N69321.AR.003593
VIEQUES EAST
5090.3a

FINAL REMEDIAL INVESTIGATION/FEASIBILITY STUDY REPORT UNEXPLODED ORDNANCE 18 (UXO 18) ATLANTIC FLEET WEAPONS TRAINING AREA FORMER VIEQUES NAVAL TRAINING RANGE VIEQUES ISLAND PR
05/01/2015
CH2M HILL

Final

Remedial Investigation/Feasibility Study Report
UXO 18

Atlantic Fleet Weapons Training Area - Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Contract Task Order 005

May 2015

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Atlantic Division

Under the

LANTDIV CLEAN 8012 Program
Contract N62470-11-D-8012

Prepared by

CH2MHILL

Executive Summary

This Remedial Investigation (RI)/Feasibility Study (FS) Report presents the data and findings obtained from investigations conducted to characterize the nature and extent of contamination, assess potential risks to human health and the environment, and evaluate remedial alternatives at UXO 18, located at the Former Vieques Naval Training Range (VNTR) in Vieques, Puerto Rico. UXO 18, also known as Cayo La Chiva, is a 12-acre island where munitions and explosives of concern (MEC) were previously identified. The island is located within several hundred yards of Blue Beach (Playa La Chiva), a public beach used for recreational activities.

The RI was implemented in two separate investigations. The MEC component of the RI was implemented in 2011 to assess the presence and extent of MEC and included transect inspections that covered approximately 5 percent of the island (and anomaly avoidance practiced during the 2011 biological survey covered an additional 3 percent), in which five MEC (5-inch rockets) were discovered and destroyed. The transects covered the accessible areas of UXO 18 and did not identify areas with significant MEC. The environmental characterization component of the RI was conducted in 2013 and included the collection of soil samples in areas that provide a conservative estimate of the nature and extent of contamination. No chemicals of concern (COCs) were identified in soil and there were no unacceptable human health or ecological risks.

The FS was conducted to evaluate remedial alternatives for UXO 18 to address potential explosive hazards associated with MEC identified in the RI. Remedial Action Objectives (RAOs) were developed to be protective of current and potential future receptors, in accordance with the current land use (i.e., potential recreational receptors) and potential future land use (same as current), when evaluating potential remedial alternatives. The RAOs for UXO 18 include reducing the explosive hazard associated with MEC to be compatible with current and anticipated future land use and reducing the potential for unauthorized access to the site.

The following four remedial alternatives were evaluated in this FS:

- Alternative 1 – No Action
    - Alternative 1 consists of performing no remedial action and serves only as a baseline to which to compare the other alternatives; it is not a viable option considered for this site.
- Alternative 2 – Land Use Controls and MEC Inspection
    - Alternative 2 involves using land use controls (LUCs) to reduce the potential explosive hazard by reducing the potential for unauthorized access to the site (shown conceptually in **Figure ES-1**). It includes maintaining existing signs and institutional controls, and long-term monitoring (LTM) to repair any damaged signage, replace any missing or damaged signage, observe any indications of trespassing, and remove any MEC that may have been exposed at the surface within any trespassing routes observed.
    - Alternative 2 is protective of human health through discouraging access to the site and performing MEC inspections and removal (if found) in the areas observed to be accessed. Because only five isolated MEC have been identified on the island, this site has a relatively low explosive hazard associated with it. This alternative will allow the natural site features, predominantly dense vegetation, to remain uncut and serve as a deterrent to accessing much of the island. The LUC maintenance coupled with the LTM inspections and 5-year reviews will ensure that the LUCs are sufficiently deterring access to the site and verify that MEC is not exposed on the ground surface in the areas readily accessible.

NOTE: THIS SUMMARY IS PRESENTED IN ENGLISH AND SPANISH FOR THE CONVENIENCE OF THE READER. EVERY EFFORT HAS BEEN MADE FOR THE TRANSLATIONS TO BE AS ACCURATE AS REASONABLY POSSIBLE. HOWEVER, READERS SHOULD BE AWARE THAT THE ENGLISH VERSION OF THE TEXT IS THE OFFICIAL VERSION.
NOTA: ESTE RESUMEN SE PRESENTA EN INGLÉS Y EN ESPAÑOL PARA LA CONVENIENCIA DEL LECTOR. SE HAN HECHO TODOS LOS ESFUERZOS PARA QUE LA TRADUCCIÓN SEA PRECISA EN LO MÁS RAZONABLEMENTE POSIBLE. SIN EMBARGO, LOS LECTORES DEBEN ESTAR AL TANTO QUE EL TEXTO EN INGLÉS ES LA VERSIÓN OFICIAL.

- Alternative 3 – Limited MEC Removal, Land Use Controls, and MEC Inspections
    - Alternative 3 consists of limited additional surface and subsurface MEC removal (up to about 1 foot [ft] below ground surface [bgs] based on shallow depth of bedrock) throughout UXO 18 to support potential future recreational uses, and LUCs and LTM. The surface and subsurface MEC removal component includes surface MEC removal from the areas that are currently free of vegetation and accessible by people accessing the island (assumed approximately 1 acre) and MEC removal to a depth of 1 ft bgs from an additional approximate 1 acre of UXO 18 to accommodate recreational use of the beaches and trails and installation of an observation tower. LUCs and LTM would be similar to Alternative 2, but would also include inspections at the beaches, trails, the area immediately surrounding the observation tower, and at any trespassing routes observed.
    - Alternative 3 involves targeted vegetation and MEC removal from areas that are identified by the Land Administrator for future recreational use; because there is currently no documented plan for the island it is assumed the area will be approximately 1 acre. Because MEC may still be present at the site following the MEC removal, the same LUCs, LTM, and 5-year reviews identified for Alternative 2 would be employed and maintained for Alternative 3.
- Alternative 4 – MEC Removal, Land Use Controls, and MEC inspections
    - Alternative 4 consists of surface and subsurface MEC removal (up to about 1 ft bgs based on shallow depth of bedrock) throughout the entire area of UXO 18, with the exception of the inaccessible portions of the site (i.e., cliffs), and LUCs, and LTM (shown conceptually in **Figure ES-2**). The LUCs and LTM would be similar as Alternative 2, since it is possible MEC would remain even after performing MEC removal.
    - Alternative 4 involves significant vegetation removal and the potential for increased runoff to the surrounding bay. Further, until the vegetation re-establishes, there is the potential for increased public access to the island, including in areas where cultural resources are located. Because MEC may still be present at the site following the MEC removal, the same LUCs, LTM, and 5-year reviews identified for Alternatives 2 and 3 would be employed and maintained for Alternative 4. Compared with Alternative 2 and 3, Alternative 4 has a significantly higher impact to the island's physical environment, the surrounding waters, and potential exposure of cultural resources.

Resumen Ejecutivo

Este reporte de la Investigación de Remediación (RI, por sus siglas en inglés)/Estudio de Viabilidad (FS, por sus siglas en inglés) presenta los datos y observaciones obtenidas de las investigaciones llevadas a cabo para caracterizar la naturaleza y la extensión de la contaminación, estudiar los riesgos potenciales a la salud humana y al ambiente, y evaluar las alternativas para el remedio en UXO 18, localizado en el Antiguo Campo de Adiestramiento Naval de Vieques (VNTR, por sus siglas en inglés) en Vieques, Puerto Rico. UXO 18, también conocido como Cayo La Chiva, es una isla de 12 acres donde se identificaron previamente municiones y explosivos de preocupación (MEC por sus siglas en inglés). La isla está localizada a varios cientos de yardas de Blue Bleach (Playa La Chiva), una playa pública usada para actividades recreativas. El RI fue implementado en dos investigaciones separadas. El componente de investigación de MEC del RI fue implementado en el 2011 para evaluar la presencia y la extensión de MEC e incluyó inspecciones por transectos que cubrieron aproximadamente 5 porciento de la isla (la acción implementada para evitar anomalías durante el estudio biológico del 2011 cubrió un 3 porciento adicional), en el cual cinco MEC (cohetes de 5 pulgadas) fueron descubiertos y destruidos. Los transectos cubrieron las áreas accesibles de UXO 18 y no se identificaron áreas con MEC significativos. EL componente de caracterización ambiental del RI fue llevado a cabo en el 2013 e incluyó la colección de muestras de suelo en áreas que proveen un estimado conservador de la naturaleza y la extensión de la contaminación. No se identificaron químicos de preocupación (COC por sus siglas en inglés) en el suelo y no hubo ningún riesgo inaceptable a la salud humana o riesgos ecológicos. El FS se llevó a cabo para evaluar las alternativas para la remediación de UXO 18 para atender los peligros de explosión potenciales asociados con MEC identificados en el RI. Objetivos de la Acción de la Remediación (RAOs por sus siglas en inglés) fueron desarrollados para proteger receptores actuales y futuros, de acuerdo con el uso actual del terreno (i.e. receptores recreativos potenciales) y el uso futuro potencial (iguales a los actuales), cuando se evalúen las alternativas de remediación potenciales. Los RAOs para UXO 18 incluyen reducir el peligro de explosión asociado con MEC para que sea compatible con el uso actual y anticipado del terreno y reducir el potencial de acceso no autorizado al sitio.

Las siguientes cuatro alternativas de remediación fueron evaluadas en este FS:

- Alternativa 1 – Ninguna Acción
    - La Alternativa 1 consiste en llevar a cabo ninguna acción de remediación y solamente sirve como base para comparar las otras alternativas; no se considera una opción viable para este sitio.
- Alternativa 2 – Controles de Uso del Terreno e Inspección de MEC.
    - La Alternativa 2 envuelve el utilizar controles de uso del terreno (LUCs por sus siglas en ingles) para reducir el riesgo potencial de explosión al minimizar el potencial acceso no autorizado al sitio (concepto se muestra en la **Figura ES-1**). Este incluye mantener los rótulos existentes y controles institucionales, y monitoreo a largo plazo (LTM por sus siglas en inglés) para reparar cualquier rótulo dañado, reemplazar cualquier rótulo faltante o dañado, observar cualquier indicación de traspaso, y remover cualquier MEC que se haya expuesto a la superficie dentro de cualquier área donde se observe traspaso.
    - La Alternativa 2 protege la salud humana al desalentar el acceso al sitio y llevar a cabo inspecciones de MEC y remoción (si son encontrados) en las áreas que se observe que son visitadas. Debido a que solamente cinco MEC aislados se han identificado en la isla, hay un peligro de explosión relativamente bajo asociado con este sitio. Esta alternativa permitirá que las características naturales del sitio, predominantemente la densa vegetación, no necesiten ser

NOTE: THIS SUMMARY IS PRESENTED IN ENGLISH AND SPANISH FOR THE CONVENIENCE OF THE READER. EVERY EFFORT HAS BEEN MADE FOR THE TRANSLATIONS TO BE AS ACCURATE AS REASONABLY POSSIBLE. HOWEVER, READERS SHOULD BE AWARE THAT THE ENGLISH VERSION OF THE TEXT IS THE OFFICIAL VERSION.
NOTA: ESTE RESUMEN SE PRESENTA EN INGLÉS Y EN ESPAÑOL PARA LA CONVENIENCIA DEL LECTOR. SE HAN HECHO TODOS LOS ESFUERZOS PARA QUE LA TRADUCCIÓN SEA PRECISA EN LO MÁS RAZONABLEMENTE POSIBLE. SIN EMBARGO, LOS LECTORES DEBEN ESTAR AL TANTO QUE EL TEXTO EN INGLÉS ES LA VERSIÓN OFICIAL.

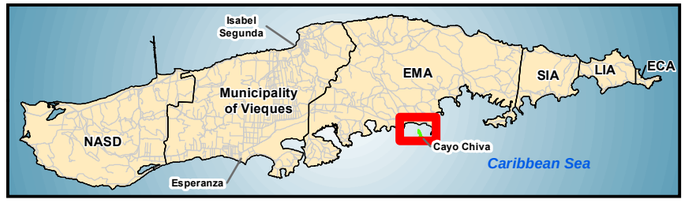
que los LUCs son suficientes para desalentar el acceso al sitio y para verificar que MEC no esté expuesto en la superficie del suelo en áreas de fácil acceso.

- Alternativa 3 – Remoción de MEC Limitada, Controles de Uso del Terreno, e Inspecciones de MEC
    - La Alternativa 3 consiste en remociones adicionales limitadas de MEC en la superficie y bajo la superficie (hasta cerca de 1 pie bajo la superficie del terreno basado en la baja profundidad del lecho de roca) a través de UXO 18 para sostener los potenciales usos recreacionales futuros, y los LUCs y LTM. El componente de remoción de MEC en la superficie y bajo la superficie incluye remoción de MEC de la superficie en áreas que se encuentran actualmente libres de vegetación y accesibles a las personas que visitan la isla (se estima 1 acre), y la remoción de MEC a una profundidad de 1 pie bajo la superficie del terreno de un área de aproximadamente 1 acre en UXO 18 para acomodar el uso recreacional de las playas y veredas y la instalación de una torre de observación. LUCs y LTM serían similares a la Alternativa 2, pero también incluirían inspecciones en las playas, veredas, el área inmediatamente alrededor de la torre de observación, y en cualquiera de las rutas de traspaso observadas.
    - La Alternativa 3 envuelve remoción enfocada de vegetación y MEC en áreas que el administrador del terreno ha identificado para uso recreacional en el futuro; se asume que el área va a ser de aproximadamente 1 acre porque actualmente no hay un plan final para la isla. Ya que podría quedar MEC en el sitio luego de la remoción de MEC, los mismos LUCs, LTM, y revisiones cada 5 años que se identificaron en la Alternativa 2 serían utilizados y mantenidos para la Alternativa 3.
- Alternativa 4 – Remoción de MEC, Controles de Uso del Terreno, e Inspecciones de MEC
    - La Alternativa 4 consiste en remoción de MEC en la superficie y bajo la superficie del terreno (hasta 1 pies basado en la baja profundidad del lecho de roca) a través de toda el área de UXO 18, con la excepción de las partes inaccesibles del sitio (i.e. barrancos), y LUCs, y LTM (concepto se muestra en la **Figura ES-2**). Los LUCs y LTM serían similares a la Alternativa 2, ya que es posible que queden MEC aun después que se realice la remoción de MEC.
    - La Alternativa 4 envuelve remoción significativa de vegetación y existe el potencial de una mayor cantidad de escorrentía hacia la bahía adyacente. En adición, hasta que la vegetación se reestablezca, podría haber un incremento de acceso público a la isla, incluyendo las áreas donde se encuentran recursos culturales. Ya que MEC aún podría estar presente luego de la remoción de MEC, los mismos LUCs, LTM, y revisiones cada 5 años identificados para las Alternativas 2 y 3 serían empleadas y mantenidas para la Alternativa 4. Comparada con las Alternativas 2 y 3, la Alternativa 4 tiene un impacto mayor al ambiente físico de la isla, las aguas adyacentes, y hay potencial de exposición de recursos culturales.

R:\USNavFacEngCom405450\Vieques\MapFiles\UXO_18_Remedial_Investigation_Feasibility_Study\FigureES-1_Alternative2_LandUseControls_MECInspections.mxd 2/10/2015 JCarr_ch2mhillenvgis

Legend

- Access Restriction Sign
- Cayo la Chiva Warning Sign
- UXO 18 Boundary



N
W E
S

0 500 1,000
Feet

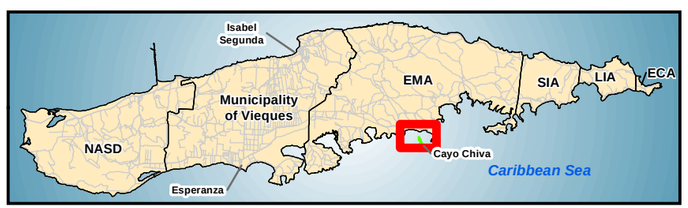
Figure ES-1
Alternative 2 – Land Use Controls and MEC Inspections
UXO 18 Remedial Investigation/Feasibility Study
Former Atlantic Fleet Weapons Training Area – Vieques
Vieques, Puerto Rico

CH2MHILL

R:\USNavFacEngCom405450\Vieques\MapFiles\UXO_18_Remedial_Investigation_Feasibility_Study\FigureES-2_MECRemovalLandUseControls_MECInspections.mxd 2/10/2015 JCarr_ch2mhillenvgis

Legend

- Access Restriction Sign
- Cayo la Chiva Warning Sign
- Surface and Subsurface MEC Removal Area



N
W E
S

0 500 1,000
Feet

Figure ES-2
MEC Removal, Land Use Controls, and MEC Inspections
UXO 18 Remedial Investigation/Feasibility Study
Former Atlantic Fleet Weapons Training Area – Vieques
Vieques, Puerto Rico

CH2MHILL

Contents

Section **Page**

Executive Summary ..... **iii**

Resumen Ejecutivo ..... **v**

Acronyms and Abbreviations ..... **xi**

Introduction **1-1**
1.1 Objectives and Approach 1-1
1.2 Site Background 1-1
1.2.1 Former VNTR and UXO 18 1-2
1.2.2 Previous Investigations and Activities 1-2

Summary of RI Field Investigation **2-1**
2.1 MEC Activities 2-1
2.2 Soil Sampling Activities 2-1
2.2.1 Incremental Surface Soil Sampling 2-2
2.2.2 Discrete Surface Soil Sampling 2-2
2.3 Decontamination and Waste Management 2-3
2.4 Environmental Data Management 2-3
2.4.1 Data Tracking and Validation 2-3
2.4.2 Regulatory Standards and Risk-Based Screening Values 2-3
2.5 Archaeological Survey 2-3

Physical Characteristics **3-1**
3.1 Physical Setting 3-1
3.2 Land Use 3-1
3.3 Ecological Setting 3-1
3.4 Cultural Resources 3-2

Nature and Extent of Contamination **4-1**
4.1 MEC 4-1
4.2 Soil Constituents 4-1
4.2.1 Hexachloroethane 4-1
4.2.2 Explosives 4-1
4.2.3 Inorganic Constituents 4-1

Chemical Fate and Transport **5-1**
5.1 Chemical Mobility and Persistence 5-1
5.2 Chemical Migration at UXO 18 5-1

Human Health Risk Assessment Summary **6-1**
6.1 Chemicals of Potential Concern 6-1
6.2 Exposure Evaluation 6-1
6.3 Risk Estimates 6-2
6.4 Chemicals of Concern 6-2

Ecological Risk Assessment Summary **7-1**
7.1 ERA Process 7-1

7.2 Ecological Setting 7-1
7.3 Analytical Data Used in the ERA 7-2
7.4 ERA Results 7-2
7.5 ERA Summary and Conclusions 7-2

Summary and Recommendations of Remedial Investigation 8-1
8.1 Summary of Remedial Investigation 8-1
8.2 Recommendations 8-1

Remedial Action Objectives and Approach 9-1
9.1 Applicable or Relevant and Appropriate Requirements 9-1
9.2 Remedial Action Objectives 9-2
9.3 Performance Criteria 9-2
9.4 General Response Actions 9-2
9.5 Screening of Remedial Technologies 9-2
9.6 Sustainability 9-3

