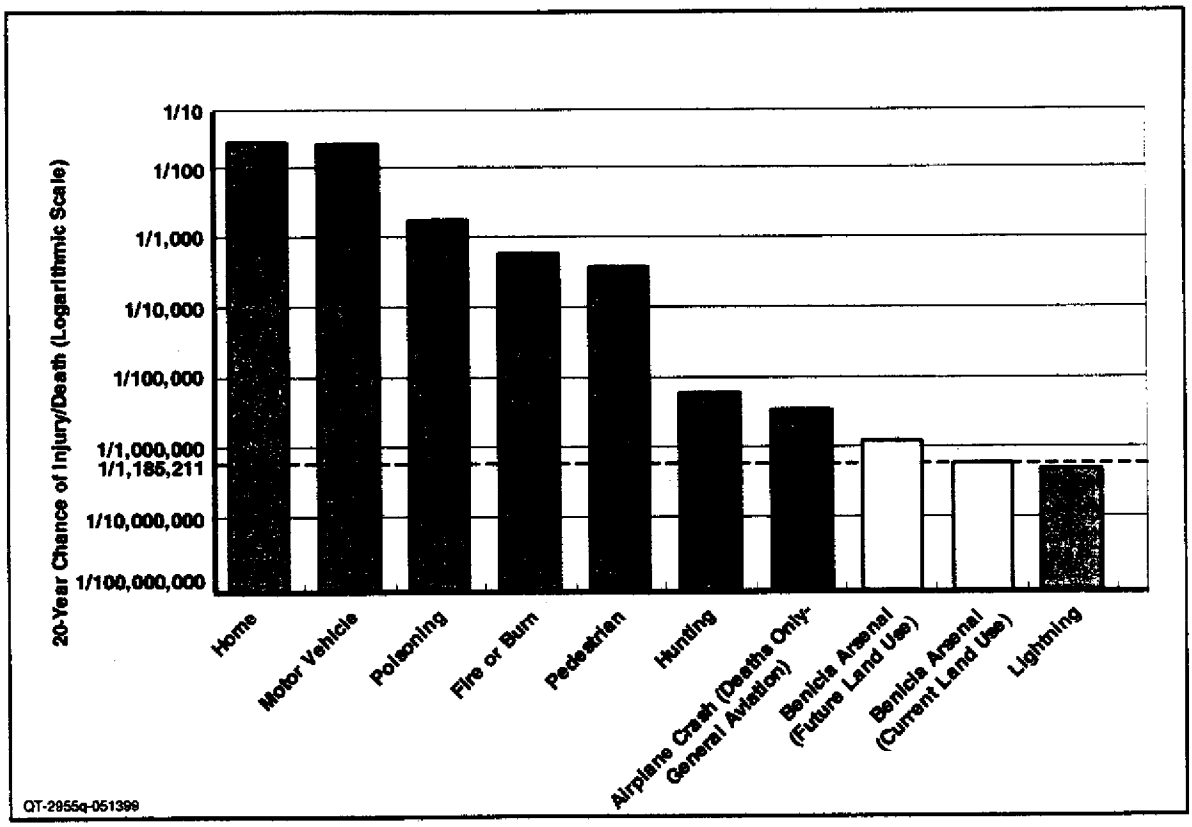

Figure E-2. Graphical Summary of Selected Comparative Risks

APPENDIX F

OE*Cert* STANDARD OPERATING PROCEDURES

APPENDIX F

OE*Cert* STANDARD OPERATING PROCEDURES

Standard operating procedures were followed during the OE*Cert* assessment at Benicia Arsenal.

ORDNANCE PENETRATION DATA

A specific CEHNC ordnance penetration analysis for Benicia Arsenal is not known to have been completed at the time of this draft risk assessment. The sampling results were used to form an expected depth distribution for the risk analysis.

SWEEP EFFICIENCY PARAMETERS

Sweep efficiency parameters were based on USAESCH guidance as provided in a memo dated 18 March 1997. The use of sweep efficiencies related to a P_d of 0.50 with a maximum of 99% was identified. The USAESCH memo is included in this appendix.

OE*Cert* Quality Control

OE*Cert* analysis results were reviewed and confirmed by John Lovett during the weeks of 19 April 1999, 3 May 1999, and 10 May 1999. Independent runs of the OE*Cert* tool were completed at that time.

CEHNC-ED-SY-T (1mm)

25 Feb 97

MEMORANDUM FOR Director, Ordnance and Explosives (OE) Team

SUBJECT: Sweep Efficiencies Used in Ordnance and Explosives Cost Effectiveness Risk Tool (OECERT)

1. The default sweep efficiencies in OECERT are appropriate for traditional techniques which yield overall detection and removal rates of around 30% for the upper ten feet. When newer technologies having much better detection rates are used, the default values in OECERT should be changed when performing the site risk assessment.

2. The enclosure provides a procedure for estimating appropriate sweep efficiencies for each of the depths required by OECERT, based on the overall detection rate for the particular search technology used.

3. Project Managers should work with their Technical Manager to determine the appropriate sweep efficiencies for each site risk assessment, based on the actual site conditions and geophysical processes used.

4. Feel free to contact Dr. John Potter if you have comments or questions.

Encl

"Original signed by
Ronald R. Lein"
RONALD R. LEIN, P.E.
Director of Engineering

CF:
ED-SY-T Read/Potter

RY YOUNG, ED-ES-G

AF FANNING, ED-SY-C

LOYD, ED-SY-T

WILSON, ED-SY

OE-CX-R

A Method for Estimating UXO Sweep Efficiency With Depth

A meaningful site risk assessment requires an estimate of UXO density as a function of depth. The quantitative evaluation of response alternatives involving removal activities requires an estimate of the effectiveness of a proposed removal activity at reducing that density, again with respect to depth. The current version of OECERT uses sweep efficiencies expressed as a percentage of UXO removed. These efficiencies are applied to UXO densities at the surface and in six discrete depth bands. The bands are 0-1 foot, 1-2 feet, 2-4 feet, 4-6 feet, 6-8 feet and 8-10 feet. Unfortunately, most data on the effectiveness of various UXO detection technologies describe only the overall effectiveness for the entire depth range used in the particular test. This effectiveness is usually expressed as a probability of detection, P_d.

The method described here can be used to estimate reasonable sweep efficiencies for these depth bands, based on a single overall P_d and a few assumptions about the nature of sweep efficiency as a function of depth. The value for P_d can be taken from any demonstration or prove out where the site conditions, UXO, technology, system employment and data analysis process are reasonably similar to those anticipated for the removal action.

The assumptions used here are:

1. The sum of sweep efficiencies by depth for all depth bands will be the overall sweep efficiency, P_d.
2. Sweep efficiency falls off smoothly with depth, first at an increasing rate, and then decreasing asymptotically to zero at a large depth.
3. Surface sweep efficiency will be 100%.
4. The sweep efficiency at 10 feet is a small, fixed value, r, related to the overall sweep efficiency.

This estimation procedure is based on a relationship between efficiency and depth of the form

$$e = f(d)$$

where e is the sweep efficiency and d is the depth. The efficiency in any depth band from x to y feet is then given by

$$e' = \int f(d)\,\partial d$$

evaluated between x and y. Furthermore, from the assumptions above, $e = f(0) = 100\%$, and e' evaluated from 0 to ∞ must be P_d.

To satisfy assumptions 2 and 3, above, we will take for f(d) an exponential equation of the form

$$e = A \exp(d \exp B)$$

where A and B are parameters that satisfy the boundary conditions given by assumptions 1 and 4. Assumption 3 is automatically satisfied for all A and B, since $e = 1$ for $d = 0$. Assumption 2 will be satisfied for a family of careful choices of A and B. Assumptions 1 and 4 are sufficient for a unique solution if r is defined. No data exist to fix r from a performance perspective. However, r can be fixed from a requirements perspective. In the current implementation of OECERT, no risk is assigned to UXO below 10 feet, since anticipated future land uses are expected to produce no exposures from UXO deeper than 10 feet. Since we are thus disinterested in UXO detection and removal below 10 feet, we can take the estimated efficiency to be small, say less than 1%.

Unique solutions can now be generated for sweep efficiency as a function of depth, at any overall (average) P_d. Efficiencies for specific depth bands, such as 1-2 feet, can be generated by integration of the particular solution over the interval. Efficiencies can also be estimated by simply averaging the values of the solutions at the end points of the intervals. The latter technique has been used to produce the following table of solutions.

Percent Sweep Efficiency

P_d (average)	Surface	0-1 feet	1-2 feet	2-4 feet	4-6 feet	6-8 feet	8-10 feet
50	100	100	97	83	49	16	3
60	100	100	100	94	71	30	5
65	100	100	100	97	81	40	7
70	100	100	100	99	89	51	11
75	100	100	100	100	95	66	18
80	100	100	100	100	98	81	33
85	100	100	100	100	100	91	53

APPENDIX G

BENICIA ARSENAL BIBLIOGRAPHY

APPENDIX G

BENICIA ARSENAL BIBLIOGRAPHY

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APPENDIX B

EE/CA CONTRACTOR STATEMENT OF WORK

APPENDIX A
ANNEX W
PERFORMANCE OF AN
ENGINEERING EVALUATION/COST ANALYSIS
FOR
THE FORMER BENICIA ARSENAL
BENICIA, SOLANO COUNTY, CALIFORNIA
26 May 1998

1.0 BACKGROUND

The work required under this Scope of Work (SOW) falls under the Defense Environmental Restoration Program (DERP). OE contamination may exist on property formerly owned by the Department of Defense in Solano County, California.