Development and Description of Remedial Alternatives 10-1
10.1 Alternative 1 – No Action 10-1
10.2 Alternative 2 – Land Use Controls and MEC Inspections 10-1
10.3 Alternative 3 – Limited MEC Removal, Land Use Controls, and MEC Inspections 10-2
10.4 Alternative 4 – MEC Removal, Land Use Controls, and MEC Inspections 10-3

Detailed Analysis of Remedial Alternatives 11-1
11.1 Evaluation Criteria 11-1
11.1.1 Threshold Criteria 11-1
11.1.2 Balancing Criteria 11-1
11.1.3 Modifying Criteria 11-3
11.2 Detailed Evaluation of Remedial Alternatives 11-3
11.3 Comparative Evaluation of Remedial Alternatives 11-3
11.3.1 Overall Protection of Human Health and the Environment 11-4
11.3.2 Compliance with ARARs 11-4
11.3.3 Long-Term Effectiveness and Permanence 11-4
11.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment 11-5
11.3.5 Short-Term Effectiveness 11-5
11.3.6 Implementability 11-6
11.3.7 Cost 11-6

Summary and Conclusions of FS 12-1

References 13-1

List of Tables (provided at the end of each section)

2-1 Summary of Samples Collected

4-1 Constituents Detected in Soil

9-1 ARARs
9-2 Technology Screening Summary

11-1 Detailed Evaluation of Remedial Action Alternatives
11-2 Comparative Analysis of Remedial Alternatives

List of Figures (provided at the end of each section)

ES-1 Alternative 2 – Land Use Controls and MEC Inspections
ES-2 MEC Removal, Land Use Controls, and MEC Inspections

1-1 Regional Location Map
1-2 UXO 18 Location Map
1-3 UXO 18 Cayo la Chiva MEC Investigation
1-4 Previous Investigation Results around UXO 18

2-1 UXO 18 RI Sample Locations

3-1 UXO 18 Topography and Geology

5-1 Conceptual Site Model

10-1 Alternative 2 – Land Use Controls and MEC Inspections
10-2 Alternative 4 – MEC Removal, Land Use Controls, and MEC Inspections

List of Appendixes

A Data Validation Reports (provided on CD)
B Data Quality Evaluation
C Raw Analytical Data Summary Table
D Human Health Risk Assessment
E Ecological Risk Assessment
F Technology Screening
G Sustainability Analysis for UXO 18
H Cost Estimates
I Responses to Regulator Comments

Acronyms and Abbreviations

amsl	above mean sea level
APPL	Agriculture & Priority Pollutants Laboratories
ARARs	applicable or relevant and appropriate requirements
BERA	baseline ecological risk assessment
bgs	below ground surface
BTU	British Thermal Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical of concern
COPC	chemical of potential concern
CSM	conceptual site model
DBH	diameter at breast height
DNER	Puerto Rico Department of Natural and Environmental Resources
DOI	Department of Interior
ECA	Eastern Conservation Area
ELCR	excess lifetime cancer risk
EMA	Eastern Maneuver Area
EOD	Explosive Ordnance Disposal
EQB	Puerto Rico Environmental Quality Board
ERP	Environmental Restoration Program
°F	degrees Fahrenheit
FFA	Federal Facility Agreement
FS	Feasibility Study
FWS	U.S. Fish and Wildlife Service
GHGs	Greenhouse gases
GPS	global positioning system
GRAs	General Response Actions
HI	hazard index
HQ	hazard quotient
ICs	Institutional Controls
IDW	investigation-derived waste
LIA	Live Impact Area
LTM	long-term monitoring
LUCs	Land Use Controls
MEC	munitions and explosives of concern
MOV	Municipality of Vieques
NASD	Naval Ammunition Support Detachment
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List

NPV	net present value
NTCRA	non-time-critical removal action
O&M	operations and maintenance
PM	particulate matter
PRAP	Proposed Remedial Action Plan
RAGS	Risk Assessment Guidance for Superfund
RAOs	remedial action objectives
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
RRD	Range Related Debris
RSLs	Regional Screening Levels
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
Search	Southeastern Archaeological Research, Inc.
SERA	screening ecological risk assessment
SIA	Surface Impact Area
SOPs	Standard Operating Procedures
TBC	to-be-considered
TOC	total organic carbon
U.S.	United States
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
UXO	unexploded ordnance
VNTR	Former Vieques Naval Training Range

SECTION 1

Introduction

This Remedial Investigation (RI)/Feasibility Study (FS) Report presents the data and findings obtained from investigations conducted to characterize the nature and extent of contamination, assess potential risks to human health and the environment, and evaluate remedial alternatives at UXO 18, located at the Former Vieques Naval Training Range (VNTR) in Vieques, Puerto Rico (**Figures 1-1** and **1-2**). UXO 18, also known as Cayo La Chiva, is a 12-acre island where munitions and explosives of concern (MEC) were previously identified. The Commonwealth of Puerto Rico is the land owner and recreational use is planned for the island. In addition, the island is located within several hundred yards of Blue Beach (Playa La Chiva), a public beach used for recreational activities.

This report was prepared under the United States (U.S.) Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC), Atlantic Division, Comprehensive Long-Term Environmental Action Navy 8012 Contract N62470-11-D-8012, Contract Task Order 005, for submittal to NAVFAC, United States Environmental Protection Agency (USEPA) Region 2, the Commonwealth of Puerto Rico Environmental Quality Board (EQB), the Commonwealth of Puerto Rico Department of Natural and Environmental Resources (DNER), and the United States Fish and Wildlife Service (USFWS). The Navy, USEPA, EQB, USFWS, and DNER work jointly as the Vieques Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Environmental Restoration Program (ERP) Technical Subcommittee.

1.1 Objectives and Approach

The UXO 18 RI was implemented through two investigations – one focusing on MEC and one focusing on potential chemical contaminants associated with the site. The MEC component was implemented in 2011 during a Preliminary Inspection to assess the presence of MEC at the site. The environmental characterization component was conducted in 2013 to assess the nature and extent of potential contamination.

The MEC component of the RI was conducted in accordance with the *Expanded Range Assessment and Phase II Site Inspection Work Plan* (CH2M HILL, 2008). The environmental characterization component of the RI was conducted in accordance with the *Master Sampling and Analysis Plan (SAP), East Vieques Terrestrial UXO Sites* (CH2M HILL, 2013), hereafter referred to as the Master SAP. The Master SAP was jointly developed by the ERP Technical Subcommittee to support the field sampling activities, including the methodology, sampling design and rationale, data quality objectives, data evaluation approach, and decision criteria.

The objectives of the FS are to identify remedial action objectives (RAOs), identify applicable or relevant and appropriate requirements (ARARs) and to-be-considered (TBC) criteria that may affect the remedy selection at UXO 18, and develop and evaluate remedial alternatives in accordance with the current and anticipated land use. The UXO 18 FS was developed in accordance with the CERCLA 1980 requirements, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 and implemented by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and USEPA's FS guidance (1998). Consistent with the CERCLA process, the FS will support recommending a preferred remedy. Subsequent to the selection of the remedy, a Proposed Remedial Action Plan (PRAP) will be prepared for public comment, followed by the Record of Decision (ROD) once public comments on the PRAP are considered.

1.2 Site Background

Vieques is located in the Caribbean Sea approximately 7 miles southeast of the eastern tip of the island of Puerto Rico (**Figure 1-1**). Vieques is the largest offshore island of the Commonwealth of Puerto Rico. It is approximately 20 miles long and 4.5 miles wide, and has an area of approximately 51 square miles (33,088 acres).

The Navy purchased large portions of Vieques in the early 1940s to conduct activities related to military training. The eastern end of Vieques (VNTR) was used for various aspects of naval gunfire training, including air-to-ground ordnance delivery and amphibious landings, as well as housing the main base of operations for these activities at Camp Garcia. Site operations on the western end of Vieques, within the former Naval Ammunition Support Detachment (NASD), consisted mainly of ammunition loading and storage, vehicle and facility maintenance, and some training.

The Navy ceased facility-wide operations on the former NASD and VNTR prior to transferring the land to the Department of Interior (DOI), Municipality of Vieques (MOV), and the Puerto Rico Conservation Trust, as required by the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001 (Public Law 106-398), which was amended by Section 1049 of the National Defense Authorization Act for Fiscal Year 2002 (Public Law 107-107). The NASD was transferred in May 2001 and the VNTR was transferred in May 2003.

On February 11, 2005, Vieques was placed on the National Priorities List (NPL) as the former Atlantic Fleet Weapons Training Area - Vieques, which required all subsequent environmental restoration activities to be conducted under CERCLA unless and until removed from CERCLA authority. The Navy, DOI, USEPA, and EQB executed a Federal Facility Agreement (FFA) on September 7, 2007 that established the procedural framework and schedule for implementing the CERCLA activities for Vieques. Although the DOI is directed to protect and conserve the transferred land as a wildlife refuge, the Navy retains the responsibility for conducting investigations and cleanup associated with past military activities.

1.2.1 Former VNTR and UXO 18

The former VNTR consists of approximately 14,600 acres and is divided into four separate operational areas that from west to east comprise: the 11,000-acre Eastern Maneuver Area (EMA); the 2,500-acre Surface Impact Area (SIA); the 900-acre Live Impact Area (LIA); and the 200-acre Eastern Conservation Area (ECA) (inset in **Figure 1-2**). The EMA was first established in 1947 and provided military maneuvering areas and ranges for the training, including amphibious landings, small arms fire, artillery and tank fire, shore fire control, and combat engineering tasks. UXO 18 is located within Bahia de la Chiva south of the EMA.

There are no known historical documents that identify any military actions or training activities at UXO 18. However, five MEC (5-inch rockets) were discovered on the island and several MEC (5-inch rockets) were identified by Navy explosive ordnance divers in the water immediately offshore of Cayo La Chiva (**Figure 1-3**). In addition to MEC, MD (smoke canisters) were observed on the ground surface (**Figure 1-3**). This information indicates Cayo La Chiva was used for some training. The MEC identified offshore are being addressed separately as part of UXO 16; this UXO 18 RI/FS addresses only the terrestrial portion (i.e., Cayo La Chiva).

1.2.2 Previous Investigations and Activities

Historical investigations at or pertinent to UXO 18 are summarized below.

1.2.2.1 Background Investigation

A background study was conducted in 2006 for the eastern portion of Vieques to develop a set background values for inorganic constituents in soil, for comparison to those at sites investigated within the former VNTR (CH2M HILL, 2007). The background data were collected from the eastern portion of Vieques to represent soil types similar to those where environmental sites are located within the former VNTR. The background inorganic constituent concentrations from the study are used for comparison with soil inorganic constituent concentrations collected during the RI at UXO 18, as discussed in Section 4. This approach was approved for use, as documented in Worksheet 11 and Figure 13 of the Master SAP (CH2M HILL, 2013). For UXO 18 background inorganic constituent concentrations for the Tl zone were used for comparison since UXO 18 falls within the same lithologic zone.

1.2.2.2 Biological Assessment

A Biological Assessment was completed at UXO 18 in June 2011 to evaluate if any endangered plant and animal species are present on the island. An on-site inspection to support the assessment was conducted using transects that covered approximately 3 percent of the island (**Figure 1-3**). The unexploded ordnance (UXO) Technician providing anomaly avoidance support for the field team did not identify any MEC during the inspection. Results of the biological assessment are included as part of this RI/FS Report as Section 3.3.

1.2.2.3 Warning Buoy and Sign Installation

In 2012, the temporary warning signs on the island were replaced with five permanent signs installed along the northern portion of the island (**Figure 1-3**) where there is the highest probability for trespasser activity because this area is closest to Blue Beach and is the only practically accessible portion. Signs were secured using 2-inch galvanized pipes on each side of the sign and the pipes were cemented 24 inches deep into the ground.

To advise kayakers, boaters, and snorkelers, six buoys were installed around the island on sandy bottom areas (**Figure 1-3**). Four-foot helical screw anchors were installed to secure the buoys to the ocean floor.

1.2.2.4 Adjacent Investigation (UXO 16)

In 2010, Navy Explosive Ordnance Disposal (EOD) divers/snorkelers conducted several visual surveys of Bahia de la Chiva to inspect for potential MEC on, or protruding from, the sediment (**Figure 1-4**). The underwater surveys covered the entire area up to 30 meters offshore of Cayo La Chiva and the remainder of the bay using transects (200 ft spacing). Nine munitions were identified just west and south of the island, including five 5-inch Zuni rockets classified as MEC and four other suspected MEC. A non-time-critical removal action (NTCRA) to address these nine items is planned.

R:\USNAVFACENGCOM405450\VIEQUES\MAPFILES\UXO_18_REMEDIAL_INVESTIGATION_FEASIBILITY_STUDY\FIGURE 1-1 - REGIONAL LOCATION MAP.MXD CELEFTHERIADIS 4/9/2014 11:22:21 AM

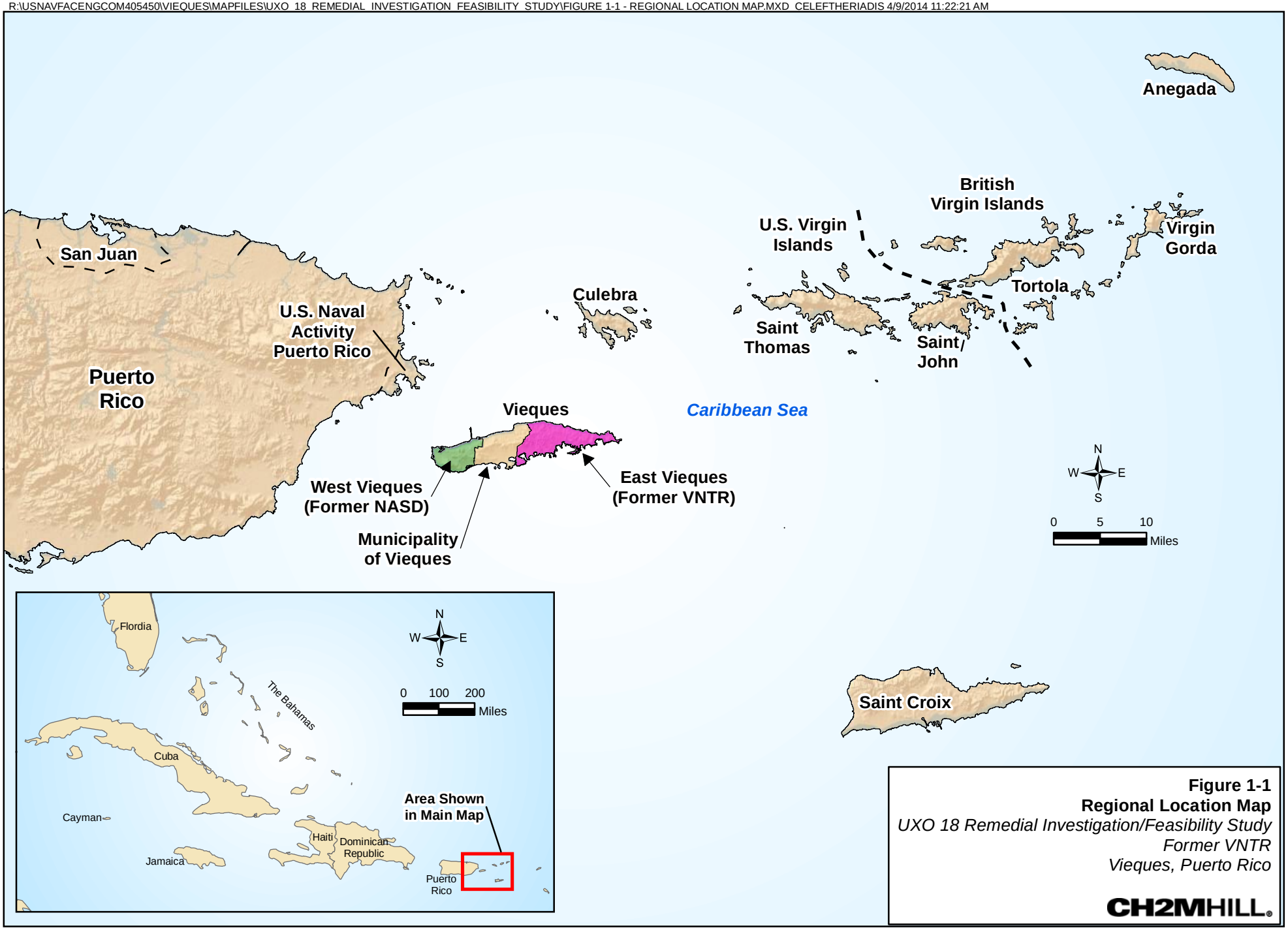


Figure 1-1
Regional Location Map
UXO 18 Remedial Investigation/Feasibility Study
Former VNTR
Vieques, Puerto Rico

CH2MHILL®

R:\USNAVFACENGCOM405450\VIEQUES\MAPFILES\UXO_18_REMEDIAL_INVESTIGATION_FEASIBILITY_STUDY\FIGURE 1-2 - UXO 18 LOCATION MAP.MXD CELEFTHERIADIS 4/21/2014 1:46:38 PM

Legend

UXO 18 - Cayo La Chiva

ECA – Eastern Conservation Area
EMA - Eastern Maneuver Area
LIA – Live Impact Area
SIA – Surface Impact Area
NASD - Naval Ammunition Support Detachment
VNTR - Vieques Naval Training Range

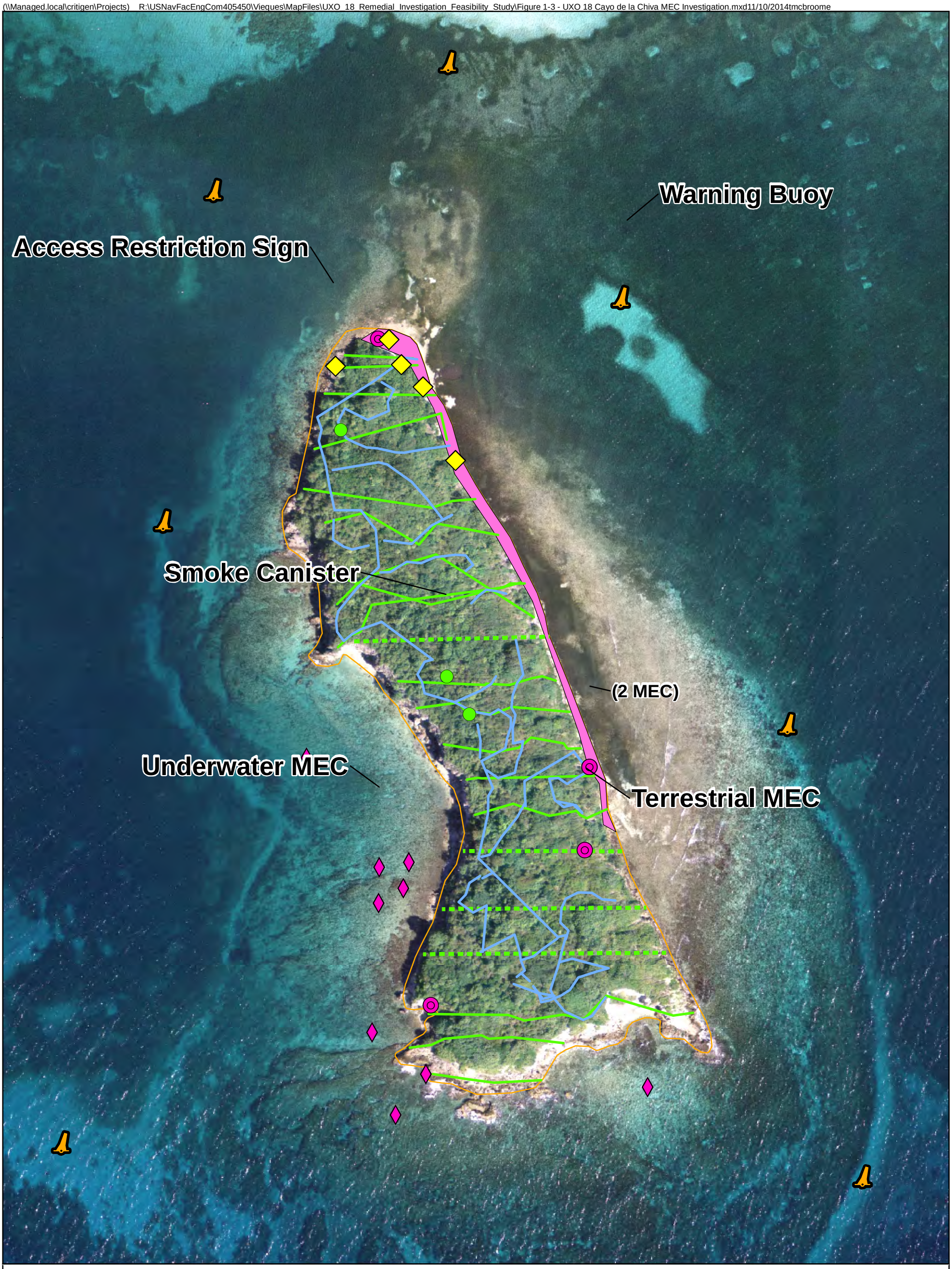
N
W E
S

0 500 1,000 Feet

Figure 1-2
UXO 18 Location Map
UXO 18 Remedial Investigation/Feasibility Study
Former VNTR
Vieques, Puerto Rico

CH2MHILL®

(\\Managed.local\critigen\Projects) R:\USNavFacEngCom405450\Vieques\MapFiles\UXO_18_Remedial_Investigation_Feasibility_Study\Figure 1-3 - UXO 18 Cayo de la Chiva MEC Investigation.mxd11/10/2014tmcbroome



Legend

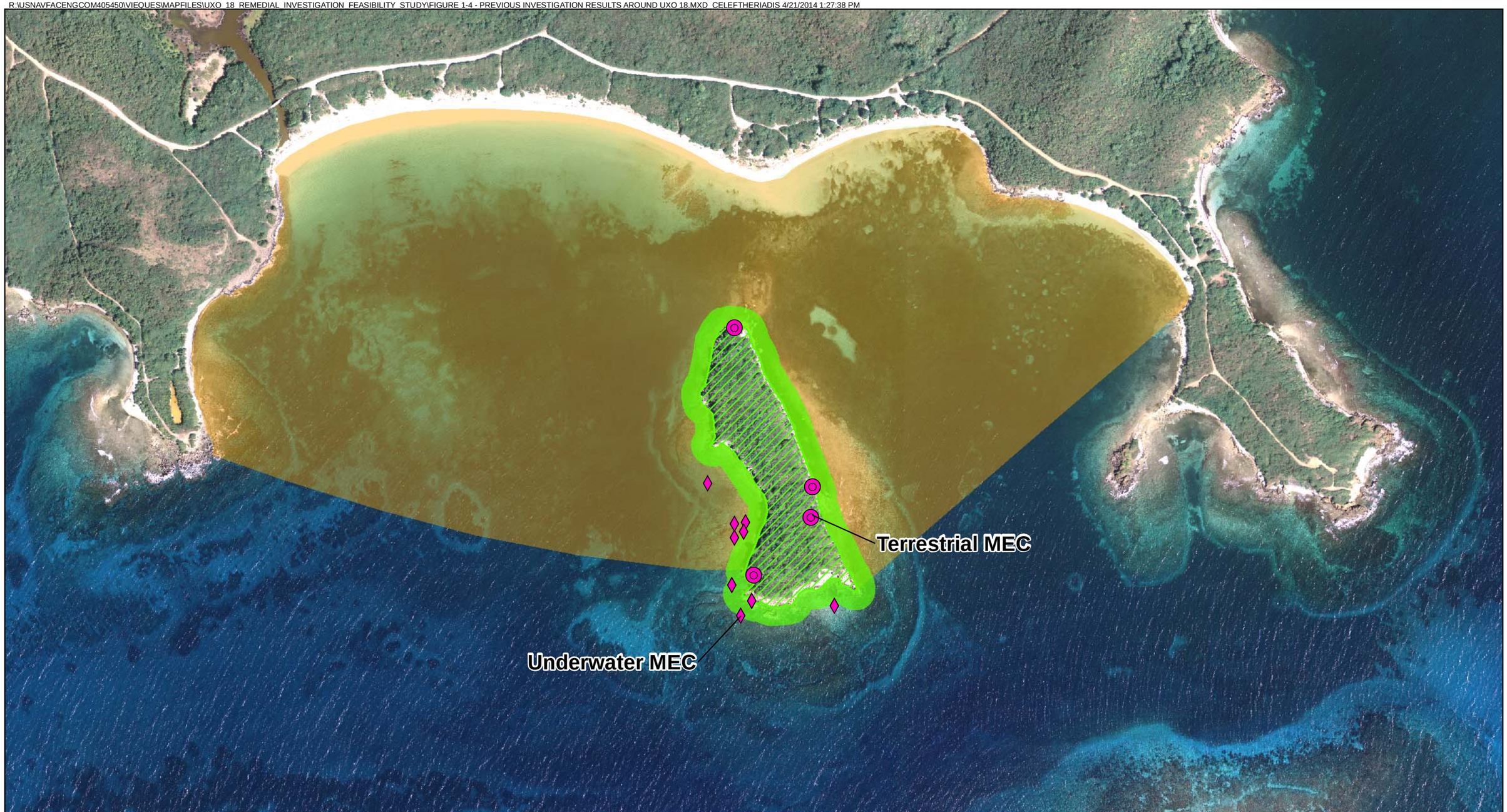
- Warning Buoy
- Access Restriction Sign
- Smoke Canister
- Terrestrial MEC
- Underwater MEC
- Biological Assessment Transects
- Site Inspection Transects
- Site Inspection Transect (approximate location)
- Site Inspection Beach Investigation Area
- UXO 18 Boundary

N
W E
S

0 150 300
Feet

Figure 1-3
UXO 18 Cayo la Chiva MEC Investigation
UXO 18 Remedial Investigation/Feasibility Study
Former VNTR
Vieques, Puerto Rico

CH2MHILL®



Legend

- Terrestrial MEC
- Underwater MEC
- Nearshore Survey
- Transect Inspections (approx. 200 ft spacing)
- Cayo La Chiva

N
W E
S

0 500 1,000 Feet

Figure 1-4
Previous Investigation Results around UXO 18
UXO 18 Remedial Investigation/Feasibility Study
Former VNTR
Vieques, Puerto Rico

CH2MHILL

SECTION 2

Summary of RI Field Investigation

This section describes the approach and methodology of the field investigation activities conducted as part of the environmental characterization component of the RI at UXO 18.

2.1 MEC Activities

Transect inspections were conducted across UXO 18 in January 2011 to determine if MEC was present on the ground surface of the island (**Figure 1-3**). One-meter-wide transects were inspected across approximately 5 percent of the island and surface swept using a Schonstedt magnetometer. Five MEC (5-inch rockets) were discovered at four locations; each was destroyed through controlled detonation on Cayo la Chiva in March 2011. In addition to the MEC, three MD (smoke canisters [HC 30 lbs ABC-M5]) were observed on the ground surface. Each canister was removed from the island for metal processing and disposal. Coupled with the inspections that were performed to support the Biological Assessment, MEC surface clearance was performed across approximately 8 percent of the island, which included the accessible (relatively sparsely vegetated) area. In addition, anomaly avoidance was performed along the sampling unit transects and no MEC was found. It is important to note that because only a thin veneer of soil is present across the island, it is unlikely any MEC could be present in the subsurface.

Due to the finding of MEC on the island and its close proximity to Blue Beach, temporary signs were posted on Cayo La Chiva to warn the public about the potential explosive hazards present on the island. Public flyers were also sent to the community in January 2011 advising the public to stay away from the island. In addition, signs were posted on Blue Beach to deter beach users from accessing Cayo La Chiva.

Results of the inspection were documented in a Technical Memorandum entitled *Preliminary Inspection of Cayo La Chiva, Former Vieques Naval Training Range, Vieques, Puerto Rico* (CH2M HILL, 2010a). Results of the Preliminary Inspection represent the nature and extent of MEC included in this RI/FS Report.

2.2 Soil Sampling Activities

The environmental characterization component of the UXO 18 RI included characterization of soil to evaluate whether there was a release of chemical contaminants from past training activities and, if so, the nature and extent of contaminants. Due to the random distribution of MEC at the site, an incremental soil sampling approach was implemented to best characterize this medium. Incremental sampling provides a single result (per chemical) for a decision unit or from one or more sampling units within that decision unit. A decision unit and associated sampling units are generally selected based on the exposure domain for human or ecological exposure, by an area influenced by a specific activity, and/or by an area of influenced by a single event. Decision unit and sampling unit size and shape are controlled by the environmental concerns posed by the contaminants present and the intended use of the site.

Due to the small size of UXO 18, the entire site was defined as one decision unit by the ERP Technical Subcommittee. Two sampling units were located in areas where MEC was previously identified, to be representative of the concentrations within a potential exposure area. One sampling unit was located where three MEC were identified, and one sampling unit was located where one MEC and one smoke canister were identified. In addition, a discrete surface soil sample was collected at each of the former smoke canister locations. **Table 2-1** summarizes the soil samples collected at UXO 18, including analyses performed, sample identifications, and depth of sampling. Because soil at the site is at most a thin veneer over shallow bedrock, the subsurface soil depth interval is not present across most or all of the site. **Figure 2-1** presents the sample locations at UXO 18.

Each discrete and incremental surface soil sample was analyzed for explosives, inorganic constituents, and wet chemistry parameters pH, total organic carbon (TOC), and redoxP; discrete surface soil samples were additionally analyzed for hexachloroethane (a semi-volatile organic compound [SVOC] potentially associated with smoke canisters). All samples collected during the RI sampling were submitted for analysis to Agriculture & Priority Pollutants Laboratories (APPL), Inc. of Clovis, California.

Prior to soil sampling activities, vegetation clearance was conducted by hand along transects within each sampling unit by USA Environmental, Inc. of Tampa, Florida. Trees larger than 3-inches in diameter and sensitive vegetation were not cleared. In addition, an archaeological survey was conducted prior to soil sampling; cultural resources identified were avoided during soil sampling activities (discussed in Section 2.4). All soil samples were collected with an anomaly avoidance escort. The locations of each sampling unit and discrete soil sample locations were surveyed using a hand-held global positioning system (GPS) by field personnel prior to sample collection.

Field activities were conducted in general accordance with the Standard Operating Procedures (SOPs) of the Master SAP and the *Final Master Standard Operating Procedures, Protocols, and Plans, Environmental Restoration Program, Vieques, Puerto Rico* (CH2M HILL, 2010b), hereafter referred to as the MSOPPP.

2.2.1 Incremental Surface Soil Sampling

Energetic and inorganic chemicals associated with munitions releases on ranges primarily occur as particulates deposited heterogeneously on the soil surface, primarily from propellant residues at firing points, explosive residues near detonations in impact areas, and from controlled detonations. The highest concentrations are present near the ground surface with the vast majority in the top inch or two (USACE, 2009 and USEPA, 2012). Therefore, incremental sampling at ranges and other areas where munitions were dropped or fired focuses on this depth interval to conservatively represent the exposure depth interval for human health and terrestrial ecological receptors.

The two sampling units were less than approximately 1 acre to account for the receptors (actual and hypothetical) on the island. Sampling units were based on compiling multiple quarter-acre grid areas established for MEC surface removal across the former VNTR. Within each sampling unit, 100 or more subsamples (increments) were collected using a nominal 0.75-inch diameter coring device, or a stainless steel spoon (where the coring device was not practical to use), to a depth of approximately 2.5 inches to achieve a total sample mass of at least 1,000 grams. The subsamples were then composited as one incremental soil sample to be homogenized by the analytical laboratory. Subsamples were collected in a random sampling approach along transects within a general uniform grid across the sampling unit. Where vegetation was present at the ground surface, it was pushed aside before collecting the subsample. Once subsamples were collected into plastic gallon-sized bags, they packed and shipped with sufficient ice to maintain the preservation temperature until they arrived at the analytical laboratory.

In total, two incremental surface soil samples (1DU01 and 1DU02), plus one triplicate sample for 1DU01, were collected on June 12, 2013, and submitted for analysis of explosives and inorganic constituents. However, the laboratory failed to meet one of the instrumentation's quality control requirements (a standard has to be run on the instrument every 12 hours) and, as a result, the explosives results were rejected by the data validator. There were no issues identified with the inorganic analyses of these samples. Therefore, the two incremental surface soil samples (1DU01 and 1DU02) and the triplicate sample were re-collected on November 15, 2013 and submitted for explosives analysis. Details of the data validation are provided in **Appendix A** and the analytical results are summarized in Section 4.

2.2.2 Discrete Surface Soil Sampling

Three discrete surface soil samples (1SO01 through 1SO03) plus one duplicate sample were collected from a depth of 0 to 1 ft below ground surface (bgs) from the former smoke canister locations and submitted for analysis of hexachloroethane, explosives, and inorganic constituents, in accordance with soil sampling protocol

in the MSOPPP (CH2M HILL, 2010b). The discrete soil samples were placed in sample jars, and then packed and shipped with sufficient ice to maintain the preservation temperature until they arrived at the analytical laboratory.

2.3 Decontamination and Waste Management

In accordance with the Master SAP, all non-disposable sampling equipment was decontaminated immediately after each use following SOP E-1. Negligible soil cuttings were produced during soil sampling; the excess soil generated was returned to each borehole. Aqueous investigation-derived waste (IDW) (decontamination water) was contained in a 5-gallon bucket and allowed to evaporate.

2.4 Environmental Data Management

Information on the evaluation of analytical data collected during the environmental investigation to meet the Project Quality Objectives, as described in the Master SAP, is discussed below.

2.4.1 Data Tracking and Validation

The management and tracking of data from the time of field collection to receipt of validated electronic analytical results were performed. Field samples and their corresponding analytical tests were recorded on chain-of-custody forms for submission to the laboratory. Chain-of-custody entries were checked to verify that all designated samples were collected and submitted for the appropriate analyses. Upon receipt of the samples by the laboratory, a comparison to the field information was made to ensure that each sample would be analyzed for the correct parameters and the proper number of QA/QC samples.

Third-party validation was performed on the analytical data reports from the investigation. Validation procedures referenced the appropriate guidance, considering the most recent version of guidance available at the time of validation, and the actual analytical method performed. Validation provides proper perspective on data availability and usability. Validation was performed by Validata Chemical Services, Inc. of Duluth, Georgia. The full data validation report is presented in **Appendix A**. A data quality evaluation was performed on the analytical data in accordance with the Master SAP. Results of the evaluation are summarized in **Appendix B**.

2.4.2 Regulatory Standards and Risk-Based Screening Values

The screening process used to evaluate risks to human and ecological receptors and the consideration of a constituent as a chemical of potential concern (COPC) or chemical of concern (COC) are discussed in Sections 5 and 6. In addition, to determine the nature of potential soil contamination within UXO 18, analytes were compared to the following screening values:

- USEPA Regional Screening Levels (RSLs) for residential and industrial soil (November 2013), adjusted as appropriate
- USEPA soil screening levels (SSLs; soil-to-groundwater leaching screening values)
- Ecological Screening Levels (CH2M HILL, 2010b)
- East Vieques background soil inorganics upper tolerance limits (CH2M HILL, 2007)

2.5 Archaeological Survey

Southeastern Archaeological Research, Inc. (Search) of Jonesville, Florida conducted an archaeological survey at UXO 18 on June 12, 2013. The survey was conducted along each sampling unit transect and in the area of the smoke canisters prior to soil sample collection and included both a reconnaissance and shovel test. Cultural resources identified were avoided during soil sampling activities; findings are summarized in Section 3.4.

Table 2-1

Summary of Samples Collected

UXO-18 Remedial Investigation/Feasibility Study

Former Vieques Naval Training Range

Vieques, Puerto Rico

Site	Decision Unit	Media Samples[1]	Analytes	Date	Sample Identification[8]	Sample Depth
UXO-18 - Cayo la Chiva	Decision Unit 1	2 SMI	Explosives[2], Inorganic Constituents[3], Wet Chemistry[4,5,6]	06/2013, 11/2013	VE-UXO18-01SMI01-0613, VE-UXO18-01SMI01-1113, VE-UXO18-01SMI01-1113A*, VE-UXO18-01SMI02-0613, VE-UXO18-01SMI02-1113, VE-UXO18-01SMI02-1113A*	0.0-2.5 inches bgs - All SMI samples
		3 SS	Semivolatile Organic Compounds[7], Explosives[2], Inorganic Constituents[3], Wet Chemistry[4,5,6]	06/2013	VE-UXO18-01SS01-0001, VE-UXO18-01SS02-0001, VE-UXO18-01SS03-0001	0 - 12 inches bgs

[1]SS=Surface soil sample, SMI=Incremental Sample

[2]Explosives by SW-846-8330B, Picric Acid by SW-846-8321, Perchlorate by SW-846-6850

[3]Total Metals by SW-846-6010C/6020A, Hexavalent chromium by SW-846-3060A, 7196A

[4]pH by SW-846-9045D

[5]TOC by Walkley Black

[6]ORP by ASTM D1498

[7]Semivolatile organic compounds (Hexachloroethane-only) by SW-846-8270D_SIM

[8]Field triplicate samples were collected for samples VE-UXO18-01SMI01-0613 and VE-UXO18-01SMI01-1113. Field duplicate sample was collected for sample VE-UXO18-01SS01-0001. The field duplicate for VE-UXO18-01SS01-0001 was analyzed for all analytes except metals by SW-846 6010C/6020A due to limited volume received at the lab.