1.1 General. Ordnance and Explosives Contamination (OE) may be buried on property encompassing the Former Benicia Arsenal. This situation may be a safety hazard and may constitute an imminent endangerment to the public. During this action, it may be necessary for the A-E to destroy on-site any OE encountered. Actions will be performed in substantial compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the National Contingency Plan (NCP). For any actions on site, administrative requirements of Federal, State, or Local permits are not required, but the substantive permit requirements shall be fulfilled. The provisions of 29 CFR 1910.120 shall apply to all actions taken at this site.

1.1.1 If the A-E encounters suspected CWM during work, the A-E shall immediately withdraw from the work area and notify the Corps of Engineers on-site Safety Specialist.

1.1.2 Due to the inherent risk in this type of operation, the A-E shall be limited to a 40-hour workweek (either five 8-hour days or four 10-hour days) when performing OE operations. Unexploded Ordnance (UXO) personnel shall not perform UXO-related tasks for more than 10 hours per day. Although Chemical Warfare Material was shipped through the site, no evidence of contamination by CWM or CWM byproducts remains.

1.2 Description. The former Benicia Arsenal is located approximately 25 miles East-northeast of San Francisco. The project area is composed of steep rolling hills and runoff collection areas, which discharge to Suisun Bay. Portions of the property are now owned by Pacific Bay Homes (a housing development company), Benicia Industries (an industrial park operated by the city of Benicia) and Exxon Oil Company.

1.3 History. The site was established in 1849 to be used primarily as a shipping and receiving facility for military equipment and materiel manufactured within CONUS and destined for military campaigns supported by the Port of San Francisco. Testing of 155-mm howitzers was performed on the Arsenal using two large concrete test tunnels. Additional details regarding site history are located in the "Benicia Arsenal Archive Search Report, March, 1994" and the "Supplement to the Benicia Arsenal Archive Search Report, May 1997" (References 6.7, 6.8, and 6.9).

1.4 Past Actions. Substantial site revision has eliminated most remnants of the arsenal facilities. Construction of Interstate highway and refinery facilities led to the demolition of many underground storage bunkers used during trans-shipping operations conducted at the Arsenal. Approximately 30 bunkers remain, most in use by the current owners or tenants. The Archive Search Report and Supplement indicate that OE contamination may be present at the Arsenal. Pacific Bay Homes (developer) recently encountered OE in the area known as the Tourtelot property which includes the location of the howitzer test tunnels (called Area 5), a 15 acre demolition area (Area 11) and a 25 acre demolition and demilitarization area (Area 12) surrounding the test tunnel structures. Pacific Bay Homes demolished the test tunnels and contracted with EMCON, an environmental/geotechnical contractor, and EDET, an OE removal contractor, to perform removal actions on the portion of the former Benicia Arsenal owned by them. Representatives of Pacific Bay Homes indicate that the objective of this effort was 100% removal of anomalies. The field actions have been suspended pending resolution of actions by the Government.

2.0 OBJECTIVE

The objective of this task order is to develop the best alternative to rectify risks attributable to OE at the site. The A-E shall perform an Engineering Evaluation/Cost Analysis (EE/CA) at the Former Benicia Arsenal and document the results. This document will be used to establish the location of the source area of the OE, determine the quantity of OE requiring remediation, and define techniques applicable to the recovery and disposal of the OEW. The EE/CA will be used to support the determination for subsequent action at the site. Development of data for use in the EE/CA will entail a review of available site history, Arial photographs, real estate transfer documents, and other historical information, an on-site assessment of suspected areas of OE contamination, and performance of on-site equipment testing. Surveying, geophysical analysis, OE sampling and statistical analysis will be performed to determine potential hazards and propose appropriate solutions for any on-site contamination identified. Institutional controls as subsequently described shall be evaluated for the site.

3.0 SPECIFIC REQUIREMENTS

The work will, in all aspects, conform to that detailed in the negotiated cost proposal submitted by the A-E in response to this Scope of Work, and Project Work Plans, as approved by CEHNC, except as modified through appropriately authorized field changes or task order modifications. The area of the field investigation comprises 131 (30-meter x 30-meter) grids randomly dispersed over the suspected OE contamintated areas (covering approximately 30 acres).

3.1 (Task 1) Site Visit, Records Review and Equipment Field-test. The A-E shall submit resumes of the lead specialists to be used for this project and obtain the approval from the Contracting Officer prior to the site visit. The site visit shall include liaison visits and coordination with appropriate offices and/or land owners at the Benicia site. During the site visit, archaeological resources, environmental concerns, and endangered species in the site areas shall be addressed. The A-E shall prepare an abbreviated site-specific health and safety plan (SSHP) and submit the plan to the Contracting Officer for review and approval prior to the visit. The A-E shall ensure that the site visit is fully coordinated and that all members of the site visit team maintain compliance with the SSHP.

3.1.1 Review Existing Data. The A-E shall review existing data as related to site uses and conditions, and as related to any OE contamination at the Benicia Arsenal site. Archaeological and historical data shall be reviewed in order to provide a clear understanding of the circumstances associated with the Benecia Arsenal site. The A-E shall propose investigation area(s) and the appropriate equipment requirements to achieve the project objectives. Capabilities of the proposed geophysical equipment shall be documented.

3.1.2 Site Visit. A site visit (not to exceed 5 days) is authorized. The A-E shall coordinate with the Project Manager (Bob Nore: 256-895-1507) at least 10 days in advance of the site visit. The site visit team shall include the A-E Project Manager and Staff Assistant. A-E Personnel shall review existing data on the physical characteristics such as: ground water depths, soil characteristics, rock outcrops, plant cover, endangered species, local weather conditions, as well as locally available records or other data in order to more clearly define suspect areas, target OE, and proposed equipment.

3.1.3 Equipment Field Test. The performance of the proposed geophysical and other field instruments shall be verified at the project site to confirm that appropriate tools and techniques are being employed on this project. The equipment and methodologies employed shall be described in a Geophysical Investigation Plan. Subdivisions within the draft Geophysical Investigation Plan shall include:

- Sensors: Selected geotechnical sensor parameters, required data corrections and data logging techniques.
- Sensor Mobility: mobility power source, speed, special considerations,
- Data Storage: sensor internal storage, external storage and any special data transfer requirements shall be addressed.
- Data analysis and interpretation techniques.

The equipment test site selected during the site visit shall be cleared of man-made objects to a depth of not less than 4 feet. Using the list of suspected OE described in the Archive Search Report, representative OE or similar items shall be buried at appropriate depths in the test plot. Geophysical equipment and techniques should be capable of achieving the performance

goals in Table 1. The geophysical instrument(s) selected shall be checked for standard response prior to surveying each grid. If equipment does not meet the standard performance criteria defined above, the A-E shall perform repairs, provide alternate equipment selections, correct settings, or revise calibration approaches and retest for criteria achievement until sufficient performance is demonstrated.

3.1.3.1 Geophysical Investigation Performance Goals. OE Detection. Function 1 shows minimum criteria the Contractor must meet to have acceptable performance when using magnetometry. Function 2 shows minimum criteria the Contractor must meet to have acceptable performance when using electromagnetic geophysical detection methods. The function used for determining acceptable performance depends upon the geophysical equipment selected and justified by the Contractor.

$$\log(d) = 1.354 \log(dia) - 2.655 \quad \text{(Function 1-magnetometry)}$$

$$\log(d) = 1.002 \log(dia) - 1.961 \quad \text{(Function 2-electromagnetics)}$$

d = actual depth to top of buried UXO, in meters.

dia = diameter of minor axis of UXO, in millimeters.

For this project: "d" corresponds to the required clearance depth for that particular location on the project site and "dia" is equal to or greater than the diameter of the smallest UXO item of interest on this project.

Horizontal Accuracy. Horizontally, 90% of all excavated items must lie within a 0.5 meter radius of their mapped surface location as shown on the "dig-sheet" and 95% of all excavated items must lie within a 1.0 meter radius circle.

False Positives. There may be no more than 15% "false positives" where anomalies reacquired by the Contractor result in no detectable, metallic material during excavations.

3.1.4 Geophysical Equipment Letter Report. The A-E shall submit a brief report describing proposed geophysical equipment and methodologies. The report shall describe the methodology for performing the field evaluation and the test results for equipment to be used. The letter report shall define the suspect areas to be geophysically mapped and the expected target OE anomaly(s) based upon the Archive Search Report. Sufficient supporting information shall be provided to justify the equipment, target, and recommendations.