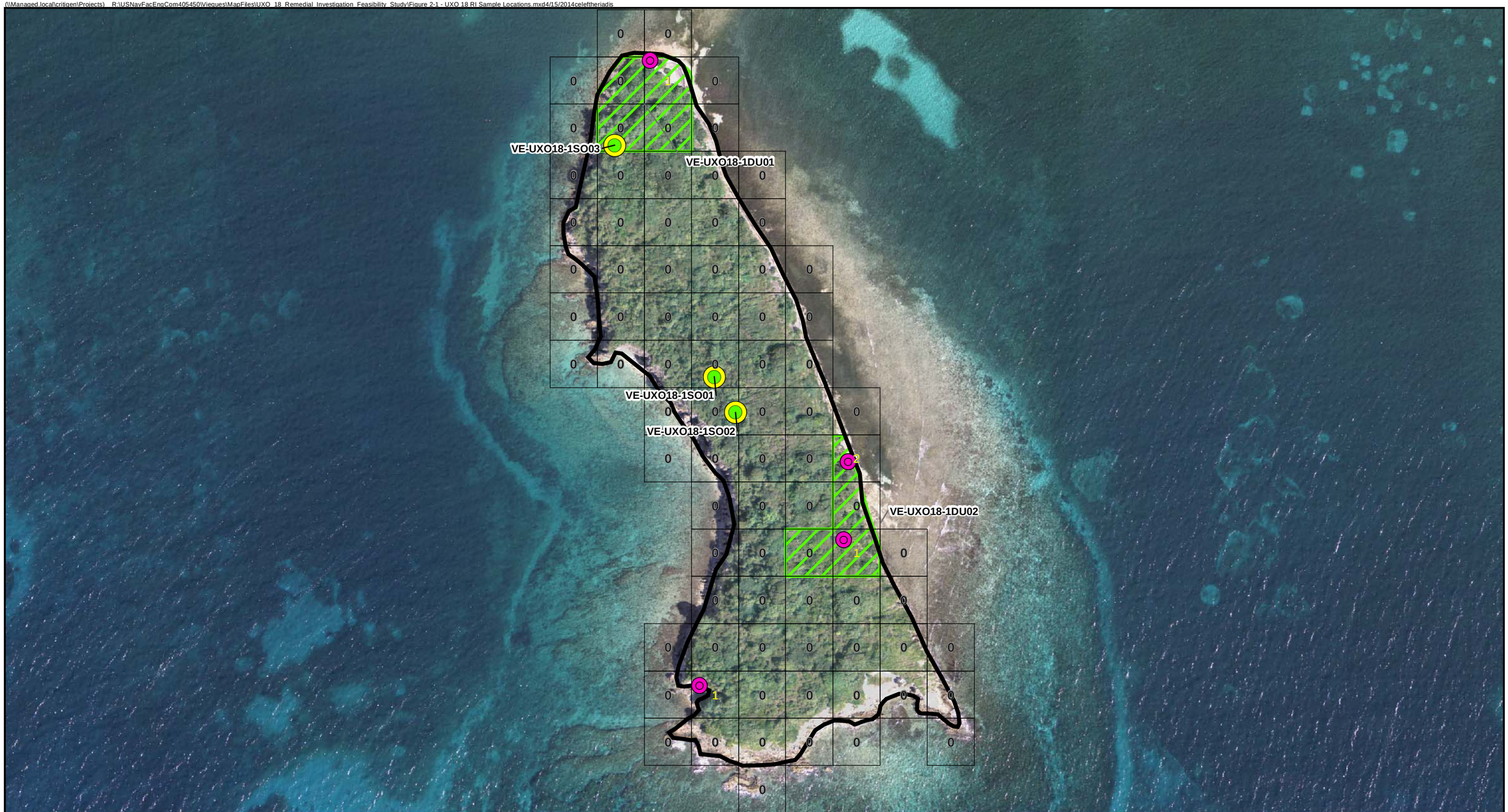
*Sample IDs ending in "A" were analyzed for picric acid only after being hand ground (similar to the preparation procedure for metals analysis on incremental samples) rather than mechanically ground as it was determined that mechanical griding was not appropriate for picric acid (due to low ground LCS recoveries).

bgs = below ground surface

RI = Remedial Investigation

FS = Feasibility Study

(\\Managed.local\critigen\Projects) R:\USNavFacEngCom405450\Vieques\MapFiles\UXO_18_Remedial_Investigation_Feasibility_Study\Figure 2-1 - UXO 18 RI Sample Locations.mxd4/15/2014celeftheriadis



Legend

- Surface Soil Sample
- Smoke Canister
- Terrestrial MEC
- Decision Unit
- Grid (30 Meter)
- Sample Unit

N
W E
S

0 150 300
Feet

Figure 2-1
UXO 18 RI Sample Locations
UXO 18 Remedial Investigation/Feasibility Study
Former VNTR
Vieques, Puerto Rico

CH2MHILL®

SECTION 3

Physical Characteristics

This section presents the pertinent physical and ecological characteristics of UXO 18, and a brief discussion of the cultural resources found.

3.1 Physical Setting

The climate of Vieques is tropical-marine. Temperatures are nearly constant at an annual average temperature of about 79 degrees Fahrenheit (°F), with August being the warmest month and February the coolest (Greenleaf/Telesca et.al. 1984). Vieques lies directly in the path of the prevailing easterly trade winds that regulate the climate of Puerto Rico. The trade winds result in a rainfall pattern characterized by a dry season from December through July and a rainy season from August through November. Heavy precipitation may result from tropical storms from June through November, which is considered normal for this area of the Caribbean. The eastern part of the island averages approximately 38 inches of rainfall per year.

Cayo La Chiva is a rocky island, isolated from the coastline at a distance of several hundred yards south of Blue Beach. The topography of UXO 18 ranges from 0 ft above mean sea level (amsl) at the perimeter (i.e., ocean boundary) to above 35 ft amsl in the central portion of the island (**Figure 3-1**). The majority of the western and southern portions of the island consist of steep, nearly vertical rock slopes rising more than 30 feet above the bay. The northern portion and very northeastern tip of the island consist of a narrow strand of sandy beach that extends to a very shallow seagrass bed within the bay. Along the eastern side, a very thin strip (less than several feet) of sand lies immediately adjacent to a steep rock slope. In general, the island is heavily vegetated. Accessible (relatively sparsely vegetated) areas account for a small percentage of the island area, based on observations during MEC surface clearance activities conducted on the island

There are no surface water features on the island. UXO 18 comprises primarily weathered limestone and dolomite, generally exposed at the ground surface. However, in some areas, thin layers (less than approximately 1 ft thick) of sandy loam overly the weathered bedrock. Only the northern portion of the island is sandy, but it is not suitable as a turtle nesting habitat. Groundwater is within bedrock and saline due to the thin veneer of soil, small size of the island, and proximity to the ocean.

3.2 Land Use

Cayo La Chiva is designated as a conservation zone (TEC, 2002). Due to the potential presence of MEC at or very near the ground surface, public access to the site is discouraged by signs along the northern perimeter of the island (accessible portion of the island), by signs at the adjacent Blue Beach access points, by warning buoys surrounding the island, and by landscape features (i.e., dense vegetation near the coastline, rocky cliffs on the southern, eastern, and western sides of the island). The public has access to Bahia de la Chiva and Blue Beach, which are popular destinations for recreational use, such as sunbathing, swimming, and fishing. Boats, swimmers, snorkelers, and divers are periodically observed around Cayo La Chiva, with some of these recreational users accessing the island. The Commonwealth of Puerto Rico owns Cayo La Chiva and recreational use is intended for the island.

3.3 Ecological Setting

A qualitative biological survey of Cayo Chiva was conducted from June 14 through 21, 2011 as part of the Biological Assessment. Three habitat types were identified, including dry scrub forest, secondary growth forest, and mangrove forest, as described below.

- The dry scrub forest covers the majority of the island and is dominated by small diameter trees and shrubs. Dominant species observed include Catclaw blackbead (*Pithecellobium unguis-cati*), torchwood (*Amyris elemifera*), gumbo limbo (*Bursera simaruba*), Jamaican caper (*Capparis cynophallophora*), seagrape (*Coccoloba uvifera*), white cedar (*Tabebuia heterophylla*), blacktorch (*Erithalis fruticosa*), buttonsage (*Lantana involucrata*), and rougeplant (*Rivina humilis*). The canopy consists mostly of small trees and shrubs 7 to 12 feet in height with 100 percent cover classified as shrubs. The groundcover is very sparse due to the dense shrub canopy, ranging from 5 to 25 percent. Dense tangles of vines are present in scattered locations throughout the island. The dry scrub habitat covers approximately 7 acres. The substrate in this habitat type is mostly limestone bedrock, fractured limestone, or a thin veneer of soil.
- The secondary growth forest occurs as isolated stands of mature trees. The dominant species include many large tree species such as water mampoo (*Pisonia subcordata*), gumbo limbo, Spanish lime (*Melicoccus bijugatus*), red manjack (*Cordia collococca*), seagrape, white cedar, white stopper (*Eugenia axillaris*) and wild banyantree (*Ficus citrifolia*). The trees in the secondary growth forest are approximately 30 feet in height with a minimum diameter at breast height (DBH) of approximately 7 inches and larger. The secondary growth forest habitat covers approximately 2 acres. The canopy density is 100 percent and the substrate is mostly soil with scattered limestone at the surface.
- The mangrove forest is a narrow fringe along the eastern and northern coast of Cayo La Chiva. This fringe is dominated by black mangrove (*Avicennia germinans*), white mangrove (*Laguncularia racemosa*), button mangrove (*Conocarpus erectus*), and Portia tree (*Thespesia populnea*). Mangrove forest habitat is approximately 1 acre. The canopy density is approximately 100 percent at the north end of the island but becomes less dense further south as the habitat becomes a narrow fringe along the beach. Substrate within the mangrove habitat is 100 percent sand.

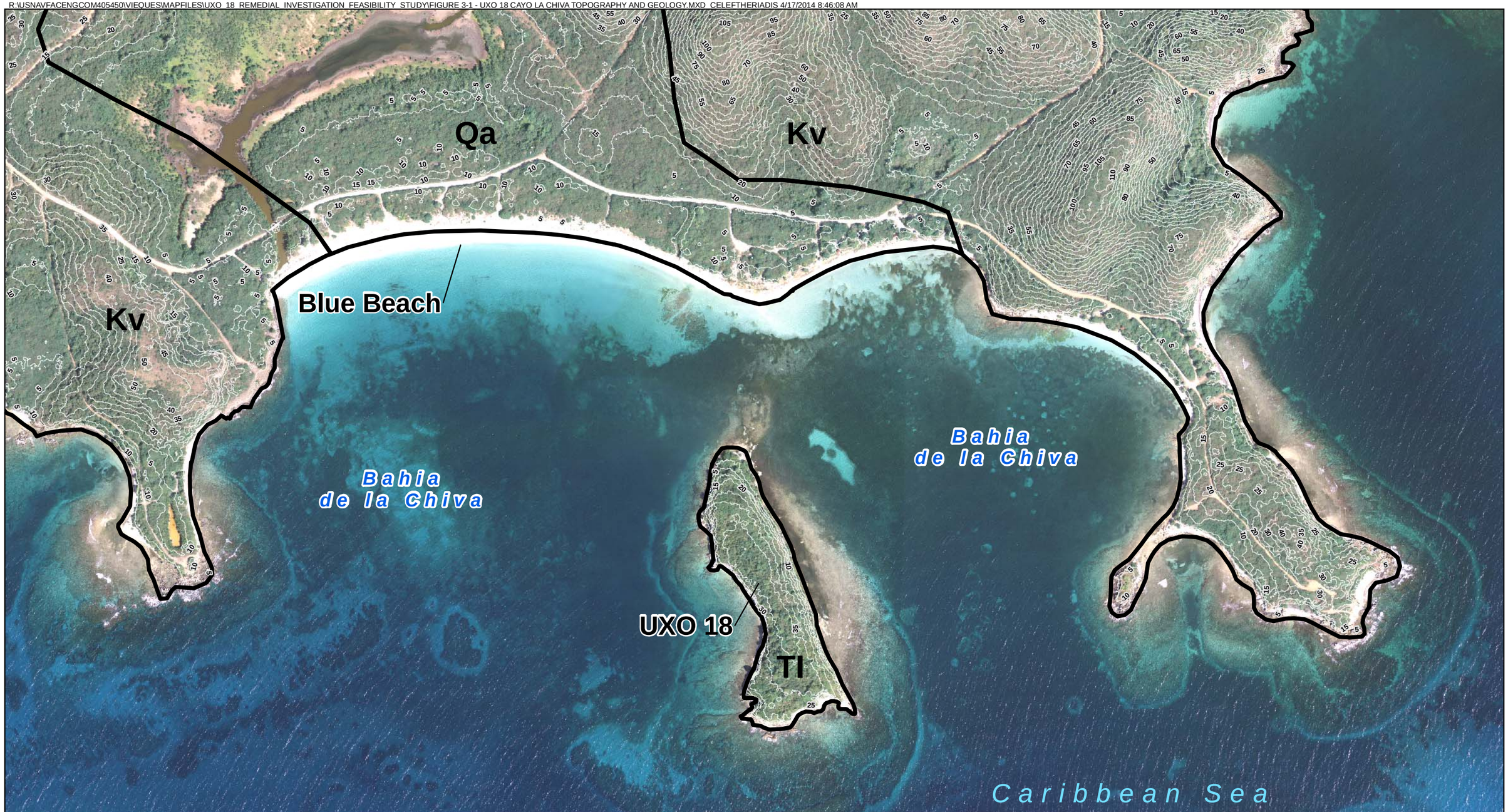
Terrestrial wildlife observed during the site survey included hermit crab (*Coenobita clypeatus*), common anole (*Anolis cristatellus*), white-winged dove (*Zenaida asiatica*), white-crowned pigeon (*Patagioenas leucocephala*), zenaida dove (*Zenaida aurita*), yellow warbler (*Dendroica petechia*), bananaquit (*Coereba flaveola*), pearly-eyed thrasher (*Margarops fuscatus*), grey kingbird (*Tyrannus dominicensis*), yellow-crowned night heron (*Nyctanassa violacea*), American kestrel (*Falco sparverius*), red-tailed hawk (*Buteo jamaicensis*), Puerto Rican flycatcher (*Myiarchus antillarum*), and magnificent frigatebird (*Fregata magnificens*). Hermit crabs were present in large numbers throughout the island. Many of the dove species appeared to be nesting and using the island for roosting. Three yellow-crowned night heron nests were found. Most passerine birds were noted roosting or flying over. The red-tailed hawk was noted flying over and did not appear to be hunting for food on Cayo La Chiva.

No federally listed threatened or endangered plant or animal species were observed during the ground survey.

3.4 Cultural Resources

A Precolumbian archaeological site was identified in the western-central portion of Cayo La Chiva the 1970s (Isla Chiva [Vi-043]). This site was determined eligible for the National Register in 1980, but currently is not listed. As part of the June 2013 archaeology survey, Precolumbian cultural materials were identified within sampling unit 1DU01, which was recorded as a newly identified archaeological site (Isla Chiva 02). Fragments of Precolumbian ceramic and marine shell were encountered at a depth of approximately 4 to 8 inches bgs. Due to the size of the island and the configuration, it is possible that the items identified within 1DU01 are associated with the previous archaeological site identified. No cultural resources were encountered within 1DU02.

R:\USNAVFACENGCOM405450\VIEQUES\MAPFILES\UXO_18_REMEDIAL_INVESTIGATION_FEASIBILITY_STUDY\FIGURE 3-1 - UXO 18 CAYO LA CHIVA TOPOGRAPHY AND GEOLOGY.MXD CELEFTHERIADIS 4/17/2014 8:46:08 AM



Legend

Topographic Contour (5 feet)

Geologic Unit

Geologic Unit Description

Qa - Alluvial Deposits

TI - Marine Sedimentary Rocks

Kv - Marine Sandstone, Lava Assemblage

N
W E
S

0 500 1,000 Feet

Figure 3-1

UXO 18 Topography and Geology

UXO 18 Remedial Investigation/Feasibility Study

Former VNTR

Vieques, Puerto Rico

CH2MHILL®

SECTION 4

Nature and Extent of Contamination

This section presents an evaluation of the nature and extent of MEC and constituents identified in soil at UXO 18.

4.1 MEC

As discussed in Section 1.2.2, five MEC (5-inch rockets) were discovered on the island and destroyed during the Preliminary Inspection (**Figure 1-3**). In addition, smoke canisters (HC 30 lbs ABC-M5) classified as MD were observed on the ground surface; the smoke canisters were expended, but at time of their operation, the HC smoke mixture would have contained approximately 47 percent hexachloroethane (an SVOC), 47 percent zinc oxide, and 6 percent grained aluminum.

The one-meter-wide transects from the Preliminary Inspection covered approximately 5 percent of the island, and another 3 percent of the island was covered (and no MEC identified) during the biological survey. In addition, no MEC was identified during the RI sampling within the two sampling units or adjacent to the former smoke canister locations. The transect inspections covered the accessible areas of UXO 18, which indicated only a few isolated MEC were present. Based on these findings, it can be assumed that other isolated MEC may be present throughout UXO 18. Based the relatively thin soil horizon (i.e., non-existent to less than about a foot), all potential MEC is at or close to the ground surface.

4.2 Soil Constituents

The locations and spatial distribution of soil samples collected at UXO 18 provides for a conservative estimate of the nature and extent of contamination. **Table 4-1** summarizes the hexachloroethane, explosives, and inorganics results for surface soil at UXO 18 and identifies the COPCs (i.e., screening criteria exceedances). Raw analytical data are included in **Appendix C**.

4.2.1 Hexachloroethane

Hexachloroethane was not detected in any of the discrete soil samples at UXO 18. Although the reporting limits (1.9 to 2.1 μg/kg) were above the soil-to-groundwater leaching screening value (SSL of 0.48 μg/kg), other primary constituents of the smoke canisters (zinc and aluminum) were detected below background concentrations, which indicates that a release of hexachloroethane is unlikely at UXO 18. Most significantly, all of the reporting limits for hexachloroethane were below the residential RSL and ecological screening value.

4.2.2 Explosives

Explosives were not detected in any soil samples at UXO 18. Although there were some explosives with reporting limits above their respective SSLs, other explosives reporting limits were below SSLs (summarized in **Appendix B**). Most significantly, all of the explosives reporting limits were below the residential RSLs and ecological screening values.

4.2.3 Inorganic Constituents

Only one inorganic constituent (thallium) was observed above both background and a screening criterion. Thallium was detected in one discrete soil sample (maximum concentration of 0.55J+ mg/kg) above the background concentration (0.13 mg/kg), adjusted residential soil RSL (0.078 mg/kg), and SSL (0.14 mg/kg). However, the detected concentration was reported as biased high, which may explain why it was not detected in any of the other samples. Further, thallium is not associated with 5-inch rockets or smoke canisters. Based on this information, thallium is either not likely present or is naturally occurring at the site.

Although some of the non-detect reporting limits (0.2 to 1.3 mg/kg) for antimony exceeded the SSL (0.27 mg/kg) and ecological screening criterion (0.27 mg/kg) in the discrete soil samples (**Appendix B**), the non-detect reporting limits were below these criteria in the incremental soil samples. Therefore, antimony concentrations, if present, are likely below all screening criteria at the site.

Hexavalent chromium was not detected at UXO 18, but the non-detect reporting limits (4 to 12 mg/kg) exceeded the SSL (0.00059 mg/kg), the adjusted Residential RSL (0.29 mg/kg), and the adjusted Industrial RSL (5.6 mg/kg; at only one incremental soil sample and one discrete soil sample) (**Appendix B**). How the elevated reporting limits were considered in the human health risk is discussed in Section 6. Hexavalent chromium is not associated with the 5-inch rockets or smoke canisters identified at the site; therefore, a release of hexavalent chromium at the site is unlikely.