3.2 (Task 2) Prepare Project Work Plan. The A-E shall prepare a site specific Work Plan (WP) describing how all subsequent work is to be performed. The WP shall describe the specific work proposed in order to meet the objectives of this SOW. The WP shall describe, in specific terms, the policies, organization, objectives, functional activities, and specific A-E quality control (QC) activities required to achieve the data quality objectives proposed for the project. The A-E shall describe how the site will be investigated, including descriptions of statistical techniques to be utilized to determine field sampling requirements. Potential investigation methods include, but are not limited to, evaluations of archival data, evaluations of historical aerial photographs, geophysical investigations, and excavation of representative areas. The A-E shall propose and justify methods and procedures that are well suited to the anticipated site conditions. The A-E shall consider technical requirements for site characterizations as well as safety, security and environmental regulations applicable to this site. The plan shall describe the goals, methods, procedures and personnel used for field sampling and data gathering activities, and shall identify techniques to statistically validate risk based conclusions and proposed remedial action requirements. The work plan shall also specifically address, but not be limited to, the following elements:

3.2.1 Geophysical Investigations. Geophysical Investigations will be a major part of the Site Characterization for this project. A-E will utilize geophysical methods to characterize grids in and around the FBA demolition and disposal areas that assure the detection performance specified in Section 3.4.1.2 of this SOW are met. OE-of-concern ranges from 20mm to 155 mm projectiles, hand-and rifle-grenades, various fuzes and other munitions components, and M83

butterfly bomblets to various sized rocket warheads. The geophysical investigations performed by the A-E shall be managed by a qualified geophysicist (i.e. an individual with a degree in geophysics, geology, geological engineering, or a closely related field who has a minimum of 5 years of directly related geophysical experience). Geophysical data storage shall be in an ASCII format. An equipment field test will be conducted on the first field day after mobilization to the site to verify that the recommended methodology and approach meet the performance criteria established for the FBA. Multiple targets of same types will be laid out in nonrandom distribution at multiple depths in a test plot. The plot will document depth of detection for: (1) the smallest OE-of-concern (e.g., 20mm, 37mm, 2" diameter spheres); (2) mid-range OE (57 mm to 75 mm); and (3) 105 mm to 155mm projectiles. The equipment field test activities will include determining the method(s) to be used to establish a standard response for the instrumentation to be used. An equipment letter report will be provided no later than 7 days after completion of the field tests to document the results. The Equipment Field Test and Geophysical Investigation will be described in the Project Work Plan, which will be prepared and approved prior to prosecution of any geophysical field activities. It is the responsibility of the A-E to select and justify appropriate geophysical methods, equipment, and personnel for use at the site. When planning the geophysical investigations for each site, the performance goals described in Table 1 of this SOW shall be met.

3.2.3 Site-Specific Safety and Health Plan (SSHP). IAW 29 CFR 1910.120, the A-E shall submit a SSHP that contains OE safety standards and procedures. The A-E shall review all available site information and develop the necessary safety and health documents sufficient to protect on-site personnel, the environment and potential off-site receptors. The A-E shall utilize the services of qualified personnel, as defined in ER-385-1-92 to oversee the development and implementation of the required safety and health documents as defined in Section 5 of this SOW.

3.2.4 Quality Control Plan (QCP). The A-E shall propose a system to manage, control, and document the performance of these tasks. The Quality Control Plan shall include both geophysical QC and data QC. Data QC includes both digital data (communications; transmissions and receipt), along with all analog data (administrative; contractual; survey, digital capture of geophysical instrument readings, and geophysical field notes). The methodology to accomplish

the quality control shall be in accordance with Chapter 5 of the CX OE Quality Management Plan, dated 28 November 1994, which identifies the minimum QC activities. The QC activities shall be documented and included in the final investigation report. The A-E shall ensure that the corporate quality policy is understood, implemented, and maintained at all levels in the organization. The geophysical survey A-E shall perform continuous tracking, checks, and adjustments of his field data for quality control and to establish efficient field procedures. The A-E is responsible for ensuring that project work proceeds smoothly in accordance with the SOW and the WP maintaining a continual vigilance for ways to increase efficiency and quality, as well as providing weekly summaries of Quality Control activities.

3.2.5 Environmental Protection Plan. A site specific Environmental Protection Plan shall be developed for the project site which documents all coordination with Federal, State, and local environmental agencies, all known endangered/threatened species, archaeological sites, wetland, and other environmental resources. The A-E shall assist CESPK in coordinating discussions with Environmental Regulatory Agencies as requested by the Contracting Officer.

3.2.6 Risk Assessment Plan: The A-E is responsible for performing an OE risk assessment as part of the EE/CA. The A-E must utilize the Government developed risk program OE Cert (Ordnance and Explosives cost effectiveness tool) to perform the risk analysis. A risk report must be provided as part of the EE/CA detailing the results of the results of the risk assessment. The contractor shall develop the risk analysis according to the Government provided OECert Standing Operating Procedure. The contractor shall determine the risk results for each type of UXO found in each sector and also do a sector total risk analysis that includes all the estimated UXO in the sector. The contractor shall utilize a statistically sound process to determine the density of each type of UXO.

3.2.7 UXO Operational Plan. The work plan shall include an UXO Operational Plan that fully describes field performance techniques, equipment, scheduling, personnel control and management, logistical considerations, and site control measures. Personnel performing UXO operations shall meet the qualification requirements of Reference 6.12, Ordnance and Explosives Center of Expertise Personnel and Work Standards for Ordnance Response.

3.2.8 Explosives Management Plan. An Explosives Management Plan shall be included in the work plan that describes explosives procurement, storage, handling, placing, and initiating processes to be used in performance of the project objectives.

3.2.9 Work, Data, and Cost Management Plan. In addition to the hard copy distribution as shown in paragraph 4.13 of this SOW, the A-E shall provide two copies of the WP (in Microsoft Word) on 3.5" computer disks, to CEHNC-OE-EM. The A-E shall submit a work schedule and manpower allocation (by task) with the WP. Any assumptions shall be stated and their basis shall be provided. The A-E shall notify the Project Manager at least 10 calendar days in advance of mobilization for the field work after the WP is approved by the Contracting Officer.

3.3 (Task 3)- Perform Location Survey. The A-E shall determine the project requirements for location surveys and mapping to accomplish project goals. Existing survey points shall be evaluated and supplemented if required to be used as the basis for on the ground staking of investigation grids to facilitate the geophysical mapping and intrusive sampling activities. Sufficient quality maps to support mapping requirements are not available for the site. Therefore, the A-E will perform aerial flyovers and generate new base map data to support location of sectors, grids,,geophysical surveys, and OE-sampling activities.

3.3.1 During all field and intrusive activities, the survey crew shall be accompanied by an EOD specialist who shall conduct visual UXO surveys for surface ordnance prior to the survey crew entering a suspect area. Based on site conditions, it is possible that an EOD escort will not be required in all areas at all times after the initial site visit. However, such a decision will be made jointly by the on-site Safety Officer and the USAESCH Safety Specialist who may rescind or modify the decision at any time.

3.3.2 All of the location surveys and mapping to be provided by this Task Order shall be conducted and/or supervised by a Registered or Professional Land Surveyor (RLS/PLS) registered and licensed by the State of California. All maps and drawings generated by the Surveyor shall be sealed and signed by the RLS/PLS.

3.3.3 Individual grid corners within the limits of the investigation area shall be established using precision surveying methods. The corners for the individual grids shall be established to the closest one foot (1.0 ft) and referenced to the California State Plane Grid Coordinate System and

NAD83. Elevations for the grid corners are not required. Grid size, distribution and orientation shall be as required to facilitate the geophysical mapping and proposed sampling. The A-E shall provide a Microstation 5.0 CADD file that shows the grid number, as staked location with corner coordinates and size. The corners of the investigative grid shall be located in the field to the closest (1.0 ft) and staked or located in a manner that the grid corner markings can be used as a basis for measurement to reacquire the geophysical anomalies for sampling. These established corners shall be used as the basis for geophysical mapping navigation and OE sampling.

3.4 (Task 4) Geophysical Mapping and Evaluation.

3.4.1 Geophysical Instrumentation. The initial performance goals for this project are shown in Table 1. Performance with geophysical mapping shall be in accordance with the approved GIP.

3.4.2 Instrument Standardization. Standardization procedures and Standard Reponse (for each system) will be established before any geophysical mapping of the investigative grids is performed. Standardization of each system (and array) will be accomplished before and after each grid is surveyed using a portable target in a fixed geometry with each receiver antenna. The portable target shall be a carbon steel sphere. Proper operation and function of the instruments used will be checked and documented in the field log each day by a standardization process prior to beginning the day's geophysical surveys. This will be accomplished by establishing a target and a background reference geometry and determining the numerical difference between target-anomaly high and background response of each system. The standard response will be recalculated and the array baseline response whenever any critical component of the instrumentation system is repaired or replaced, or as changing survey conditions warrant. Multiple anomaly-versus-background measurements will be made to allow computation of a mean residual (anomaly response) and calculation of a standard deviation specific to the system. Standardization consists of comparing the residual anomaly to an acceptance range and recording the values in the daily logs. Acceptance range is specified +/-10 percent of the standard response (calculated mean residual anomaly). The standardization response and acceptance range shall be recorded in the field logbooks assigned to each array or system. If a system does not respond within the acceptance range, the standardization measurements are repeated. Three sequential

failures will cause the system to be removed from service. Any failed system must be replaced/ repaired and a new standard response (with a new standard deviation and acceptance range) calculated before being redeployed to the field. Geophysical investigation tools shall be field tested daily to ensure they are operating properly. Field tests over the test plot will not be a part of the daily routine. However, all instrumentation will be deployed to survey the plot and the data reviewed to validate instrument performance prior to use in geophysically investigating any grid.

3.4.3 Site Investigations. Instrument operators will monitor audio and digital output in real-time to detect EM anomalies along the survey transect lanes. Field data tracking, checks, and adjustments to collection processes will be continuously performed. A bean bag or other marker will be dropped at the approximate location of each identified anomaly. After all lanes in a particular grid have been surveyed, the operator will immediately return to each anomaly marker and locate and mark the centroid of each identified anomaly. Wood hubs (gennies) will be set one meter north and one meter east of the anomaly locations. Geophysical data will be digitally recorded at one (1) meter line spacings and <0.3-meter station intervals over the entire grid. Processing of digital data will be limited to production of simple contour/image plots. The contour/image will be used only as a quality assurance tool to compare real-time anomaly locations with digitally-discriminated locations. Digital data (identiifed relative to the southwest corner of each grid) will be archived to (a) document the geophysical investigation, including thoroughness of the survey, detection efficiency, and locations of identified anomalies, (b) provide a means of quantifying the confidence that can be applied to the EE/CA results, and (c) preserve and documentation of the extent, precision, accuracy, and quality of the geophysical investigation. All geophysical data shall be transmitted to the CEHNC server upon completion of the field activities.

3.5 (Task 5) Performance of OE Sampling.

3.5.1 The A-E shall provide all necessary personnel and equipment to perform OE sampling at the site. The A-E shall use the Government furnished statistical anomaly selection computer program provided by the Government in order to determine the amount of anomaly excavation required in each grid. The purpose of anomaly excavation is to determine the presence and nature of OE contamination. All anomalies need not necessarily be excavated. The statistical

evaluation program shall be used to ensure that the grids are statistically characterized through minimal excavations. Results from geophysical investigations shall be utilized to complete statistical determinations that will identify anomalies to be excavated. The A-E shall dispose of all OE excavated or otherwise located during this investigation; however no demolitions shall be performed that may jeopardize any historical or archeological structure or location. OE or suspected OE items shall be demolished in place unless other conditions prohibit such. Intrusive exploration will be performed for each anomaly sampled until a representative source is identified or a depth of 4.0 feet has been reached. Mapped anomaly locations will be measured distances from the corners of each grid. UXO personnel shall intrusively explore each anomaly location, in accordance with GridStats protocols, by excavating a 3-foot diameter pit centered on the anomaly location identified by the geophysical team to a minimum depth of 1.5 feet and identifying all metallic sources within the pit. If no source that adequately accounts for the geophysical anomaly is identified, the pit shall be deepened until a representative source is identified or a maximum depth of 4.0 feet has been reached. If deeper excavation is required, the on-site Huntsville Center Safety specialist or CEHNC-OE-DC-B will make the decision. The results of the excavations shall include all pertinent features of the anomaly to include items such as description, actual location, depth, size, mass and any other information that would assist in classifying the geophysical anomaly. No digital OE-sampling field data will be produced for this project. OE sampling data will be delivered to the Government within 12 working days following the completion of sampling activities for a particular grid.

3.5.2 All access/excavation/detonation holes shall be backfilled and returned to the natural state. The project site's physical condition shall be returned to its original state to as great a degree as is practicable.

3.5.3 The A-E shall maintain a detailed accounting of all OE items/components encountered. This accounting shall include the amounts of OE, the identification and condition, depth located, disposition and the location/mapping. This accounting shall be part of the final report.

3.5.4 The A-E shall maintain a detailed accounting system for all demolition materials used to detonate OE on-site.

3.5.6 If a scenario is encountered that an unidentifiable UXO is located or a suspected toxic chemical munition is encountered, or a situation occurs which prevents detonation in-place, the on-site CEHNC Safety Specialist or CEHNC Safety Office shall be notified, who in turn will request the appropriate support.

3.5.6 The A-E shall be responsible for developing a statistical estimate of density for each type of UXO found in each sector. The A-E will be required to use the statistical methodology provided by the Government unless permission is granted prior to investigation start to use another method.

3.6 (Task 6) Turn-in of Recovered Inert Ordnance and OE Related Scrap. The A-E shall provide all necessary personnel and equipment to accomplish this task. The A-E shall coordinate with a local scrap dealer for the turn-in procedures to be followed.

3.6.1 The A-E shall complete a DD Form 1348-1A as turn-in documentation. Instructions for completing this form are contained in the Defense Utilization and Disposal Manual, DoD 4160.21-M. The Senior UXO Supervisor shall sign the Certificate as follows: "I certify that the property listed hereon has been inspected by me and, to the best of my knowledge and belief, contains no items of a dangerous nature."

3.6.2 Turn-in documentation receipts shall be submitted as a component of the EE/CA Report.

3.7 (Task 7) Institutional Analysis. The A-E shall prepare an institutional analysis to support the development of institutional control alternatives plans of action. Institutional controls rely on the existing powers and authorities of other Government agencies to protect the public at large from OE risks. Instead of direct elimination of the OE from the site, these plans rely on behavior modification, and access control strategies to reduce or eliminate OE risks. The objective of this report is to document which government agencies have jurisdiction over OE contaminated lands and to assess their capability and willingness to assert control which could protect the public at large from explosive hazards. Additionally, this report should document the obligation of government, corporate, or private landholders of OE contaminated lands to protect citizens from safety hazards under tort law.

3.7.1 Institutional Summaries. For each institution selected for review, the following information shall be provided:

+ Name of Agency
+ Origin of Institution
+ Basis of Authority
+ Sunset Provisions
+ Geographic Jurisdiction
+ Public Safety Function
+ Land Use Control Function
+ Financial Capability
+ Constraints to Institutional Effectiveness (OE Safety)

3.7.2 Institutional Analysis Report. The basic report shall include:

+ Purpose of Study
+ Methodology
+ Scope of effort/ Selection Criteria
+ Acceptance of Joint Responsibility
+ Technical Capability
+ Intergovernmental Relationships
+ Stability
+ Funding Sources
+ Recommendations

3.8 (Task 8) Prepare EE/CA Report. The A-E shall prepare and submit an EE/CA report fully documenting the field work and subsequent evaluations and recommendations made by the A-E. The textual portions of the report shall be fully supported with accompanying maps, charts, and tables as necessary to fully describe and document all work performed and all conclusions and recommendations presented. The maps, charts and tables shall be generated by the GIS wherever possible. The report shall describe the location and predict the identification of

buried ordnance, differentiate between buried ordnance and non-ordnance geophysical anomalies, and describe the alternative land uses and anticipated costs of performing OE removal actions at the site.

3.8.1 Alternatives Development. A full range of alternatives to address project objectives must be developed. Screening of alternatives will produce a manageable set of plans that address the concerns of the community, regulators and the DoD. Alternatives must accommodate the anticipated land use and incorporate requirements necessary to coordinate with defined land use plans if at all possible. Alternatives should be distinct, feasible, and fully developed. All plans that make the draft report must be developed to the same level of detail. Infeasible plans will be discarded during the screening process. A minimum of four alternative plans shall be developed:

+ One alternative shall emphasize the basic strategy of access control (use of direct intervention, land use restrictions, regulatory control, and other passive measures).

+ Two shall emphasize the basic strategy of physical strategy of physical removal.

+ One alternative shall combine all strategies.

Alternatives must be completely developed. Several alternatives that address a single strategy may be developed if there are significant differences in plan performance with respect to selection criteria and it is significant to the decision process. Only the best of unique strategies will be combined. All management, execution and support roles will be identified. All costs to all participating agencies will be estimated.

3.9 (Task 9) EE/CA Action Memorandum. After the EE/CA has been approved by the Contracting Officer, the A-E shall prepare an EE/CA Action Memorandum in accordance with the EPA Guidance Document, "Superfund Removal Procedures, Action Memorandum Guidance, EPA/540/P-90/004, December 1990" for signature by the appropriate CEHNC personnel as directed by the Contracting Officer.

3.10 (Task 10) Community Relations Support. The A-E shall attend and participate in public meetings in support of CESPK as directed by the Contracting Officer. The support shall include preparation and delivery of briefings, graphics and presentations, and participation in site visits.

3.11 (Task 11) Meetings and Project Management.

3.11.1 The A-E shall, during the life of the Individual Task Order, manage the task order in accordance with the SOW Appendix A. All project management associated with this task order, with the exception of direct technical oversight of work described in the preceding tasks, shall be accounted for in this task. The A-E shall attend and participate in one meeting as directed by the Contracting Officerr. The A-E shall provide a minimum of three professionals, thoroughly familiar with the project, at the meeting. The meeting should not last more than one day.