It is important to note that all other inorganics, including zinc and aluminum, were detected below background concentrations. This information further supports that the individual inorganics discussed above, as well as all other inorganics concentrations detected at UXO 18, are naturally occurring.

Table 4-1
Explosives and Inorganic Constituents Detections and Exceedances in Soil
UXO 18 Remedial Investigation/Feasibility Study
Former Vieques Naval Training Range
Vieques, Puerto Rico

Station ID	Vieques East Background, Zone TI SS & SMI**	Adjusted Industrial Soil RSLs (May, 2014)	Adjusted Residential Soil RSLs (May, 2014)	SSLs (Risk-based if no MCL-based value)	Vieques ESVs Soil	VE-UXO18-01DU01				
Sample ID						VE-UXO18-01SMI01-0613	VE-UXO18-01SMI01T-0613	VE-UXO18-01SMI01TT-0613	VE-UXO18-01SMI01-1113	VE-UXO18-01SMI01-1113A*
Sample Date						06/12/13	06/12/13	06/12/13	11/15/13	11/15/13
Chemical Name										
Semivolatile Organic Compounds (µg/kg)										
No Detections[2]										
Explosives (µg/kg)										
No Detections[1]										
Total Metals (mg/kg)										
Aluminum	35,000	100,000	7,700	30,000	--	18.4 J	42.5 J	262 J	NA	NA
Arsenic	9.2	3	0.67	0.29	18	0.3 U	0.3 U	0.3 U	NA	NA
Barium	212	22,000	1,500	82	330	2.4	2.1	1.8	NA	NA
Beryllium	0.95	230	16	3.2	40	0.2 UJ	0.2 UJ	0.2 UJ	NA	NA
Cadmium	2.4	98	7	0.38	32	0.08 U	0.08 U	0.08 U	NA	NA
Calcium	417,000	--	--	--	--	38,300	41,300	31,500	NA	NA
Chromium	70.0	--	--	100,000	64	0.2 U	0.21 J	0.69	NA	NA
Chromium (hexavalent)	--	6.3	0.3	0.00067	--	4 U	4 U	4 U	NA	NA
Chromium (trivalent, calc)	--	100,000	12,000	100,000	--	0	0.21 J	0.69	NA	NA
Cobalt	15.8	35	2.3	0.27	13	0.057 J	0.061 J	0.098 J	NA	NA
Copper	94.2	4,700	310	46	70	0.4 UJ	0.4 UJ	0.46 J	NA	NA
Iron	38,100	82,000	5,500	350	--	4 J	13	185	NA	NA
Lead	16.0	800	400	14	120	0.4 UJ	0.4 UJ	0.2 J	NA	NA
Magnesium	22,200	--	--	--	--	1,240 J	1,430 J	1,300 J	NA	NA
Manganese	1,630	2,600	180	21	220	19.3	17.1	14.9	NA	NA
Nickel	41	2,200	150	26	38	0.4 UJ	0.4 UJ	0.17 J	NA	NA
Potassium	10,800	--	--	--	--	62 J	42.8 J	70.9 J	NA	NA
Selenium	1.3	580	39	0.26	0.52	0.1 U	0.1 U	0.1 U	NA	NA
Sodium	1,590	--	--	--	--	294	271	202	NA	NA
Thallium	0.13	1.2	0.078	0.14	1	0.05 UJ	0.05 UJ	0.05 UJ	NA	NA
Vanadium	55.7	580	39	86	130	0.4 UJ	0.4 UJ	0.5 J	NA	NA
Zinc	32	35,000	2,300	370	120	2.4 J	2.7 J	3.6 J	NA	NA
Wet Chemistry										
pH (pH units)	--	--	--	--	--	7.6	NA	NA	NA	NA
Redox (MV) (mv)	--	--	--	--	--	164	NA	NA	NA	NA
Total organic carbon (TOC) (mg/kg)	--	--	--	--	--	19,900	NA	NA	NA	NA

\\vbofpp01\Proj\CLEANII\BASES\Vieques\UXO 18\RIFS\DRAFT FINAL\Tables\[Table 4-1 - VE_UXO18_SMI&SS_rde_tbl_loaded_r2.xls], jdean6, 02/13/2014

Notes:
Bold text indicates exceedance of Adjusted Industrial Soil RSLs
Underline indicates exceedance of Adjusted Residential Soil RSLs
Shading indicates exceedance of SSLs
RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
J - Analyte present, value may or may not be accurate or precise
J+ - Analyte present, value may be biased high, actual value may be lower
NA - Not analyzed
U - Nondetect
UJ - Nondetect, quantitation limit may be inaccurate
mg/kg - Milligrams per kilogram
MV - Millivolts
µg/kg - Micrograms per kilogram
**Sample IDs ending in "A" were analyzed for picric acid after being hand ground rather than ground following 8330B procedure for incremental samples.*
*** A metals exceedance (i.e., indication of potential contamination) is highlighted only if the parameter concentration exceeds both the screening value and the Vieques East Background value. Background is not considered in identifying chemicals of potential concern for risk assessment purposes, as discussed in Sections 6 and 7.*

[1] *All 8330B explosives and picric acid results for the June 2013 SMI samples were rejected and deemed not usable. These samples were re-collected in November 2013.*

[2] *SVOC analysis was only performed only on discrete soil samples.*

Table 4-1

Explosives and Inorganic Constituents Detections and Exceedances in Soil

UXO 18 Remedial Investigation/Feasibility Study

Former Vieques Naval Training Range

Vieques, Puerto Rico

Station ID	Vieques East Background, Zone TI SS & SMI**	Adjusted Industrial Soil RSLs (May, 2014)	Adjusted Residential Soil RSLs (May, 2014)	SSLs (Risk-based if no MCL-based value)	Vieques ESVs Soil	VE-UXO18-01DU01				VE-UXO18-01DU02		
Sample ID						VE-UXO18-01SMI01T-1113	VE-UXO18-01SMI01T-1113A*	VE-UXO18-01SMI01TT-1113	VE-UXO18-01SMI01TT-1113A*	VE-UXO18-01SMI02-0613	VE-UXO18-01SMI02-1113	VE-UXO18-01SMI02-1113A*
Sample Date						11/15/13	11/15/13	11/15/13	11/15/13	06/12/13	11/15/13	11/15/13
Chemical Name												
Semivolatile Organic Compounds (µg/kg)												
No Detections[2]												
Explosives (µg/kg)												
No Detections[1]												
Total Metals (mg/kg)												
Aluminum	35,000	100,000	7,700	30,000	--	NA	NA	NA	NA	598 J	NA	NA
Arsenic	9.2	3	0.67	0.29	18	NA	NA	NA	NA	0.3 U	NA	NA
Barium	212	22,000	1,500	82	330	NA	NA	NA	NA	4.5	NA	NA
Beryllium	0.95	230	16	3.2	40	NA	NA	NA	NA	0.2 UJ	NA	NA
Cadmium	2.4	98	7	0.38	32	NA	NA	NA	NA	0.08 U	NA	NA
Calcium	417,000	--	--	--	--	NA	NA	NA	NA	27,100	NA	NA
Chromium	70.0	--	--	100,000	64	NA	NA	NA	NA	0.85	NA	NA
Chromium (hexavalent)	--	6.3	0.3	0.00067	--	NA	NA	NA	NA	10 U	NA	NA
Chromium (trivalent, calc)	--	100,000	12,000	100,000	--	NA	NA	NA	NA	0.85	NA	NA
Cobalt	15.8	35	2.3	0.27	13	NA	NA	NA	NA	0.24	NA	NA
Copper	94.2	4,700	310	46	70	NA	NA	NA	NA	0.68 J	NA	NA
Iron	38,100	82,000	5,500	350	--	NA	NA	NA	NA	316	NA	NA
Lead	16.0	800	400	14	120	NA	NA	NA	NA	0.4 UJ	NA	NA
Magnesium	22,200	--	--	--	--	NA	NA	NA	NA	620 J	NA	NA
Manganese	1,630	2,600	180	21	220	NA	NA	NA	NA	54.6	NA	NA
Nickel	41	2,200	150	26	38	NA	NA	NA	NA	0.36 J	NA	NA
Potassium	10,800	--	--	--	--	NA	NA	NA	NA	184 J	NA	NA
Selenium	1.3	580	39	0.26	0.52	NA	NA	NA	NA	0.12 J	NA	NA
Sodium	1,590	--	--	--	--	NA	NA	NA	NA	61.7 J	NA	NA
Thallium	0.13	1.2	0.078	0.14	1	NA	NA	NA	NA	0.05 UJ	NA	NA
Vanadium	55.7	580	39	86	130	NA	NA	NA	NA	0.54 J	NA	NA
Zinc	32	35,000	2,300	370	120	NA	NA	NA	NA	2.9 J	NA	NA
Wet Chemistry												
pH (pH units)	--	--	--	--	--	NA	NA	NA	NA	7.5	NA	NA
Redox (MV) (mv)	--	--	--	--	--	NA	NA	NA	NA	147	NA	NA
Total organic carbon (TOC) (mg/kg)	--	--	--	--	--	NA	NA	NA	NA	86,700	NA	NA

\\vbofpp01\Proj\CLEANII\BASES\Vieques\UXO 18\RIFS\DRAFT FINAL\Tables\[Table 4-1 - VE_UXO18_SMI&SS_rde_tbl_loaded_r2.xls], jdean6, 02/13/2014

Notes:

Bold text indicates exceedance of Adjusted Industrial Soil RSLs

Underline indicates exceedance of Adjusted Residential Soil RSLs

Shading indicates exceedance of SSLs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

J - Analyte present, value may or may not be accurate or precise

J+ - Analyte present, value may be biased high, actual value may be lower

NA - Not analyzed

U - Nondetect

UJ - Nondetect, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

MV - Millivolts

µg/kg - Micrograms per kilogram

**Sample IDs ending in "A" were analyzed for picric acid after being hand ground rather than ground following 8330B procedure for incremental samples.*

*** A metals exceedance (i.e., indication of potential contamination) is highlighted only if the parameter concentration exceeds both the screening value and the Vieques East Background value. Background is not considered in identifying chemicals of potential concern for risk assessment purposes, as discussed in Sections 6 and 7.*

[1] All 8330B explosives and picric acid results for the June 2013 SMI samples were rejected and deemed not usable. These samples were re-collected in November 2013.

[2] SVOC analysis was only performed only on discrete soil samples.

Table 4-1

Explosives and Inorganic Constituents Detections and Exceedances in Soil

UXO 18 Remedial Investigation/Feasibility Study

Former Vieques Naval Training Range

Vieques, Puerto Rico

Station ID	**Vieques East Background, Zone TI SS & SMI****	**Adjusted Industrial Soil RSLs (May, 2014)**	**Adjusted Residential Soil RSLs (May, 2014)**	**SSLs (Risk-based if no MCL-based value)**	**Vieques ESVs Soil**	VE-UXO18-01SO001		VE-UXO18-01SO002	VE-UXO18-01SO03
Sample ID						VE-UXO18-01SS01-0001	VE-UXO18-01SS01P-0001	VE-UXO18-01SS02-0001	VE-UXO18-01SS03-0001
Sample Date						06/12/13	06/12/13	06/12/13	06/12/13
Chemical Name									
Semivolatile Organic Compounds (µg/kg)									
No Detections[2]									
Explosives (µg/kg)									
No Detections[1]									
Total Metals (mg/kg)									
Aluminum	35,000	100,000	7,700	30,000	--	NA	3,630	4,470 J	9,720
Arsenic	9.2	3	0.67	0.29	18	NA	2.2 J	2.2 J	4.8
Barium	212	22,000	1,500	82	330	NA	34.5	49 J	43.3
Beryllium	0.95	230	16	3.2	40	NA	0.23 U	0.25 UJ	0.09 J
Cadmium	2.4	98	7	0.38	32	NA	0.18 J	0.32 J	0.25 J
Calcium	417,000	--	--	--	--	NA	265,000	238,000 J	229,000
Chromium	70.0	--	--	100,000	64	NA	6.3	9.2	11.4
Chromium (hexavalent)	--	6.3	0.3	0.00067	--	4.5 U	4.6 U	12 U	5 U
Chromium (trivalent, calc)	--	100,000	12,000	100,000	--	NA	6.3	9.2	11.4
Cobalt	15.8	35	2.3	0.27	13	NA	2.4	2.5	2.4
Copper	94.2	4,700	310	46	70	NA	8.1	13 J	13.6
Iron	38,100	82,000	5,500	350	--	NA	2,680	3,740 J	7,710
Lead	16.0	800	400	14	120	NA	0.46 U	0.49 UJ	2
Magnesium	22,200	--	--	--	--	NA	3,630	4,780 J	12,300
Manganese	1,630	2,600	180	21	220	NA	110	184 J	315
Nickel	41	2,200	150	26	38	NA	1.9	2.5 J	3.8
Potassium	10,800	--	--	--	--	NA	827	1,060	2,350
Selenium	1.3	580	39	0.26	0.52	NA	0.57 U	0.75 J+	0.98 J+
Sodium	1,590	--	--	--	--	NA	452	627 J	494
Thallium	0.13	1.2	0.078	0.14	1	NA	0.28 U	0.31 U	0.55 J+
Vanadium	55.7	580	39	86	130	NA	5.1	7 J	14.6
Zinc	32	35,000	2,300	370	120	NA	10.1	21.3 J	23.7
Wet Chemistry									
pH (pH units)	--	--	--	--	--	7.8	NA	7.9	7.6
Redox (MV) (mv)	--	--	--	--	--	199	NA	209	224
Total organic carbon (TOC) (mg/kg)	--	--	--	--	--	48,000	NA	64,000	68,000

\\vbofpp01\Proj\CLEANII\BASES\Vieques\UXO 18\RIFS\DRAFT FINAL\Tables\[Table 4-1 - VE_UXO18_SMI&SS_rde_tbl_loaded_r2.xls], jdean6, 02/13/2014

Notes:

Bold text indicates exceedance of Adjusted Industrial Soil RSLs

Underline indicates exceedance of Adjusted Residential Soil RSLs

Shading indicates exceedance of SSLs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

J - Analyte present, value may or may not be accurate or precise

J+ - Analyte present, value may be biased high, actual value may be lower

NA - Not analyzed

U - Nondetect

UJ - Nondetect, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

MV - Millivolts

µg/kg - Micrograms per kilogram

**Sample IDs ending in "A" were analyzed for picric acid after being hand ground rather than ground following 8330B procedure for incremental samples.*

*** A metals exceedance (i.e., indication of potential contamination) is highlighted only if the parameter concentration exceeds both the screening value and the Vieques East Background value. Background is not considered in identifying chemicals of potential concern for risk assessment purposes, as discussed in Sections 6 and 7.*

[1] *All 8330B explosives and picric acid results for the June 2013 SMI samples were rejected and deemed not usable. These samples were re-collected in November 2013.*

[2] *SVOC analysis was only performed only on discrete soil samples.*

SECTION 5

Chemical Fate and Transport

This section discusses the fate and transport of chemicals observed in soil at UXO 18. Fate and transport consists of identification of theoretical chemical phases and migration and degradation pathways. An understanding of the mobility and persistence of a chemical in the subsurface is part of the overall assessment of the potential for that chemical to cause an adverse human health or environmental effect.

This section also includes the conceptual site model (CSM) of UXO 18 (**Figure 5-1**). The CSM qualitatively combines and interprets the compendium of information presented in this section and earlier sections of the report, including the physical setting, potential contaminant sources, migration of potential contaminants, and the potential exposure and receptor pathways. The CSM is a living document used to support potential risk management decisions and aids in defining the effectiveness of remedial alternatives, if necessary.

5.1 Chemical Mobility and Persistence

The mobility and persistence of chemicals at the site are determined by their physical, chemical, and biological interaction with the environment. Mobility is the potential for a chemical to migrate from a site, and persistence is a measure of how long a chemical will remain in the environment. The key mechanisms controlling mobility and persistence include solubility, sorption, volatilization, transformation, and bioaccumulation.

Chemicals that are readily soluble in water have greater migration potential and may be more amenable to transformation processes if suitable conditions exist. Sorption occurs when a constituent adheres to and becomes associated with solid particles; clays and organic matter are likely to sorb chemicals. Volatilization occurs when a compound transfers from the aqueous phase to the gas phase. Transformation occurs when the valence state of a chemical is increased (oxidation) or decreased (reduction). It can be caused by changes in E_h (oxidation potential) and/or pH and by microbial or nonmicrobial (abiotic) processes. Bioaccumulation potential is the extent to which a chemical will partition from a physical medium (i.e., water, soil, or sediment) into the tissues of an organism, often to the lipophilic parts (e.g., fat) of an organism.

5.2 Chemical Migration at UXO 18

This subsection discusses the site-specific sources and potential mechanisms for contaminant release and migration from these sources. **Figure 5-1** presents the UXO 18 CSM and supports the discussion in this section. It is important to note that no chemical contamination was detected at UXO 18, so the migration discussion pertains to naturally occurring chemicals or hypothetical contaminants.

MEC and the smoke canisters are the potential source of contamination at UXO 18. Chemical contaminants had the potential to be released to the environmental media from historical detonations and from the deterioration of MEC. Wind erosion is a potential mechanism for release of chemicals to the atmosphere from soil, but this mode of transport is inhibited by vegetation. Surface runoff could erode soil and deposit chemicals adhering to the soil, as directed by the ground topography. Contaminants at the ground surface could migrate downward through the bedrock by leaching from precipitation infiltration.

Actual and potential receptors at the site are both human and ecological. Workers (conservatively assumed) and recreational users (adults, adolescents, and children) may be exposed to soil and to the explosive hazard associated with MEC. Potentially complete exposure pathways for terrestrial ecological receptors exposed to surface soil include plants, soil invertebrates, birds, mammals, and reptiles. Potential birds and mammals consuming invertebrates, plants, and/or small mammals include the Fruit Bat, Velvet Free-tailed Bat, Norway Rat, Indian Mongoose, Common Ground Dove, Pearly-eyed Thrasher, Cave Swallow, and Red-tailed Hawk.