3.11.2 The A-E shall provide support to CESPK in defining and performing logistical functions for a public meeting to be held in Benicia, California. This shall include mailing the notification to all persons and agencies on the mailing list as directed. All costs associated with this public meeting shall be paid by the A-E. The A-E shall provide a Senior UXO Supervisor to assist in this public meeting. The Government will conduct the public meeting.

4.0 SUBMITTALS AND CORRESPONDENCE

4.1 Format and Content of EE/CA. An EE/CA presenting all data, analyses, and recommendations shall be prepared and submitted by the A-E. All drawings shall be of engineering quality in drafted form with sufficient detail to show interrelations of major features. The contents and format of the EE/CA shall be arranged in accordance with all pertinent guidance documents and submitted in a format that is structurally and graphically similar to existing site related documents available through CESPK. When drawings are required, data may be combined to reduce the number of drawings. Reports shall consist of 8-1/2 inch by 11 inch pages with drawings other than the construction drawing folded, if necessary, to this size. A line numbering system shall be used, with each section of the reports having a unique decimal designation. The report covers for each submittal shall consist of durable 3-ring binders and shall hold pages firmly while allowing easy removal, addition, or replacement of pages. A report title page shall identify the site, the A-E, the Corps of Engineers, Huntsville Engineering and Support Center, and the date. The A-E identification shall not dominate the title page. All data, including raw analytical and electronic data, generated under this task order are the property of the DoD and the government has unlimited rights regarding its use.

4.2 Review Comments. Various reviewers will have the opportunity to review submittals made by the A-E under this task order. The A-E shall review all comments received through the CEHNC Project Manager and evaluate their appropriateness based upon their merit and the requirements of the SOW. The A-E shall issue to the Project Manager a formal, written response to each comment no later than 21 days after the A-E receives the comment.

4.3 Draft Reports. Each page of draft reports shall be stamped "DRAFT". Submittals shall include incorporation and notation of all previous review comments.

4.4 Identification of Responsible Personnel. Each report shall identify the specific members and title of the A-E's staff and subcontractors that had significant, specific input into the reports' preparation or review. All final submittals shall be sealed by the registered Professional Engineer-In-Charge.

4.5 Presentations. The A-E shall make presentations of work performed as required. Presentations anticipated as probable under this contract include a Community Relations meeting, Pre-removal meeting, and Post-removal meeting. The presentation shall consist of a summary of the work accomplished and anticipated followed by an open discussion among those present.

4.6 Minutes of Meetings. The A-E shall prepare and submit minutes of all meetings attended in association with this contract to the Contracting Officer or his representative within 10 calendar days. The A-E shall provide an informal working copy of meeting minutes electronically within three working days following a meeting.

4.7 Correspondence. The A-E shall keep a record of each phone conversation and written correspondence affecting decisions relating to the performance of this task order. A summary of the phone conversations and written correspondence shall be submitted with the monthly progress report to the Contracting Officer.

4.8 Project Control and Reporting. The A-E shall prepare and submit a master network schedule, cost and manpower plan, monthly progress reports, technical progress reports, monthly individual performance reports and cost/schedule variance report, work task proposal plan, and a program control plan in accordance with Section 4.5 of Appendix A to the basic task order SOW.

4.9 Monthly Progress Report. The A-E shall prepare and submit a monthly progress report describing the work performed since the previous report, work currently underway and

work anticipated. The report shall state whether current work is on schedule. If the work is not on schedule, the A-E shall state what actions are anticipated in order to get back on-schedule. The report shall be submitted not later than the 10th day of the following month.

4.9.1 Monthly Exposure Hour Report. The A-E shall submit the total hours worked in the field and the number of vehicle miles driven in direct support of the contract to CEHNC-OE-S-P NLT the 10th day of the month following completion of the months field activities. Any on-site accidents shall be listed and described in the report.

4.10 On-Site Coordination. The A-E shall keep the Contracting Officer's on-site representative informed of day-to-day field activities occurring on-site. Where A-E activities are likely to require coordination with various other activities at the site, the A-E shall notify the POC identified by the Contracting Officer sufficiently ahead of time to allow for coordination activities to take place.

4.11 Computer Files. All final text files generated by the A-E under this task order shall be furnished to the Contracting Officer in Word~~Perfect 5.1~~ 6.0 or higher software, IBM PC compatible format. All final GIS data, design drawings and survey data generated by the A-E under this task order shall be submitted in the proper format and media that will permit their loading, storage, and use without modification or additional software on the Huntsville Center GIS workstations. The Huntsville Center system consists of Intergraph TD-4 and 5 Intel dual Pentium GIS workstations. The workstations run under the Windows NT operating system with Microstation 5.0 utilizing the Microstation Geographical Information System Environment (MGE) compliment of software and the Oracle relational database. GIS related software includes: Microstation 5.0, Oracle 7.0, Modelview, IRAS B and C, DB Access, MGE Basic Nucleus, MGE Analysis, MGE Map Finisher, MGE Projection Manager, MGE Terrain Modeler, MGE Grid Analysis, MGE GIS Translators, MGE Voxel Analysis and Vistamap. Imaging and Environmental packages will be added to meet CEHNC's mission requirements. Other specific packages to be considered must be proposed to CEHNC for approval and for system and mission compatibility. Design drawings shall be digitized into Microstation 5.0 three dimensional design files and furnished to the Contracting Officer on either eight millimeter 5 GB tape or 3.5" floppies, or pre-approved CD format.

4.12 Public Affairs. The A-E shall not publicly disclose any data generated or reviewed under this task order. The A-E shall refer all requests for information concerning site conditions to the CESPK Public Affairs Office and the CEHNC Public Affairs Office. Reports and data generated under this task order are the property of the DoD and distribution to any other source by the A-E, unless authorized by the Contracting Officer, is prohibited.

4.13 Addresses. The following addresses shall be used in mailing submittals:

ADDRESSEE	COPIES
COMMANDER US ARMY ENGINEERING CENTER, HUNTSVILLE ATTN: CEHNC-OE-DC-B (Bob Nore) 4820 University Square Huntsville, AL 35816-1822	8
COMMANDER US ARMY ENGINEER DISTRICT, SACRAMENTO ATTN: CESPK -PM-M (Mike Metro) 1325 J Street Sacramento, CA 95816	4
Commander, 52nd EOD Group Building 736, Fort Gillem Forest Park, GA 30050-5000	1

4.14 Schedule and Submittals. The A-E shall submit all deliverable data to the Contracting Officer and other reviewers shown in Section 4.13 in accordance with the following schedule. All submittals shall be delivered to all addressees no later than the close of business on

the day indicated in this paragraph. In addition, submittals to regulatory reviewers shall be shipped by registered mail or other method where a signed receipt is obtained indicating the date received and the individual accepting the submittal.

DOCUMENT	DATE DUE
1. Equipment Letter Report	27 Oct 98
1. Draft Work Plan	21 Aug 98
A-E Receive Comments from Govt.	11 Sep 98
2. Final Work Plan	25 Sep 98
A-E Receive Approval to Begin Field Work	2 Oct 98
[3 calendar month field effort]	
5. Draft EE/CA	1 Feb 98
A-E Receive Comments from Govt.	5 Mar 99
6. Final EE/CA	5 Apr 99
7. Monthly Report	NLT 20th of following month
8. Minutes of Meetings	NLT 10 days after each Meeting

The overall completion date of this task order is 30 July 1999.

5.0 HEALTH AND SAFETY PLAN

5.1 Safety and Health Program. The Occupational Safety and Health Administration (OSHA) requires all employers performing on-site activities to develop and maintain an ongoing written Safety and Health Program in compliance with OSHA Standard 29 CFR 1910.120(b)/29CFR1926.65(b). The program, including updates, shall be made available upon request.

5.2. Site Safety and Health Plan (SSHP). The SSHP required by 29CFR1910.120(b)/29CFR1926.65(b)(4), and as defined by this SOW, shall be prepared and submitted. On-site activities shall not commence until the plan has been reviewed and accepted. The SSHP shall describe the site-specific safety and health procedures, practices and equipment to be implemented and utilized in order to protect affected personnel from the potential hazards

associated with the site-specific tasks to be performed. The level of detail provided in the SSHP shall be tailored to the type of work, complexity of operations to be accomplished and the hazards anticipated. The A-E shall address all elements contained in Appendix B of ER 385-1-92 in preparing the SSHP. Where the use of a specific topic is not applicable to the project, the A-E shall provide a negative declaration to establish that adequate consideration was given of the topic and gives a brief justification for its omission. Information readily available in standards texts shall be repeated only to the extent necessary to meet the requirements of this SOW. The SSHP shall not duplicate general information contained in the Safety and Health Program that is not specifically related to this project.

5.3 Abbreviated Health and Safety Plan. For sites where only a walkover will be performed, and where a UXO Specialist conducts the walkover, the A-E may be required to submit only an "Abbreviated Health and Safety Plan". The format for this document will be provided by the CEHNC Safety Office.

6.0 REFERENCES

6.1 National Contingency Plan, 40 CFR 300.

6.2 "Preparation of Contracts for OE Related Contracts," CEHND 1105-3-14, 25 May 95.

6.3 Federal Acquisition Regulation, FAR Clause 52.236-13: Accident Prevention.

6.4 U.S. Army Corps of Engineers, ER-385-1-92, Appendix B, Safety and Occupational Health Document Requirements for Hazardous Toxic and Radioactive Waste (HTRW) and Ordnance and Explosive Waste (OE) Activities, 18 March 1994.

6.5 Occupational Safety and Health Administration (OSHA) General Industry Standards, 29 CFR 1910 and Construction Industry Standards, 29 CFR 1926; especially 196.120/29CFR1926.65- "Hazardous Waste Site Operations and Emergency Response."

6.6 NIOSH/OSHA/USCG/EPA, "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," October 1985. (DHHS(NIOSH) Publication No. 85-115).

6.7 Archive Search Report, Findings, Benicia Arsenal, Benicia, Solano County, California, US Army Corps of Engineers, St. Louis District, March, 1994.

6.8 Archive Search Report, Conclusions and Recommendations, Benicia Arsenal, Benicia, Solano County, California, US Army Corps of Engineers, St. Louis District, March, 1994.

6.9 Archive Search Report, Supplement to the March 1994 Archives Search Report for Benicia Arsenal, Benicia Arsenal, Benicia, Solano County, California, US Army Corps of Engineers, St. Louis District, May 1997.

6.10 U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM-385-1-1, October 1992.

6.11 ETL 385-1-1 Safety Concepts and Basic Considerations for Unexploded Ordnance Operations, US Army Corps of Engineers, Engineering and Support Center Huntsville. 3 Sept 1996

6.12 Ordnance and Explosives (OE) Center of Expertise (CX) Personnel and Work Standards for Ordnance Response, US Army Corps of Engineers, Engineering and Support Center Huntsville.

APPENDIX C

SUMMARY OF OE SAMPLING RESULTS

APPENDIX C - ABSTRACT

This Appendix presents a summary of results for subsurface sampling performed at the Former Benicia Arsenal. Column headings identify grid number, sector number and location, sampling start and end dates, number of anomalies within each grid, length, width and area of each grid, and the number of samples collected. The remaining column headings categorize the contents found in each anomaly location during subsurface sampling. The contents of each anomaly were classified into one of four categories: UXO, OE Scrap, Non-OE Scrap, and False Positive.

The "% anomalies dug" column refers to the percentage of anomalies that were actually sampled for each grid. This was calculated by dividing the number of "samples collected" by the "number of anomalies". The term "N/A" refers to grids that had no anomalies identified for subsurface sampling.

The "percentage of anomalies dug" for each sector was calculated by dividing the "total number of anomalies investigated" by the "total number of anomalies" for that sector. For example, Sector 1 has a total of 660 anomalies identified for subsurface sampling. Of those anomalies, only 404 were sampled, resulting in an overall sampling percentage of 61%.

The table listed below provides a summary of recovered OE items for each of the five sectors at the Former Benicia Arsenal. The "percentage of subsurface anomalies containing OE Scrap" for each sector was calculated by dividing the number of "subsurface anomalies containing OE Scrap" by the number of "subsurface anomalies sampled".

SUMMARY OF RECOVERED OE SCRAP ITEMS BY SECTOR

Sector Number	Total Subsurface Anomalies	Subsurface Anomalies Sampled	Subsurface Anomalies Containing OE Scrap	% Subsurface Anomalies Containing OE Scrap
1	660	404	0	0%
2[a]	7	7	0	0%
3A	525	245	89	36%
3B	465	219	183	84%
3C	35	34	0	0%
4	247	177	38	21%
5	691	397	76	19%
Grid OT01[b]	--	--	--	--
Total	2,630	1,483	386	26%

Note: (a) Sampling results for Sector 2 include only those from Grid 0202.
(b) Subsurface sampling was not performed in Grid OT01.
OE = ordnance and explosives

Sector 1
Revetment Area
Number of grids: 32

Table C-1
Ordnance and Explosives (OE) Sampling Results

GridStats Summary

Grid	Sector Number/Location:	Sampling Start Date:	Sampling End Date:	Number of Anomalies:	Length (feet):	Width (feet):	Grid Area (square feet):	Samples Collected:	False Positives*:	Non-OE:	OE Scrap:	UXO:	UXO Type	UXO Depth	% Anomalies Dug
0101	Sector 1, Revetment Area	No Right-of-Entry			100	100	10,000								
0102	Sector 1, Revetment Area	No Right-of-Entry			100	100	10,000								
0103	Sector 1, Revetment Area	No Right-of-Entry			100	100	10,000								
0104	Sector 1, Revetment Area	No Right-of-Entry			100	100	10,000								
0105	Sector 1, Revetment Area	Grid Deleted			100	100	10,000								
0106	Sector 1, Revetment Area	No Right-of-Entry			100	100	10,000								
0107	Sector 1, Revetment Area	No Right-of-Entry			100	100	10,000								
0108	Sector 1, Revetment Area	No Right-of-Entry			100	100	10,000								
0109	Sector 1, Revetment Area	03/03/99	03/03/99	8	100	100	10,000	8	2	6	0	0	--	--	100%
0110	Sector 1, Revetment Area	03/03/99	03/03/99	7	100	100	10,000	7	3	4	0	0	--	--	100%
0111	Sector 1, Revetment Area	03/03/99	03/03/99	32	100	100	10,000	22	1	21	0	0	--	--	69%
0112	Sector 1, Revetment Area	03/03/99	03/03/99	28	100	100	10,000	22	2	20	0	0	--	--	79%
0113	Sector 1, Revetment Area	03/03/99	03/03/99	10	100	100	10,000	10	2	8	0	0	--	--	100%
0114	Sector 1, Revetment Area	03/02/99	03/02/99	17	100	100	10,000	17	0	17	0	0	--	--	100%
0115	Sector 1, Revetment Area	02/22/99	02/22/99	7	100	100	10,000	7	0	7	0	0	--	--	100%
0116	Sector 1, Revetment Area	03/02/99	03/02/99	7	100	100	10,000	7	2	5	0	0	--	--	100%
0117	Sector 1, Revetment Area	03/02/99	03/02/99	12	100	100	10,000	12	2	10	0	0	--	--	100%
0118	Sector 1, Revetment Area	02/22/99	02/22/99	3	100	100	10,000	3	1	2	0	0	--	--	100%
0119	Sector 1, Revetment Area	03/06/99	03/06/99	38	100	100	10,000	21	3	18	0	0	--	--	55%
0120	Sector 1, Revetment Area	03/03/99	03/03/99	15	100	100	10,000	15	3	12	0	0	--	--	100%
0121	Sector 1, Revetment Area	03/06/99	03/06/99	75	100	100	10,000	27	0	27	0	0	--	--	36%
0122	Sector 1, Revetment Area	03/03/99	03/03/99	64	100	100	10,000	25	0	25	0	0	--	--	39%
0123	Sector 1, Revetment Area	03/02/99	03/02/99	11	100	100	10,000	11	0	11	0	0	--	--	100%
0124	Sector 1, Revetment Area	03/03/99	03/03/99	58	100	100	10,000	22	0	22	0	0	--	--	38%
0125	Sector 1, Revetment Area	03/02/99	03/02/99	27	100	100	10,000	22	0	22	0	0	--	--	81%
0126	Sector 1, Revetment Area	03/01/99	03/01/99	18	100	100	10,000	18	2	16	0	0	--	--	100%
0127	Sector 1, Revetment Area	03/06/99	03/06/99	67	100	100	10,000	25	0	25	0	0	--	--	37%
0128	Sector 1, Revetment Area	03/02/99	03/02/99	16	100	100	10,000	16	1	15	0	0	--	--	100%
0129	Sector 1, Revetment Area	03/02/99	03/02/99	22	100	100	10,000	20	0	20	0	0	--	--	91%
0130	Sector 1, Revetment Area	03/03/99	03/03/99	39	100	100	10,000	22	0	22	0	0	--	--	56%
0131	Sector 1, Revetment Area	03/02/99	03/02/99	57	100	100	10,000	23	0	23	0	0	--	--	40%
0132	Sector 1, Revetment Area	03/02/99	03/02/99	22	100	100	10,000	22	0	22	0	0	--	--	100%

*** False Positives = Number of anomalies where dig team found nothing**

Total number of anomalies:	**660**
Total number of anomalies investigated:	**404**
Percentage of anomalies dug:	**61%**
Percentage of false positives:	**6%**

Total number of anomalies containing UXO:	**0**
Total number of anomalies containing OE scrap:	**0**
Total number of anomalies containing non-OE scrap:	**380**
Total number of false positives:	**24**