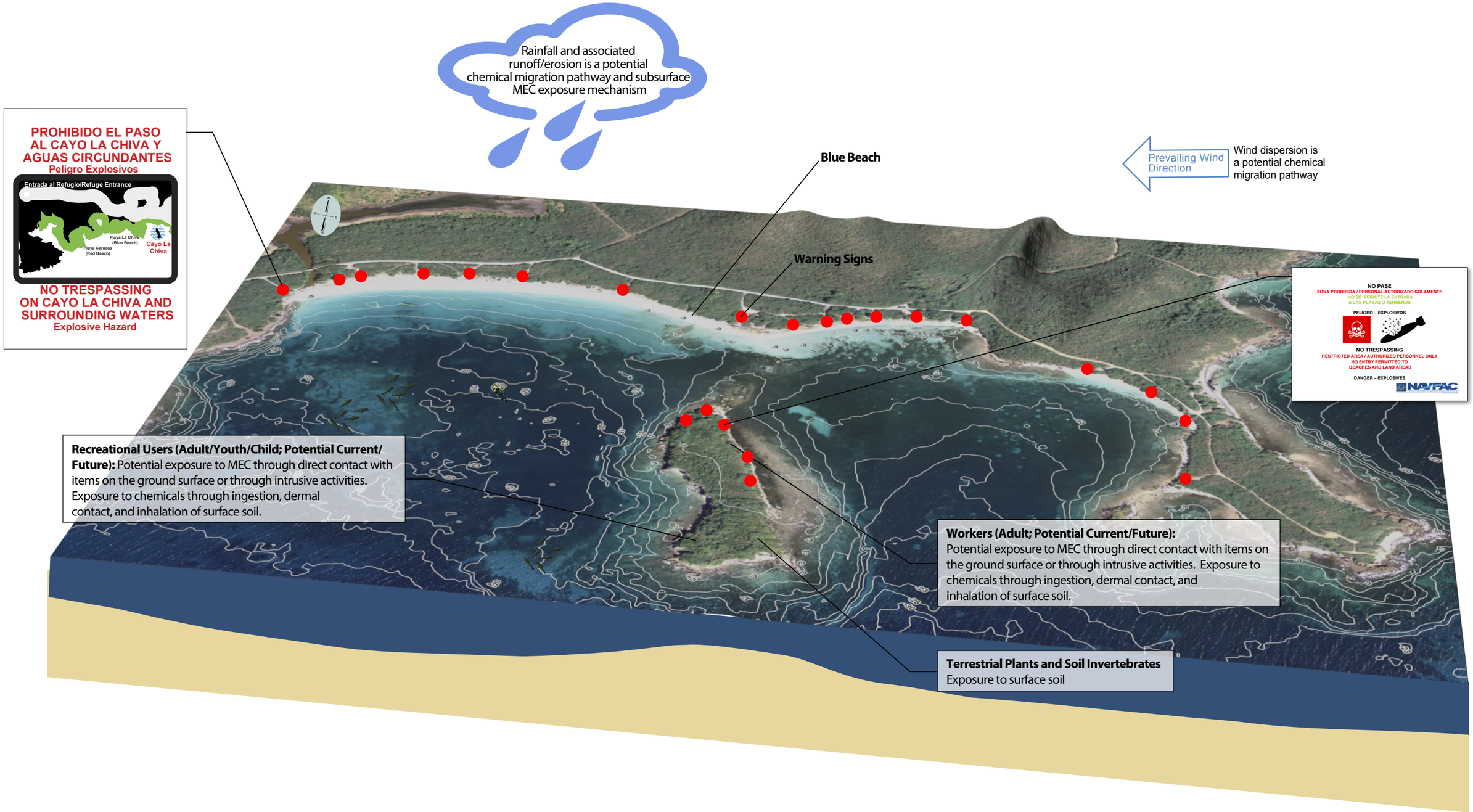


Figure 5-1
Conceptual Site Model
UXO 18 Remedial Investigation/Fesibility Study
Former Atlantic Fleet WEeapons Training Area - Vieques
Vieques, Puerto Rico

SECTION 6

Human Health Risk Assessment Summary

An HHRA was conducted for UXO 18 that evaluated potential current and future health risks from exposure to constituents in site soil based on the analytical data collected during the RI. The HHRA was conducted in accordance with the Vieques Master HHRA protocol (CH2M HILL, 2010b), which is consistent with USEPA Region 2 policy and USEPA guidance documents. The primary guidance documents used in preparation of the HHRA are the USEPA Risk Assessment Guidance for Superfund (RAGS) Parts A, D, E, and F (USEPA, 1989; 2001; 2004; 2009), and Human Health Evaluation Manual (HHEM), Superfund Guidance: Update of Standard Default Exposure Factors (USEPA, 2014). The complete HHRA is presented in **Appendix D**. This section summarizes the key components and findings of the HHRA.

6.1 Chemicals of Potential Concern

The soil dataset consists of three discrete soil samples collected from the 0-1 foot interval and two incremental soil samples collected from the 0-2.5 inch interval. Discrete soil samples were analyzed for hexachloroethane, inorganics plus hexavalent chromium, and explosives; incremental soil samples were analyzed for inorganics plus hexavalent chromium, and explosives in accordance with the Master SAP (CH2MHILL, 2013).

COPCs were identified for surface soil using the screening process presented in the Vieques Master HHRA protocol (CH2M HILL, 2010b). The following COPCs were identified for each receptor group:

- **Recreational Users:**
  - Six inorganics (aluminum, arsenic, cobalt, iron, manganese, and thallium) in surface soil for the direct contact exposure pathways.
- **Workers:**
  - One inorganic (arsenic) in surface soil for the direct contact exposure pathways.

6.2 Exposure Evaluation

Potential current and future receptors were evaluated in the HHRA. As noted in Section 3.1 of **Appendix D** and in the conceptual model for potential human receptors (**Appendix D, Table 1 of Attachment D-1** and **Figure 1 of Attachment D-2**), current/future receptors evaluated in the HHRA consisted of recreational users (adult, youth [6-16 years old], and child [1-6 years old]) and workers. The recreational user scenarios involve being at the site 104 days per year for 6 years as a child, 10 years as an adolescent, and 24 years as an adult, and incidentally ingesting and dermally contacting soil at intake rates representative of residential exposures. Since it is reasonable to assume that recreational use of the site by the same person would not occur more frequently, longer, or at higher ingestion or dermal contact rates than those assumed for recreational users, the recreational user exposure scenarios are protective of potential recreational use of the site.

The following potential exposure pathways were quantified for potential receptors identified at the site:

- Recreational Users (Adult/Youth/Child; Potential Current/Future): Ingestion, dermal contact, and inhalation exposures to surface soil (0-1 foot).
- Workers (Adult; Potential Current/Future): Ingestion, dermal contact, and inhalation exposures to surface soil (0-1 foot).

6.3 Risk Estimates

USEPA's target (acceptable) range for excess lifetime cancer risk (ELCR) associated with CERCLA sites is 1-in-10,000 ($1x10^{-4}$) to 1-in-1,000,000 ($1x10^{-6}$). Similarly, the target (acceptable) non-cancer hazard index (HI) is 1 or less per target organ. Risk estimates were calculated for potential receptors and exposure pathways using conservative assumptions for exposure factors and exposure point concentrations. The risk estimates are summarized below:

- **Recreational Users – Current/Future Scenario**

  Surface soil (ingestion, dermal contact, and inhalation)

  - Adult: $1x10^{-6}$ ELCR, all target organ-specific HI < 1
  - Youth: $9x10^{-7}$ ELCR, all target organ-specific HI < 1
  - Child: $3x10^{-6}$ ELCR, all target organ-specific HI < 1

- **Workers – Current/Future Scenario**

  Surface Soil (ingestion, dermal contact, and inhalation)

  - $4x10^{-7}$ ELCR, all target organ-specific HI < 1

6.4 Chemicals of Concern

COCs are generally identified when the potential ELCR or HI for a receptor group exceeds USEPA threshold values (a total ELCR of $1x10^{-4}$ or a target organ-specific HI of 1) and concentrations are site-related and above background levels. For each receptor group, when a potential ELCR of $1x10^{-4}$ is exceeded for an environmental medium, the COPCs above background levels and posing an individual ELCR greater than $1x10^{-6}$ in that environmental medium are identified as COCs. When a potential target organ-specific HI exceeds 1 for an environmental medium, the COPCs above background levels and posing a hazard quotient (HQ) greater than 0.1 for the target organ in that environmental medium are identified as COCs. Factors such as nature of contamination source, laboratory contamination, and common pesticide use (unrelated to spills, improper storage disposal or use) are considered when identifying COCs.

ELCR and HI estimates for potential soil exposures at UXO 18 are within USEPA-acceptable levels for all receptor groups. The potential ELCRs for the exposure scenarios evaluated at the site are within or less than the target ELCR range of $1x10^{-6}$ to $1x10^{-4}$. All estimated target organ-specific HIs are less than the threshold of 1. Additionally, the maximum detected concentrations of all COPCs identified in surface soil, except thallium, are below their respective background concentrations. Therefore, no COCs were identified at the site.

SECTION 7

Ecological Risk Assessment Summary

A screening ecological risk assessment (SERA), constituting Steps 1 and 2 of the ecological risk assessment (ERA) process, and the first step (Step 3A) of a baseline ecological risk assessment (BERA) was conducted for UXO 18 using incremental and discrete surface soil data collected during the RI. The complete ERA is presented in **Appendix E** of this RI/FS Report. This section summarizes the key components and findings of the UXO 18 ERA.

7.1 ERA Process

The approach, methods, and assumptions used for this ERA were based upon the final ERA protocol presented in the *Master Standard Operating Procedures, Protocols, and Plans* (CH2M HILL, 2010b) and the *Master Ecological Risk Assessment Protocol for Vieques Environmental Restoration Program – Update 1 (Addendum)* (CH2M HILL, 2010c). The ERA was conducted in accordance with the *Navy Policy for Conducting Ecological Risk Assessments* (CNO, 1999) and the Navy guidance for implementing this ERA policy (NAVFAC, 2003). These guidance documents describe a process consisting of eight steps, of which Steps 1 through 3A were conducted for this ERA. Steps 1 and 2 comprise the SERA, which are conducted using intentionally conservative assumptions. Where the results of the SERA indicate that unacceptable risks are possible, the evaluation continues on to Step 3A, the first step in the BERA.

7.2 Ecological Setting

Cayo La Chiva is an approximately 12-acre rocky island offshore of Blue Beach (Playa La Chiva), which includes approximately 7.2 acres of dry scrub forest, 2.4 acres of secondary growth forest, 0.8 acres of mangrove forest, and 1.6 acres of unvegetated rocky shoreline and sandy beach. Three habitat types occur on Cayo La Chiva, comprising dry scrub forest, secondary growth forest, and mangrove forest. The dry scrub forest covers the majority of the island (approximately 7 acres) and is dominated by small diameter trees and shrubs. Dominant species include catclaw blackbead (*Pithecellobium unguis-cati*), torchwood (*Amyris elemifera*), gumbo limbo (*Bursera simaruba*), Jamaican caper (*Capparis cynophallophora*), seagrape (*Coccoloba uvifera*), white cedar (*Tabebuia heterophylla*), blacktorch (*Erithalis fruticosa*), buttonsage (*Lantana involucrata*), and rougeplant (*Rivina humilis*). The secondary growth forest covers approximately 2 acres and occurs as isolated stands of mature trees. The dominant species include many large tree species such as water mampoo (*Pisonia subcordata*), gumbo limbo, Spanish lime (*Melicoccus bijugatus*), red manjack (*Cordia collococca*), seagrape, white cedar, white stopper (*Eugenia axillaris*) and wild banyantree (*Ficus citrifolia*). The tree species are approximately 30 feet in height. The mangrove forest (approximately 1 acre) occurs as a narrow fringe along the eastern and northern coast of Cayo La Chiva, and is dominated by black mangrove (*Avicennia germinans*), white mangrove (*Laguncularia racemosa*), button mangrove (*Conocarpus erectus*), and Portia tree (*Thespesia populnea*).

Other biological resources include hermit crab (*Coenobita clypeatus*), common anole (*Anolis cristatellus*), white-winged dove (*Zenaida asiatica*), white-crowned pigeon (*Patagioenas leucocephala*), zenaida dove (*Zenaida aurita*), yellow warbler (*Dendroica petechia*), bananaquit (*Coereba flaveola*), pearly-eyed thrasher (*Margarops fuscatus*), grey kingbird (*Tyrannus dominicensis*), yellow-crowned night heron (*Nyctanassa violacea*), American kestrel (*Falco sparverius*), red-tailed hawk (*Buteo jamaicensis*), Puerto Rican flycatcher (*Myiarchus antillarum*), and magnificent frigatebird (*Fregata magnificens*). No listed plant or animal species were observed during the ground survey.

7.3 Analytical Data Used in the ERA

One incremental surface soil sample was collected within each of two sampling units where MEC was previously identified. Discrete surface soil samples were collected from 0 to 1 ft bgs at each of three smoke canister locations. Each soil sample was analyzed for explosives, inorganic constituents, pH, and total organic carbon (TOC). In addition, hexachloroethane was analyzed in the three discrete surface soil samples.

7.4 ERA Results

Potentially complete exposure pathways exist for terrestrial receptors exposed to surface soil across UXO 18. Receptor groups evaluated in this ERA comprise terrestrial plants, soil invertebrates, reptiles, birds, and mammals. For the evaluation of direct exposure of chemicals detected in soil to plants and invertebrates, the multi-incremental and discrete surface soil data sets were evaluated separately considering that they represent slightly different exposure areas (i.e., incremental composites of soil from across approximately 1-acre sampling units, versus discrete samples at isolated smoke canisters), as discussed below. For food web exposure, samples from both data sets were combined considering that wide ranging birds and mammals may forage throughout UXO 18.

Eleven assessment endpoints were developed for terrestrial habitats at UXO 18. Lines of evidence for terrestrial habitats included: (1) comparison of surface soil concentrations with ecological screening values; (2) comparison of modeled dietary doses with ingestion toxicity reference values; and (3) comparison of site surface soil concentrations with background concentrations.

No chemicals were identified as Step 3A COPCs in areas represented by surface soil multi-incremental samples or discrete samples. In addition, no chemicals were retained as COPCs for terrestrial food web exposures. In conclusion, no unacceptable risks were identified for terrestrial receptors associated with UXO 18. A more detailed description of the ERA results is provided in the complete ERA in **Appendix E**.

7.5 ERA Summary and Conclusions

No COCs were identified for surface soil multi-incremental samples and discrete samples at UXO 18. Similarly, no COCs were identified for food web exposures. Thus, risks to ecological receptors are acceptable at UXO 18.

SECTION 8

Summary and Recommendations of Remedial Investigation

This section summarizes the findings of the RI and the recommendations made based on those findings.

8.1 Summary of Remedial Investigation

The RI was implemented in two separate investigations – one focusing on MEC and one focusing on potential chemical contaminants at the site.

- The MEC component of the RI was implemented in 2011 to assess the presence and extent of MEC at the site such that the potential explosives hazard could be determined. Transect inspections covered approximately 5 percent of the island (and anomaly avoidance practiced during the 2011 biological survey covered an additional 3 percent), in which five MEC (5-inch rockets) were discovered and destroyed. In addition, three smoke canisters were observed on the ground surface and subsequently removed, but they did not represent an explosive hazard. The transects covered the accessible areas of UXO 18 and did not identify areas with significant MEC (i.e., only a few isolated MEC were found).
- The environmental characterization component of the RI was conducted in June and November of 2013 and included the collection of soil samples in areas that provide conservative estimate of the nature and extent of contamination. No COCs were identified in soil and there were no unacceptable human health or ecological risks.

8.2 Recommendations

Based on the conclusion of the RI, MEC (in addition to the 5 rockets) is potentially present on UXO 18. However, soil sampling and associated data evaluation, including risk assessments, indicate existing chemical concentrations pose no unacceptable risks and are likely attributable to background. Since no COCs were identified, the remedial alternatives evaluation is necessary only for potential explosive hazards associated with the potential presence of MEC.

SECTION 9

Remedial Action Objectives and Approach

This section discusses the applicable or relevant and appropriate requirements (ARARs), remedial action objectives (RAOs), performance criteria, and the initial steps to develop remedial alternatives, including the identification of general response actions (GRAs) and screening of potential remedial technologies for UXO 18.

The FS was prepared in general accordance with the following guidance documents:

- *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988)
- *Consideration of Green and Sustainable Remediation Practices in the Defense Environmental Restoration Program* (DoD, 2009)
- *National Oil and Hazardous Substances Pollution National Contingency Plan* (NCP)
- *Section 120 of CERCLA as amended by the Superfund Amendments and Reauthorization Act* (SARA)

9.1 Applicable or Relevant and Appropriate Requirements

CERCLA remedial actions must meet ARARs for selected remedies unless a specific ARAR waiver is requested. ARARs are federal and state (commonwealth) public health and environmental requirements used to help define the extent of site cleanup, identify sensitive land areas or land uses, develop remedial alternatives, and direct site remediation.

Applicable requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state (commonwealth) law that address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at the site.

Relevant and Appropriate requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state (commonwealth) law that are well suited to the particular site. While not necessarily “applicable” to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance of the site, relevant and appropriate requirements address problems or situations sufficiently similar to those encountered at the site to justify their use.

Factors to be considered (TBC) are non-promulgated advisories or guidance, issued by federal or state (commonwealth) government, that are not legally binding and do not have the status of potential ARARs. However, in many circumstances such factors are considered along with ARARs in determining the level of cleanup required to protect human health and the environment.

Remedial actions must comply with both federal and state (commonwealth) ARARs. For a state (commonwealth) requirement to be an ARAR, it must meet three criteria:

- It must meet the definition of an ARAR.
- It must be more stringent than federal requirements.
- It must be a promulgated standard, requirement, criterion, or limitation under a state (commonwealth) environmental or facility citing law.

There are three types of ARARs. *Location-specific* ARARs restrict the occurrence of chemicals in certain sensitive environments, such as wetlands (for example, the Endangered Species Act). *Action-specific* ARARs are activity or technology based, which typically control remedial activities that generate hazardous wastes (for example,

RCRA). *Chemical-specific* ARARs are health based or risk management based numbers that provide concentration limits for the occurrence of a chemical in the environment. Remedial actions must comply with both federal and state (commonwealth) ARARs. The statutes and regulations listed in **Table 9-1** contain the ARARs for UXO 18.

9.2 Remedial Action Objectives

The RAOs consist of specific goals for protecting human health. The RAOs reflect the potential for MEC to remain at UXO 18.

Based on the current and potential future land use, RAOs were developed to be protective of current and potential future receptors, in accordance with the current land use (i.e., potential recreational receptors on the island) and potential future land use, when evaluating potential remedial alternatives. The RAOs for UXO 18 are as follows:

- Reduce the explosive hazard associated with MEC to be compatible with current and anticipated future land use.
- Reduce the potential for unauthorized access to the site.

9.3 Performance Criteria

Performance criteria are established for purposes of evaluating remedial alternatives and for use in the conceptual design and cost estimates. The performance criteria described below represent the levels of performance necessary to meet the RAOs.

- For alternative that includes MEC removal, it will be conducted in accordance with the quality control requirements established in the MEC Master Work Plan for Vieques (CH2M HILL, 2006); each aspect of work will be subject to the three phases of control (Preparatory Phase, Initial Phase, and Follow-Up Phase) and quality assurance review.
- Ensure Land Use Controls (LUCs) are in place and adequately monitored and maintained.

9.4 General Response Actions

The General Response Actions (GRAs) describe the range of actions that will satisfy the RAOs at the site. The GRAs may include no action, land use controls, monitoring, containment, removal, treatment, disposal or any combination of these. Consideration of the No Action GRA is required by CERCLA. **Appendix F** contains a discussion of the UXO 18 GRAs.