Sector 2
Artillery Test Area
Number of grids: 17

Table C-2
Ordnance and Explosives (OE) Sampling Results

GridStats Summary

Grid	Sector Number/Location:	Sampling Start Date:	Sampling End Date:	Number of Anomalies:	Length (feet):	Width (feet):	Grid Area (square feet):	Samples Collected:	False Positives*:	Non-OE:	OE Scrap:	UXO:	UXO Type	UXO Depth	% Anomalies Dug
0201	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0202	Sector 2, Artillery Test Area	02/19/99	02/19/99	7	100	100	10,000	7	2	5	0	0	--	--	100%
0203	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0204	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0205	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0206	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0207	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0208	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0209	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0210	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0211	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0212	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0213	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0214	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0215	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0216	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								
0217	Sector 2, Artillery Test Area	No Right-of-Entry			100	100	10,000								

* False Positives = Number of anomalies where dig team found nothing

Total number of anomalies:	7	Total number of anomalies containing UXO:	0
Total number of anomalies investigated:	7	Total number of anomalies containing OE scrap:	0
Percentage of anomalies dug:	100%	Total number of anomalies containing non-OE scrap:	5
Percentage of false positives:	29%	Total number of false positives:	2

Sector 3A
Tourtelot Property
Number of grids: 21

Table C-3
Ordnance and Explosives (OE) Sampling Results

GridStats Summary

Grid	Sector Number/Location:	Sampling Start Date:	Sampling End Date:	Number of Anomalies:	Length (feet):	Width (feet):	Grid Area (square feet):	Samples Collected:	False Positives*:	Non-OE:	OE Scrap:	UXO:	UXO Type	UXO Depth	% Anomalies Dug
0308	Sector 3A, Tourtelot Property	02/25/99	02/25/99	23	100	100	10,000	20	1	1	18	0	--	--	87%
0314	Sector 3A, Tourtelot Property	02/26/99	03/01/99	67	100	100	10,000	23	0	9	14	0	--	--	34%
0315	Sector 3A, Tourtelot Property	02/16/99	02/16/99	2	100	100	10,000	2	1	1	0	0	--	--	100%
0318	Sector 3A, Tourtelot Property	02/22/99	03/02/99	83	100	100	10,000	27	0	27	0	0	--	--	33%
0319	Sector 3A, Tourtelot Property	02/16/99	02/16/99	2	100	100	10,000	2	0	2	0	0	--	--	100%
0322	Sector 3A, Tourtelot Property	03/01/99	03/01/99	90	100	100	10,000	30	1	18	11	0	--	--	33%
0323	Sector 3A, Tourtelot Property	02/16/99	02/16/99	7	100	100	10,000	7	0	7	0	0	--	--	100%
0324	Sector 3A, Tourtelot Property	03/01/99	03/01/99	30	100	100	10,000	20	3	11	6	0	--	--	67%
0325	Sector 3A, Tourtelot Property	02/22/99	02/22/99	13	100	100	10,000	13	2	11	0	0	--	--	100%
0326	Sector 3A, Tourtelot Property	02/22/99	02/22/99	157	100	100	10,000	50	3	14	33	0	--	--	32%
0327	Sector 3A, Tourtelot Property	02/16/99	02/16/99	18	100	100	10,000	18	2	16	0	0	--	--	100%
0329	Sector 3A, Tourtelot Property	02/16/99	02/16/99	4	100	100	10,000	4	1	3	0	0	--	--	100%
0331	Sector 3A, Tourtelot Property	02/17/99	02/17/99	6	100	100	10,000	6	0	5	1	0	--	--	100%
0332	Sector 3A, Tourtelot Property	02/17/99	02/17/99	2	100	100	10,000	2	1	1	0	0	--	--	100%
0333	Sector 3A, Tourtelot Property	02/16/99	02/16/99	3	100	100	10,000	3	0	2	1	0	--	--	100%
0334	Sector 3A, Tourtelot Property	02/16/99	02/16/99	2	100	100	10,000	2	2	0	0	0	--	--	100%
0335	Sector 3A, Tourtelot Property	02/16/99	02/16/99	0	100	100	10,000	0	0	0	0	0	--	--	N/A
0336	Sector 3A, Tourtelot Property	02/16/99	02/16/99	1	100	100	10,000	1	1	0	0	0	--	--	100%
0337	Sector 3A, Tourtelot Property	02/25/99	02/25/99	9	100	100	10,000	9	3	2	4	0	--	--	100%
0338	Sector 3A, Tourtelot Property	02/16/99	02/16/99	4	100	100	10,000	4	3	1	0	0	--	--	100%
0339	Sector 3A, Tourtelot Property	02/16/99	02/16/99	2	100	100	10,000	2	0	1	1	0	--	--	100%

N/A = Percentage does not apply. Grid has no reported anomalies.
* False Positives = Number of anomalies where dig team found nothing

Total number of anomalies:	525
Total number of anomalies investigated:	245
Percentage of anomalies dug:	47%
Percentage of false positives:	10%

Total number of anomalies containing UXO:	0
Total number of anomalies containing OE scrap:	89
Total number of anomalies containing non-OE scrap:	132
Total number of false positives:	24

Sector 3B
Tourtelot Property
Number of grids: 10

Table C-4
Ordnance and Explosives (OE) Sampling Results

GridStats Summary

Grid	Sector Number/Location:	Sampling Start Date:	Sampling End Date:	Number of Anomalies:	Length (feet):	Width (feet):	Grid Area (square feet):	Samples Collected:	False Positives*:	Non-OE:	OE Scrap:	UXO:	UXO Type	UXO Depth	% Anomalies Dug
0301	Sector 3B, Tourtelot Property	03/01/99	03/01/99	39	100	100	10,000	20	2	5	13	0	--	--	51%
0302	Sector 3B, Tourtelot Property	03/02/99	03/02/99	23	100	100	10,000	20	4	4	12	0	--	--	87%
0306	Sector 3B, Tourtelot Property	02/18/99	02/18/99	54	100	100	10,000	20	0	0	20	0	--	--	37%
0307	Sector 3B, Tourtelot Property	02/16/99	02/16/99	29	100	100	10,000	20	0	2	18	0	--	--	69%
0311	Sector 3B, Tourtelot Property	02/16/99	02/19/99	29	100	100	10,000	20	1	1	18	0	--	--	69%
0312	Sector 3B, Tourtelot Property	02/23/99	03/07/99	134	100	100	10,000	54	0	1	51	2	37mm, 75mm	6"-24"	40%
0313	Sector 3B, Tourtelot Property	02/18/99	02/18/99	60	100	100	10,000	20	0	2	18	0	--	--	33%
0316	Sector 3B, Tourtelot Property	02/19/99	02/19/99	4	100	100	10,000	4	2	1	1	0	--	--	100%
0317	Sector 3B, Tourtelot Property	02/19/99	02/19/99	17	100	100	10,000	17	1	1	15	0	--	--	100%
0321	Sector 3B, Tourtelot Property	02/23/99	02/23/99	76	100	100	10,000	24	3	4	17	0	--	--	32%

* False Positives = Number of anomalies where dig team found nothing

Total number of anomalies:	465
Total number of anomalies investigated:	219
Percentage of anomalies dug:	47%
Percentage of false positives:	6%

Total number of anomalies containing UXO:	2
Total number of anomalies containing OE scrap:	183
Total number of anomalies containing non-OE scrap:	21
Total number of false positives:	13

Sector 3C
City Property Adjacent To Tourtelot Property
Number of grids: 8

Table C-5
Ordnance and Explosives (OE) Sampling Results

GridStats Summary

Grid	Sector Number/Location:	Sampling Start Date:	Sampling End Date:	Number of Anomalies:	Length (feet):	Width (feet):	Grid Area (square feet):	Samples Collected:	False Positives*:	Non-OE:	OE Scrap:	UXO:	UXO Type	UXO Depth	% Anomalies Dug
0303	Sector 3C, City Property Adjacent To Tourtelot Property	02/24/99	02/24/99	0	100	100	10,000	0	0	0	0	0	--	--	N/A
0304	Sector 3C, City Property Adjacent To Tourtelot Property	03/01/99	03/01/99	9	100	100	10,000	9	4	5	0	0	--	--	100%
0305	Sector 3C, City Property Adjacent To Tourtelot Property	02/24/99	02/24/99	0	100	100	10,000	0	0	0	0	0	--	--	N/A
0309	Sector 3C, City Property Adjacent To Tourtelot Property	02/24/99	02/24/99	0	100	100	10,000	0	0	0	0	0	--	--	N/A
0310	Sector 3C, City Property Adjacent To Tourtelot Property	03/01/99	03/01/99	21	100	100	10,000	20	2	18	0	0	--	--	95%
0320	Sector 3C, City Property Adjacent To Tourtelot Property	03/01/99	03/01/99	3	100	100	10,000	3	1	2	0	0	--	--	100%
0328	Sector 3C, City Property Adjacent To Tourtelot Property	02/25/99	02/25/99	0	100	100	10,000	0	0	0	0	0	--	--	N/A
0330	Sector 3C, City Property Adjacent To Tourtelot Property	03/01/99	03/01/99	2	100	100	10,000	2	0	2	0	0	--	--	100%

N/A = Percentage does not apply. Grid has no reported anomalies.
* False Positives = Number of anomalies where dig team found nothing

Total number of anomalies:	35
Total number of anomalies investigated:	34
Percentage of anomalies dug:	97%
Percentage of false positives:	21%