With the exception of the No Action alternative, each GRA can be achieved through the implementation of site-specific remedial technologies. In this context, the following definitions apply:

- Remedial technologies are defined as the general categories of remedies under a GRA.
- Process options are specific categories of remedies within each remedial technology. The process options are used to implement each remedial technology.

9.5 Screening of Remedial Technologies

The technology types and process options available for remediation of various media were screened. The purpose of this step is to identify the technologies that may be applicable at UXO 18. **Appendix F** provides a narrative description and summary of technology screening for UXO 18. **Table 9-2** summarizes the results of the technology screening process and presents only those technologies retained for further evaluation via the screening process presented in **Appendix F**. Certain technologies and/or process options are not appropriate for

implementation at UXO 18 because of impracticality, site conditions, or site access, and were excluded from further consideration.

9.6 Sustainability

Executive Order 13242, *Strengthening Federal Environmental, Energy, and Transportation Management*, requires Federal agencies to implement sustainable practices. Sustainability is a *greening* process focused on energy conservation, reduction of greenhouse gases, waste minimization, and re-use and recycling of materials. These considerations are not NCP requirements for remedial alternatives, but may be considered during the alternative selection process.

Green remediation results in effective cleanups minimizing the environmental and energy footprints of site remediation and revitalization (USEPA, 2008). Sustainable practices emphasize the need to more closely evaluate core elements of a cleanup project, compare the site-specific value of conservation benefits gained by different strategies of green remediation, and weigh the environmental trade-offs of potential strategies.

The sustainability of each alternative is evaluated by the SiteWise™ tool. SiteWise™ is a stand-alone analytical tool to efficiently and systematically conduct a sustainability analysis of remediation technologies, thereby providing a tool for selecting a remediation alternative that is based not only on the seven standard NCP selection criteria as detailed in Section 12, but also on the basis of the environmental footprint of the technology. This analysis evaluates the environmental footprint of each remedial alternative considered in terms of five metrics, comprising:

1. Greenhouse gases (GHGs) reported as carbon dioxide equivalents (CO_2e), consisting of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O);
2. Energy usage (expressed as British Thermal Unit [BTU]);
3. Water consumption (gallons)
4. Air emissions of criteria pollutants consisting of oxides of nitrogen (NOx) and sulfur (SOx), and particulate matter (PM); and
5. Accident risk (risk of injury and risk of fatality).

A low environmental footprint indicates low deleterious impacts to environmental and social metrics, which collectively make up the SiteWise™ sustainability metrics. Conversely, a high environmental footprint indicates high deleterious impacts associated with the SiteWise™ metrics. A summary of the sustainability analysis for SWMU 18 is included in **Appendix G**. The major conclusions of this sustainability analysis are incorporated into the short-term effectiveness criterion evaluation in Section 11 of this RI/FS Report.

Table 9-1(a)
Federal Chemical-Specific ARARs
UXO 18 Remedial Investigation/Feasibility Study Report
Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Media	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
No Federal Chemical-Specific ARARs apply.						

Table 9-1(b)
Puerto Rico Chemical-Specific ARARs
UXO 18 Remedial Investigation/Feasibility Study Report
Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Media	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
No Puerto Rico Chemical-Specific ARARs apply.						

Table 9-1(c)
Federal Location-Specific ARARs
UXO 18 Remedial Investigation/Feasibility Study Report
Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Location	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Coastal Zone Management Act						
Coastal zone or area that will affect the coastal zone	Federal activities must be consistent with, to the area that will affect maximum extent practicable, State coastal zone management programs. Federal agencies must supply the State with a consistency determination.	Activity taking place in a wetland, flood plain, estuary, beach, dune, barrier island, coral reef, and fish and wildlife and their habitat, within the coastal zone.	15 CFR 930.33(a)(1), (a)(2), (b); .35(a), (b); .36(a)	2, 3, and 4	Applicable	Activities at UXO 18 that will affect Puerto Rico's coastal zone will be consistent to the maximum extent practicable with Puerto Rico's enforceable policies. Activities performed on-site and in compliance with CERCLA are not subject to administrative review; however the substantive requirements of making a consistency determination will be met.
Migratory Bird Treaty Act						
Migratory bird area	Protects almost all species of native birds in the United States from unregulated taking.	Presence of migratory birds.	*Migratory Bird Treaty Act* , 16 USC 703	2, 3, and 4	Applicable	The site is located in the Atlantic Americas Migratory Flyway. If migratory birds, or their nests or eggs, are identified at the site, operations will not destroy the birds, nests, or eggs.

Table 9-1(d)
Puerto Rico Location-Specific ARARs
UXO 18 Remedial Investigation/Feasibility Study Report
Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Location	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
No Puerto Rico Location-Specific ARARs apply.						

Table 9-1(e)
Federal Action-Specific ARARs
UXO 18 Remedial Investigation/Feasibility Study Report
Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Action	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Management of non-hazardous solid waste onsite in containers or in piles.	Non-hazardous solid waste staged onsite must not create a hazard or public nuisance.	Generation of non-hazardous solid waste that is managed onsite in containers or in piles.	40 CFR 273.3-1(a); 3-3; 3-4(a); 3-7(a); 3-8(d)	2, 3, and 4	Applicable	It is anticipated that non-hazardous solid wastes will be generated during the implementation of these alternatives. IDW will be sampled to confirm characterization prior to disposal. It will be assumed that MDAS is regulated as scrap metal.
Performing activities that will disturb greater than one acre of land	Requires the development and implementation of best management practices and erosion and sedimentation control measures during construction activity.	Implementation of construction activities that will disturb more than one acre of land	one to five acres: 40 CFR 122.26(a)(1)(ii), (a) (9)(i)(b), (b)(15); 122.44(k)(2) and (s)(1) five acres or more: 40 CFR 122.26(a)(1)(ii), (a)(9)(i)(b), (b)(14)(x); 122.44(k)(2) and (s)(2)	3 and 4	Applicable	If any of the selected remedies or the combination thereof disturb greater than one acre of land a Storm Water Pollution Prevention Plan will be prepared and implemented. Since activities are taking place onsite and in compliance with CERCLA, the substantive requirements will be met, but a permit will not be required.
Management of military munitions	Specifies management requirements for those military munitions that are no longer exempt from the definition of solid waste	Management of unused military munitions that have been disposed of or fired/used military munitions that have been removed from the range.	40 CFR 266.202(b) and (c) ; 205 (a) and (b)	2, 3, and 4	Applicable	If any military munitions lose their exemption from the definition of solid waste they will be handled in accordance with these rules.

Table 9-1(f)
Puerto Rico Action-Specific ARARs
UXO 18 Remedial Investigation/Feasibility Study Report
Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Action	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Land disturbance	A Control of Erosion and Sediment (CES) Plan and a Work Plan must be prepared for any activities that involve the alteration of ground or soil conditions that have not been specifically excluded.	Disturbance of more than 40 cubic meters of soil during construction activity	Puerto Rico Regulation 5754.1230(B), (C)	3 and 4	Applicable	Remedial alternatives involve the disturbance of more than 40 cubic meters of soil. A CES and Work Plan will be prepared for this activity.
Production of Fugitive Dust	Dust control measures must be implemented during construction activities to prevent emissions beyond the property boundary. These include, but are not limited to, the use of water or other chemicals on road ways to control dust, covering haul trucks, and cleaning tracked soil off of paved roads.	Construction activity causing particulate matter to become airborne	Puerto Rico Regulation 5300.404(A)(2), (4), (7); (B)	2, 3, and 4	Applicable	Applicable to activities that produce fugitive dust. Dust control measures will be implemented.
Performing construction activities that generate noise	No construction activity may be performed at night or in such a way that vibrations are produced that can be felt beyond the property boundary. If equipment used in construction is not manufactured in accordance with USEPA standards for newly manufactured equipment then it may not produce noise that exceeds 70 dBA.	Construction activity including earthwork	Puerto Rico Regulation 3418.3.1.5(A),(C);3.1.10; 3.1.13; and 4.1	2, 3, and 4	Applicable	The site is considered to be in Zone II (Commercial) for noise production. Noise pollution during MEC clearance and demolition, dewatering, and earthwork activities will be prevented.
Management of non-hazardous solid waste onsite in containers and piles	Non-hazardous solid waste staged onsite must not create a hazard or public nuisance.	Generation of non-hazardous solid waste that is managed onsite in containers or in piles.	Puerto Rico Non-Hazardous Solid Waste Regulation 531.H	2, 3, and 4	Applicable	It is anticipated that non-hazardous solid wastes will be generated during the implementation of these alternatives. IDW will be sampled to confirm characterization prior to disposal. It will be assumed that MDAS is regulated as scrap metal.

TABLE 9-2
Technology Screening Summary
UXO 18 Remedial Investigation/Feasibility Study
Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

General Response Actions	Remedial Technology	Process Options	Descriptions	Effectiveness	Implementability	Relative Cost	Retain	Reject
No Action	None	None	No active remedial action. This process option is retained to provide the basis for comparing active process options and technologies.	Not effective in protecting human health, as this does not include measures to reduce the potential for uncontrolled human exposure to any remaining MEC.	Unlikely to obtain regulatory or community acceptance.	Low	x	
Land Use Controls (LUCs)	Administrative Restrictions	LUCs (engineering and institutional controls)	LUCs issued for areas with potential presence of MEC. The Navy uses a Web-based management tool, LUC Tracker, as part of the Naval Installation Restoration Information System.	Effective in protecting in human health by educating recreational users, thereby reducing the potential for human contact with any remaining MEC.	Easy to implement. Access to the site can be deterred through restrictions placed on the island. In addition, access to the island from land requires swimming/paddling/boating to the island and encountering topography/landscape features (e.g., steep cliffs, shallow coral barrier) that manage trespassing (in addition to signs [see below]).	Low	x	
	Access Restrictions	Fences	Security fences installed and maintained to manage access to the island.	Effective in protecting human health by reducing the potential for human contact with MEC with physical barrier.	While technically possible to implement, fencing has not been found to be more effective than signage, would detracts from the aesthetic appeal of the island, and is not generally viewed favorably by the community.			x
	Access Restrictions	Signs and buoys	Warning signs and buoys installed and maintained to manage access to the island.	Effective in protecting human health by reducing the potential for human contact with MEC through education.	Easy to implement. Signs installed in areas where access to the island occurs (northern perimeter) and at adjacent Blue Beach.		x	
Containment	Engineered Cap	Asphalt, concrete, geomembrane, or clay cap	Installation of a physical barrier over MEC.	Effective in limiting potential for erosion to expose subsurface MEC. MEC will potentially remain onsite beneath cap.	Technically impractical to implement island-wide. Would require extensive vegetation clearing, surface MEC clearance, and transport of materials to the island by boat.	High		x
Removal	MEC Removal	MEC Removal	Removal of MEC from the ground surface and near surface.	Effective in reducing potential for exposure to MEC.	Moderate to difficult depending on whether it is done in localized, accessed areas or the island as a whole, the number of items encountered, and site conditions (e.g., vegetation, site access, etc.)	High	x	

Notes:
Effectiveness is the ability to perform as part of an overall alternative that can meet the objective under conditions and limitations that exist onsite
Implementability is the likelihood that the process could be implemented as part of the remedial action plan under the physical, regulatory, technical, and schedule constraints.
Relative cost is for comparative purposes only and it is judged relative to the other processes and technologies that perform similar functions.

SECTION 10

Development and Description of Remedial Alternatives

This section presents a description of remedial alternatives developed to meet the RAOs. Remedial alternatives were developed by assembling remedial technologies and representative process options after the initial screening process. Remedial alternatives were developed based on site-specific considerations primarily related to the nature of the MEC and site physical characteristics. Cost estimates for each remedial alternative are provided in **Appendix G.**

The following three remedial alternatives were developed to address the explosive hazard with MEC:

- Alternative 1— No Action
- Alternative 2— Land Use Controls and MEC Inspections
- Alternative 3— Limited MEC Removal, Land Use Controls, and MEC Inspections
- Alternative 4— MEC Removal, Land Use Controls, and MEC Inspections

A detailed description of each of these alternatives is provided below.

10.1 Alternative 1 – No Action

Alternative 1 is required by the NCP to be retained throughout the FS process as a baseline for comparison to the other approaches. No Action means that no remedial actions or process options would be implemented, and no attempt would be made to meet the RAOs.

The components and assumptions of Alternative 1 are the following:

- The site would remain in its current condition.
- Access to the site is currently discouraged by signage along the perimeter of the island and the beach access points of the nearby recreational beach (Blue Beach); however, no capital or operation and maintenance (O&M) activities would be involved, and the restrictions in place would not be monitored, maintained, or replaced.

Alternative 1 does not meet the RAOs as there is no mechanism in place to monitor the hazard warning signs on island and at Blue Beach and to repair or replace as necessary. Although the explosives hazard of MEC to authorized site workers and recreational users was reduced by the detonations of the MEC previously identified, the alternative does not include the means to continue discouraging access.

10.2 Alternative 2 – Land Use Controls and MEC Inspections

Alternative 2 involves using LUCs to reduce the potential explosive hazard by reducing the potential for unauthorized access to the site. Implementation of the LUCs would be in general accordance with USEPA published guidance for CERCLA and Resource Conservation and Recovery Act (RCRA) response actions (USEPA, 2000). The conceptual layout of Alternative 2 is shown in **Figure 10-1.** It should be noted that the signs displayed in **Figure 10-1** are conceptual. The actual sign language and graphics would be presented in the remedial action work plan.

The major components and assumptions for Alternative 2 are:

- MEC surface clearance has already been performed on the accessible area (relatively sparsely vegetated) of Cayo La Chiva. In addition, because only a thin veneer of soil is present across the island, it is unlikely any MEC could be present in the subsurface.
- Maintaining physical barriers (i.e., signage on island, Blue Beach, and Punta Galintez) and implementing institutional controls (ICs such as a deed notation to restrict future access). The LUCs would provide the ability for land use management with UXO support as necessary (e.g., anomaly avoidance under the direction of a qualified UXO technician) and to optimize any long-term monitoring (LTM) program, while deterring any use not approved for the site (e.g., trespassing, uncontrolled construction, etc.). Once the actual land use is determined, the details of LUCs will be presented in a work plan for their implementation.
- For the purposes of the FS, it is assumed that 5 signs on island and 19 signs on Blue Beach and Punta Galintez would be maintained. The actual number of signs would be included in the LTM work plan provided for regulatory review and approval.
- An LTM program would be established, including periodic site inspections to observe any indications of trespassing, repair any damage to signage, replace any missing or significantly damaged signage, and identify and remove any MEC that may have been exposed at the surface within any trespassing routes observed. For the purposes of the FS, it is assumed that site inspections would be conducted annually to inspect the signs and potential trespassing routes for a period of 30 years. The actual frequency and duration of LTM would be included in the LTM work plan provided for regulatory review and approval and would be based on such factors as remaining potential presence of MEC, site conditions, climatic conditions, etc.
- Five-year reviews (for an assumed 30 years) would be performed for periodic evaluation of the effectiveness of the LUCs.

10.3 Alternative 3 – Limited MEC Removal, Land Use Controls, and MEC Inspections

Alternative 3 consists of limited additional surface and subsurface MEC removal (up to about 1 ft bgs based on shallow depth of bedrock) throughout UXO 18 to support potential future recreational uses. The planned future recreational use of Cayo la Chiva is currently not known; however, it is assumed that recreational use could consist of beach access, interpretive trails, and an observation tower. Because this type of land use is hypothetical and locations of potential recreational features are not known, there is no figure associated with this alternative.

The surface and subsurface MEC removal component includes surface MEC removal from the areas that are currently free of vegetation and accessible by people accessing the island (assumed approximately 1 acre) and MEC removal to a depth of 1 ft bgs from an additional approximate 1 acre of UXO 18 to accommodate recreational use of the beaches and trails and installation of the observation tower. The depth of 1 foot was assumed for this alternative because bedrock across the site is generally found within this interval, because it is consistent with the likely maximum depth of uncontrolled disturbance by recreational users and trespassers, and because it provides a margin of safety for potential exposure of MEC from soil erosion. The LUCs and LTM for this alternative would the same as described in Alternative 2, since it is possible MEC would remain at the site.

The MEC removal would follow similar approaches to those used for the MEC removal actions throughout the former VNTR and NASD, including mobilization and demobilization, archaeological survey (as necessary), vegetation clearance, subsurface anomaly detection and investigation using hand-held detectors (mag and dig up to about 1 ft bgs), MEC removal, and demilitarization of recovered MEC items.

The major components and assumptions for Alternative 3 are:

- Vegetation clearance with anomaly avoidance support be conducted to establish the interpretive trails and facilitate the MEC removal activities; the actual layout and dimensions of the trail, as applicable, will be provided by the land owner prior to the execution of this alternative.
- A technology-aided MEC removal would be conducted using mag-and-dig techniques to remove potential MEC/MPPEH from the ground surface and up to 1 ft bgs in the subsurface. Subsurface anomalies may comprise a combination of MEC, range related debris (RRD), MD, trash, and rocks with a high iron content. Therefore, the number of anomalies may be considerably higher than the actual number of MEC. For the purposes of the Alternative 3 cost estimate, it is assumed there are 50 anomalies per acre. This assumption is based on subsurface anomaly densities observed at nearby Blue Beach and PAOC EE.
- Site restoration will consist of backfilling excavation holes with excavated soils following the MEC removal activities. Since the trails and tower area will be used for future recreational activities, these areas will not be subject to any active planting or other restoration by the Navy.
- Biological and archaeological surveys may need to be completed at UXO 18 prior to any vegetation clearance and MEC removal activities. If necessary, the surveys would be conducted to protect sensitive or threatened and endangered flora and fauna and to ensure that the work does not negatively impact a known archaeological site on the island.
- LUCS would be implemented/maintained as described in Alternative 2.
- An LTM program would be implemented similar to that as described in Alternative 2, and the area requiring inspection would consist of the beaches, the trails, and area immediately surrounding the tower, as well as any trespassing routes observed away from the trails.
- Five-year reviews (for an assumed 30 years) would be required as described in Alternative 2.

As summarized in Section 3.4, it is possible that a significant portion of the island may be considered a cultural resource. As a result, it is assumed that in order to fully address the explosive hazard associated with potential MEC within the areas to be addressed and to be protective of the cultural resource, the MEC removal activities in this area will take place under the supervision of an archaeologist.

10.4 Alternative 4 – MEC Removal, Land Use Controls, and MEC Inspections

Alternative 4 consists of surface and subsurface MEC removal (up to about 1 ft bgs based on shallow depth of bedrock) throughout UXO 18, the implementation of LUCs, and LTM to monitor their effectiveness and identify changes in site conditions that may increase the potential MEC hazards. The conceptual layout of Alternative 4 is shown in **Figure 10-2**.

The surface and subsurface MEC removal component includes MEC removal to a depth of 1 ft bgs over the entire area of UXO 18, with the exception of the inaccessible portions of the site (i.e., cliffs). The depth of 1 foot was assumed for this alternative because bedrock across the site is generally found within this interval, because it is consistent with the likely maximum depth of uncontrolled disturbance by recreational users, and because it provides a margin of safety for potential exposure of MEC from soil erosion. The LUCs and LTM for this alternative would the same as described in Alternative 2, since it is possible MEC would remain even after performing MEC removal.