Total number of anomalies containing UXO:	0
Total number of anomalies containing OE scrap:	0
Total number of anomalies containing non-OE scrap:	27
Total number of false positives:	7

Sector 4
Demolition Site on Exxon Property
Number of grids: 22

Table C-6
Ordnance and Explosives (OE) Sampling Results

GridStats Summary

Grid	Sector Number/Location:	Sampling Start Date:	Sampling End Date:	Number of Anomalies:	Length (feet):	Width (feet):	Grid Area (square feet):	Samples Collected:	False Positives*:	Non-OE:	OE Scrap:	UXO:	UXO Type	UXO Depth	% Anomalies Dug
0401	Sector 4, Demo Site on Exxon Property	03/08/99	03/08/99	19	100	100	10,000	19	1	4	14	0	--	--	100%
0402	Sector 4, Demo Site on Exxon Property	03/08/99	03/08/99	26	100	100	10,000	20	5	15	0	0	--	--	77%
0403	Sector 4, Demo Site on Exxon Property	03/07/99	03/07/99	5	100	100	10,000	5	2	3	0	0	--	--	100%
0404	Sector 4, Demo Site on Exxon Property	03/08/99	03/08/99	34	100	100	10,000	20	3	16	1	0	--	--	59%
0405	Sector 4, Demo Site on Exxon Property	03/08/99	03/08/99	53	100	100	10,000	23	0	12	11	0	--	--	43%
0406	Sector 4, Demo Site on Exxon Property	Grid Deleted			100	100	10,000								
0407	Sector 4, Demo Site on Exxon Property	03/07/99	03/07/99	6	100	100	10,000	6	3	1	2	0	--	--	100%
0408	Sector 4, Demo Site on Exxon Property	03/07/99	03/07/99	2	100	100	10,000	2	0	2	0	0	--	--	100%
0409	Sector 4, Demo Site on Exxon Property	03/08/99	03/08/99	5	100	100	10,000	5	5	0	0	0	--	--	100%
0410	Sector 4, Demo Site on Exxon Property	03/08/99	03/08/99	10	100	100	10,000	10	1	4	5	0	--	--	100%
0411	Sector 4, Demo Site on Exxon Property	03/07/99	03/07/99	4	100	100	10,000	4	0	4	0	0	--	--	100%
0412	Sector 4, Demo Site on Exxon Property	03/08/99	03/08/99	40	100	100	10,000	20	0	15	5	0	--	--	50%
0413	Sector 4, Demo Site on Exxon Property	03/07/99	03/07/99	3	100	100	10,000	3	0	3	0	0	--	--	100%
0414	Sector 4, Demo Site on Exxon Property	03/07/99	03/07/99	6	100	100	10,000	6	0	6	0	0	--	--	100%
0415	Sector 4, Demo Site on Exxon Property	03/07/99	03/07/99	4	100	100	10,000	4	0	4	0	0	--	--	100%
0416	Sector 4, Demo Site on Exxon Property	03/09/99	03/09/99	8	100	100	10,000	8	0	8	0	0	--	--	100%
0417	Sector 4, Demo Site on Exxon Property	03/07/99	03/07/99	6	100	100	10,000	6	0	6	0	0	--	--	100%
0418	Sector 4, Demo Site on Exxon Property	03/09/99	03/09/99	9	100	100	10,000	9	6	3	0	0	--	--	100%
0419	Sector 4, Demo Site on Exxon Property	Grid Deleted			100	100	10,000								
0420	Sector 4, Demo Site on Exxon Property	03/01/99	03/01/99	0	100	100	10,000	0	0	0	0	0	--	--	N/A
0421	Sector 4, Demo Site on Exxon Property	03/07/99	03/07/99	7	100	100	10,000	7	5	2	0	0	--	--	100%
0422	Sector 4, Demo Site on Exxon Property	03/01/99	03/01/99	0	100	100	10,000	0	0	0	0	0	--	--	N/A

N/A = Percentage does not apply. Grid has no reported anomalies.
*** False Positives = Number of anomalies where dig team found nothing**

Total number of anomalies:	**247**
Total number of anomalies investigated:	**177**
Percentage of anomalies dug:	**72%**
Percentage of false positives:	**18%**

Total number of anomalies containing UXO:	**0**
Total number of anomalies containing OE scrap:	**38**
Total number of anomalies containing non-OE scrap:	**108**
Total number of false positives:	**31**

Sector 5
Camel Barn Area
Number of grids: 20

Table C-7
Ordnance and Explosives (OE) Sampling Results

GridStats Summary

Grid	Sector Number/Location:	Sampling Start Date:	Sampling End Date:	Number of Anomalies:	Length (feet):	Width (feet):	Grid Area (square feet):	Samples Collected:	False Positives*:	Non-OE:	OE Scrap:	UXO:	UXO Type	UXO Depth	% Anomalies Dug
0501	Sector 5, Camel Barn Area	03/14/99	03/14/99	17	100	100	10,000	17	10	7	0	0	--	--	100%
0502	Sector 5, Camel Barn Area	03/08/99	03/14/99	43	100	100	10,000	20	2	17	1	0	--	--	47%
0503	Sector 5, Camel Barn Area	03/13/99	03/13/99	49	100	100	10,000	22	2	20	0	0	--	--	45%
0504	Sector 5, Camel Barn Area	03/06/99	03/13/99	25	100	100	10,000	20	0	18	2	0	--	--	80%
0505	Sector 5, Camel Barn Area	03/13/99	03/13/99	21	100	100	10,000	16	1	15	0	0	--	--	76%
0506	Sector 5, Camel Barn Area	03/13/99	03/13/99	10	100	100	10,000	10	1	9	0	0	--	--	100%
0507	Sector 5, Camel Barn Area	03/13/99	03/13/99	20	100	100	10,000	20	1	18	1	0	--	--	100%
0508	Sector 5, Camel Barn Area	03/06/99	03/13/99	39	100	100	10,000	20	3	12	4	1	75mm Shrapnel Projectile (1), 3"/50 APHE Projectile (1)	16"	51%
0509	Sector 5, Camel Barn Area	03/13/99	03/13/99	72	100	100	10,000	29	2	24	3	0	--	--	40%
0510	Sector 5, Camel Barn Area	03/13/99	03/13/99	52	100	100	10,000	21	0	21	0	0	--	--	40%
0511	Sector 5, Camel Barn Area	03/13/99	03/13/99	47	100	100	10,000	20	0	20	0	0	--	--	43%
0512	Sector 5, Camel Barn Area	03/14/99	03/14/99	36	100	100	10,000	20	0	8	11	1	Grenade (1)	4"	56%
0513	Sector 5, Camel Barn Area	03/06/99	03/06/99	22	100	100	10,000	22	2	11	4	5	Grenades (5), 3"/50 APHE Projectiles (4), Stokes Mortar Fuze (1), Base Fuze (1)	4"-32"	100%
0514	Sector 5, Camel Barn Area	03/09/99	03/09/99	24	100	100	10,000	20	2	1	17	0	--	--	83%
0515	Sector 5, Camel Barn Area	03/09/99	03/14/99	53	100	100	10,000	22	1	20	1	0	--	--	42%
0516	Sector 5, Camel Barn Area	03/14/99	03/14/99	18	100	100	10,000	18	5	0	13	0	--	--	100%
0517	Sector 5, Camel Barn Area	03/09/99	03/09/99	36	100	100	10,000	20	2	16	0	0	--	--	56%
0518	Sector 5, Camel Barn Area	03/09/99	03/09/99	30	100	100	10,000	20	0	18	2	0	--	--	67%
0519	Sector 5, Camel Barn Area	03/14/99	03/14/99	43	100	100	10,000	20	3	4	12	1	Grenade (1)	0"	47%
0520	Sector 5, Camel Barn Area	03/14/99	03/14/99	34	100	100	10,000	20	3	12	5	0	--	--	59%

* False Positives = Number of anomalies where dig team found nothing

Total number of anomalies:	691
Total number of anomalies investigated:	387
Percentage of anomalies dug:	57%
Percentage of false positives:	10%

Total number of anomalies containing UXO:	8
Total number of anomalies containing OE scrap:	76
Total number of anomalies containing non-OE scrap:	273
Total number of false positives:	40

Grid OT01
Overturned Truck Area
Number of grids: 1

Table C-8
Ordnance and Explosives (OE) Sampling Results

GridStats Summary

Grid	Sector Number/Location:	Sampling Start Date:	Sampling End Date:	Number of Anomalies:	Length (feet):	Width (feet):	Grid Area (square feet):	Samples Collected:	False Positives*:	Non OE:	OE Scrap:	UXO:	UXO Type	UXO Depth	% Anomalies Dug
OT01	Overturned Truck Area	No Right-of-Entry			100	100	10,000								

* False Positives = Number of anomalies where dig team found nothing

Total number of anomalies:	0
Total number of anomalies investigated:	0
Percentage of anomalies dug:	0%
Percentage of false positives:	0%

Total number of anomalies containing UXO:	0
Total number of anomalies containing OE scrap:	0
Total number of anomalies containing non-OE scrap:	0
Total number of false positives:	0