The MEC removal would follow similar approaches to those used for the MEC removal actions throughout the former VNTR and NASD, including mobilization and demobilization, archaeological survey, vegetation clearance,

subsurface anomaly detection and investigation using hand-held detectors (mag and dig up to about 1 ft bgs), MEC removal, demilitarization of recovered MEC items, and site restoration.

The major components and assumptions for Alternative 4 are:

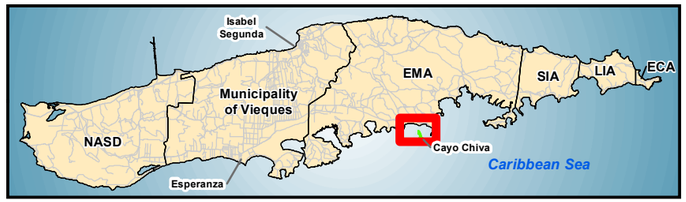
- Vegetation clearance with anomaly avoidance support would be required for the entire vegetated portion of the terrestrial area to ensure vegetation does not obstruct the ability to perform island-wide MEC removal (i.e., visual inspection, instrument use, anomaly removal).
- A technology-aided surface removal (i.e., magnetometer) would be conducted to remove MEC exposed at and near the ground surface. Subsurface anomalies may comprise a combination of MEC, RRD, MD, trash, and rocks with a high iron content. Therefore, the number of anomalies may be considerably higher than the actual number of MEC. For the purposes of the Alternative 4 cost estimate, it is assumed there are 50 anomalies per acre. This assumption is based on subsurface anomaly densities observed at nearby Blue Beach and PAOC EE.
- Site restoration will consist of backfilling of excavation holes with excavated soils following the MEC removal activities and restoration of the subtropical dry forest area(s) on the island. It is assumed that a Navy contractor will be hired to establish a greenhouse for starting plants prior to planting them on the island with anomaly avoidance support. In addition, it is assumed that a native grass/wildflower mix will be spread across the island to help retain/fix the soil as the planted trees and shrubs grow and mature.
- Biological and archaeological surveys may need to be completed at UXO 18 prior to any vegetation clearance and MEC removal activities. If necessary, the surveys would be conducted to protect sensitive or threatened and endangered flora and fauna and to ensure that the work does not negatively impact a known archaeological site on the island.
- LUCS would be implemented/maintained as described in Alternative 2.
- An LTM program would be implemented similar to that as described in Alternative 2, but the area requiring inspection would likely be significantly larger due to the complete vegetation removal across the island leading to increased areas that would be publicly accessible as the planted vegetation re-establishes itself on the island.
- Five-year reviews (for an assumed 30 years) would be required as described in Alternative 2.

As summarized in Section 3.4, it is possible that a significant portion of the island may be considered a cultural resource. As a result, it is assumed that in order to fully address the explosive hazard associated with potential MEC at the island and to be protective of the cultural resource, the MEC removal activities in this area will take place under the supervision of an archaeologist.

(\\mnustrictgfs01\ctg$\projects) R:\USNavFacEngCom405450\Vieques\MapFiles\UXO_18_Remedial_Investigation_Feasibility_Study\Figure 10-1 - Alternative 2 – Land Use Controls and MEC Inspections.mxd5/7/2014

Legend

- Access Restriction Sign
- Cayo la Chiva Warning Sign
- UXO 18 Boundary



N
W E
S

0 500 1,000
Feet

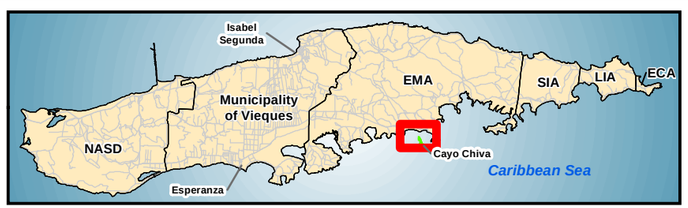
Figure 10-1
Alternative 2 – Land Use Controls and MEC Inspections
UXO 18 Remedial Investigation/Feasibility Study
Former Atlantic Fleet Weapons Training Area – Vieques
Vieques, Puerto Rico

CH2MHILL®

R:\USNavFacEngCom405450\Vieques\MapFiles\UXO_18_Remedial_Investigation_Feasibility_Study\Figure 10-2 - MEC Removal Land Use Controls and MEC Inspections.mxd 2/12/2015 JCarr_ch2mhillenvgis

Legend

- Access Restriction Sign
- Cayo la Chiva Warning Sign
- Surface and Subsurface MEC Removal Area



N
W E
S

0 500 1,000
Feet

Figure 10-2
Alternative 4 - MEC Removal, Land Use Controls, and MEC Inspections
UXO 18 Remedial Investigation/Feasibility Study
Former Atlantic Fleet Weapons Training Area – Vieques
Vieques, Puerto Rico

CH2MHILL

SECTION 11

Detailed Analysis of Remedial Alternatives

This section presents a detailed analysis of the remedial alternatives developed in Section 10. The detailed analysis of remedial alternatives follows the methodology outlined in the NCP. Alternatives are then compared against one another to highlight differences and preferential characteristics.

11.1 Evaluation Criteria

CERCLA guidance requires evaluation of each alternative against nine criteria listed in 40 Code of Federal Regulations (CFR) 300.430(e)(9). Criteria were published in the March 8, 1990, *Federal Register* (55 FR 8666), as a basis for comparing relative performance, implementability, and cost of alternatives. This approach is intended to provide sufficient information for comparison of alternatives, and for selection of the most appropriate site-specific remedial action. Evaluation criteria are listed below:

1. Overall protection of human health and the environment
2. Compliance with ARARs
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, and volume through treatment
5. Short-term effectiveness
6. Implementability
7. Cost
8. Community acceptance
9. State/Commonwealth acceptance

The first two categories from the above list are mandatory criteria for an alternative's consideration, and are referred to as *threshold criteria*. However, alternatives which do not satisfy ARAR requirements *can* be considered if a specific ARAR waiver is granted. The next five categories are the primary criteria upon which the detailed analysis is based, and are referred to as "balancing criteria." The remaining two evaluation categories are considered *modifying criteria* that are to be evaluated following the public comment process. The FS evaluates the remedial alternatives against the first seven criteria, which are defined below.

11.1.1 Threshold Criteria

Threshold criteria are standards that an alternative must meet to be eligible for selection as a remedial action. There is little flexibility with meeting the threshold criteria—the alternative must meet them or it is unacceptable, unless a waiver is obtained from an ARAR where one or more site exceptions defined in the NCP occur.

- **Overall Protection of Human Health and the Environment.** Protectiveness is the main requirement that remedial actions must meet under CERCLA. It is an assessment of whether an alternative achieves and maintains adequate protection of human health and the environment. A remedy is protective if it eliminates, reduces, or controls potentially unacceptable risks posed by the site through each exposure pathway. The RAOs are established based on protectiveness.
- **Compliance with ARARs.** Compliance with ARARs is one of the statutory requirements of remedy selection. This criterion is used to determine whether the alternatives would meet the pertinent applicable federal, state (commonwealth), and local ARARs identified in Section 9.

11.1.2 Balancing Criteria

Unlike threshold criteria, the five balancing criteria detailed below weigh trade-offs between alternatives. A low rating on one balancing criterion may be compensated by a high rating on another. Balancing criteria represent principles upon which the detailed evaluation and comparative analysis of alternatives is based.

- **Long-term Effectiveness and Permanence.** CERCLA emphasizes selection of remedies which ensure both short- and long-term protection of human health and the environment. This criterion evaluates residual risks or hazards that may persist after implementation of a remedial action. Assessment includes evaluation of the adequacy and reliability of controls. Factors considered appropriate include the following:
  - Magnitude of residual risks or hazards as a result of untreated waste, byproducts, or following conclusion of remedial activities. Degree of residual hazards, primarily the volume with respect to MEC, is considered.
  - Adequacy and reliability of controls necessary to manage untreated waste. Evaluation considers long-term protection from residuals, potential technical modifications that may be required, and potential hazards posed by the modifications.
- **Reduction of Toxicity, Mobility, and Volume through Treatment.** This criterion addresses the statutory preference for remedies that employ treatment to significantly reduce the toxicity, mobility, or volume of the hazardous substances. That preference is satisfied when treatment is used to reduce the principal threats at a site by reducing the total volume of affected media. This criterion is specific to evaluating only how the treatment reduces toxicity, mobility, and volume. It does not address containment actions such as capping or covering.
- **Short-term Effectiveness.** This criterion addresses short-term impacts of the remedial alternatives by examining the effectiveness of alternatives in protecting human health and the environment during construction and implementation activities. Short-term impacts include runoff, dust, vapor, access issues, traffic, potential spills, noise and other byproducts of construction and remedy implementation, until response objectives are achieved. Short-term effects are evaluated against the following considerations:
  - Short-term risks that might be posed to the community during implementation of an alternative.
  - Potential impacts to workers during remedy implementation, including effectiveness and reliability of protective measures, with consideration of the accident risk calculated by SiteWise™.
  - Potential environmental effects (i.e., SiteWise™ environmental footprint calculation) from remedy implementation, including effectiveness and reliability of mitigation measures.
  - Timeframe for implementation and achieved protection.
- **Implementability.** This criterion evaluates technical and administrative feasibility of an alternative, to include availability of materials and services required for implementation. Implementability is evaluated per the following factors:
  - Technical feasibility, including difficulties and unknowns associated with construction, operation, technological reliability, ease of undertaking additional remedial actions, and ability to monitor remedial effectiveness.
  - Administrative feasibility, including coordination activities, ability and time required for necessary approvals, and issuance of required permits.
  - Availability of services and materials, as applicable, including: adequate offsite treatment, storage, and disposal capacity; necessary equipment, specialists, manpower, and provisions; prospective and emerging technologies.
- **Cost.** For the detailed cost analysis of alternatives, the expenditures required to complete each measure are estimated in terms of both capital and annual O&M costs. Given these values, a present-worth calculation for each alternative can be calculated for comparison. The cost estimates in this section provide an accuracy of –30 to +50 percent. Costs are projected for a period of 30 years or required remedial duration in

accordance with *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (USEPA, 2000b).

Selection of specific technologies utilized in alternative configurations is not intended to limit final design options, but rather provides a baseline for cost estimation. Final cost, and resultant feasibility, depends on actual labor and material costs, competitive market conditions, site conditions, project scope, implementation schedule, contracted design, and other variables. Due to these factors, project feasibility and funding needs must be reviewed carefully before specific financial decisions are made, to help ensure proper evaluation, budget, and adequate funding. Specific details and cost estimates may need to be refined during final remedial design, as applicable.

11.1.3 Modifying Criteria

The following criteria modify selection of recommended alternatives:

- **Community Acceptance.** This assessment includes determination of public opinion, support of, and/or opposition to components of remedial options.
- **State (Commonwealth) Acceptance**. State (commonwealth) concerns taken into consideration include the following:
  - The state's (commonwealth's) position and key interests related to alternatives
  - State (commonwealth) comments on ARARs (or proposed waivers)

Modifying criteria are evaluated following public comment, and as result, community and state (commonwealth) acceptance is not addressed in this FS. State (commonwealth) acceptance and community acceptance criteria will be evaluated by addressing comments received after the public has reviewed site documents [e.g., Proposed Plan]. This evaluation will be presented in the Responsiveness Summary of the ROD.

The following subsections evaluate remedial alternatives against the first seven criteria described above. Sufficient detail is incorporated into the analysis to understand significant aspects of each alternative, and to identify associated uncertainties.

11.2 Detailed Evaluation of Remedial Alternatives

The three remedial alternatives were evaluated in detail using the seven evaluation criteria described in Section 4.1. The detailed evaluation is summarized in **Table 11-1** in a reader-friendly, side-by-side format and are not duplicated within the text. The text in the remainder of Section 11 focuses on the key differences between the alternatives.

Detailed cost estimates of the remedial alternatives are provided in **Appendix H**, which breaks down the estimated capital, annual O&M, and net present value (NPV), calculated based on a 3.8 percent discount rate for 30 years, as applicable. The discount rate was selected based on the Federal Office of Management and Budget (http://www.whitehouse.gov/sites/default/files/omb/assets/a94/dischist-2012.pdf). The alternative cost estimates are in 2014 dollars, based on RS Means and engineer's estimates for similar projects.

11.3 Comparative Evaluation of Remedial Alternatives

This subsection evaluates the relative performance of each remedial alternative against the specific evaluation criteria. A qualitative comparative analysis was conducted for each remedial alternative relative to one another based on each of seven NCP criteria, as shown in **Tables 11-2**. The purpose of this analysis is to score the relative advantages and disadvantages of each remedial alternative in order to support the selection of the recommended remedial alternative. The comparative analysis focuses on factors that provide distinctions between the remedial alternatives.

11.3.1 Overall Protection of Human Health and the Environment

Alternatives 2, 3, and 4 are protective of human health and the environment because they reduce the explosive hazard associated with MEC potentially present at the site. Alternatives 3 and 4 assume additional MEC would be found and destroyed following the removal of some or all vegetation on the island, respectively; however, the industry standard assumption is that some MEC may be left behind. As noted previously, high concentrations of MEC are not expected to be present based on previous surveys. Compared to Alternatives 2 and 3, Alternative 4would result in a significantly higher impact on the environment through complete vegetation clearance and potential land disturbance. Alternative 4 and, to a lesser degree, Alternative 3 also increase the risk of short term soil erosion and runoff into the adjacent Bahia de la Chiva; site restoration activities included in Alternative 4 will reduce the long-term erosion impacts to the site through planting appropriate native vegetation.

Alternative 1 is not adequately protective of human health and the environment because it would not maintain LUCs to reduce the potential for uncontrolled human contact with potential MEC.

11.3.2 Compliance with ARARs

Table 9-1 presents a compilation and evaluation of state (Commonwealth) and federal chemical-specific, location-specific, and action-specific ARARs. Each alternative complies with the ARARs.

11.3.3 Long-Term Effectiveness and Permanence

All three alternatives provide good long-term effectiveness and permanence, primarily because few MEC are anticipated on the island, contact with them is unlikely, and LUCs and LTM in common to all alternatives will be effective at reducing the long-term explosive hazard. Because the previous investigations identified a low number of scattered MEC (that were subsequently addressed), it is anticipated any MEC remaining at the site is sporadic and in areas less accessible.

While at first glance, it may appear that Alternatives 3 also 4 provide a lower magnitude of residual risk because they involve additional MEC removal, as noted previously, it is anticipated that there is very little remaining MEC and that they would be in relatively inaccessible areas. Therefore, the reduction in magnitude of residual risk associated with Alternatives 3 and 4 is negligible compared to Alternative 2. The assertion that there will be a marginal decrease in residual risk associated with access to the island through Alternatives 3 and 4 is supported by the fact that there have only been 5 MEC identified on the island to date despite numerous site visits, site inspections covered the accessible portion of the island, the thin soil veneer indicates subsurface MEC is highly unlikely, and there are no known or documented live fire training activities that occurred at the site (so the presence of five items of the same kind is likely the result of a single event). Further, it is highly likely that additional clearance activities (i.e., visual sweep, anomaly identification) would be needed to support recreational use of the island. Anomaly avoidance would be conducted during construction of recreational features such as trails and observations tower(s), but it is likely that little or no additional MEC would be found.

With the implementation of LUCs and establishment of an LTM program, Alternatives 2, 3, and 4 all provide excellent reliability of controls. However, the controls are the most effective when coupled with the MEC removal actions described in Alternatives 3 and 4, with the reliability of the controls increasing proportionally with the amount of area being cleared of MEC. As such, within this excellent reliability of controls for Alternatives 2, 3, and 4, Alternative 4 will have the highest ranking, with Alternatives 3 and 2 having decreasing reliability (in that order).

Alternative 1 does not achieve long-term effectiveness as there are no long-term measures that would be maintained to control exposure to the potential explosive hazard.

It is important to note that in the absence of vegetation with such a thin veneer of soil above bedrock, as would exist under Alternative 4, even with erosion control measures in place, it would not take much soil erosion to

potentially permanently alter the ability for vegetation to grow, thereby potentially limiting the ability for restoration to be effective.

It is noted that all of the remedial alternatives result in the potential for MEC to remain at the site and, therefore, require 5-Year Reviews to evaluate remedy effectiveness. In addition, LTM would be conducted to continually evaluate the potential presence of MEC within accessed areas of the site to ensure the selected remedy remains protective of human health.

11.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment

As noted previously, MEC was removed from the accessible portions of Cayo La Chiva. Alternative 2 will remove MEC found during any future LTM (i.e., in areas accessed by recreational users and exposed by erosion). Alternative 3 will remove MEC found during construction of trails and observation tower (little or none anticipated as noted previously) and any MEC found during future LTM, as for Alternative 2. Alternative 4 will remove MEC found during island-wide clearance (little anticipated as noted previously) and any MEC found during future LTM, as for Alternative 2. Therefore, all three alternatives have similar reduction of toxicity, mobility, or volume through treatment. However sporadic and infrequent MEC are expected to exist at the site, it is anticipated that the reduction in toxicity, mobility, and volume through treatment will increase proportionally with the amount of area cleared of MEC. As such, Alternative 4 will have the highest ranking, with Alternatives 3 and 2 having decreasing reliability (in that order) with respect to this criterion. It should be noted however, that exposing the soil through vegetation clearance may enhance erosion and actually increase mobility of any subsurface MEC. The existing vegetation is the best mechanism to retain the stabilization effects of soil.

11.3.5 Short-Term Effectiveness

Alternative 2 achieves the greatest degree of short-term effectiveness, balancing protection of the community during remedial actions, protection of workers during remedial actions, environmental impacts, and the time until RAOs are achieved. Because each of these criteria varies for Alternative 2 in comparison to the other Alternatives, the short-term effectiveness is discussed for each criterion in the following bullets rather than for short-term effectiveness as a whole.

- Alternatives 2, 3, and 4 are similarly protective of the community during the remedial action. Alternative 2 involves maintaining signs at locations where signs have already been installed; therefore, the implementation of Alternative 2 would not have short-term impacts on the community (unless MEC is found during LTM). Alternatives 3 and 4 would have larger impacts on the community, as they may result in temporary closure of Blue Beach while any MEC found during limited or island-wide MEC removal is destroyed through open detonation.
- Alternative 2 would result in significantly lower construction worker impacts than Alternatives 3 and 4 because Alternative 2 involves only sign maintenance (and potentially MEC removal during LTM, which is in common to Alternatives 2, 3, and 4). Alternatives 3 and 4 include vegetation and MEC removal on the island. Working with potentially live munitions is the main hazard to workers during the implementation and is a major factor (along with environmental footprint) for why Alternatives 3 and 4 score lower than Alternative 2 for short-term effectiveness; given the areas being addressed, Alternative 4 will present a higher hazard to workers than Alternative 3 since a much larger area would be addressed and result in the higher potential for exposure to MEC. The worker hazard would be managed through the use of qualified personnel (e.g., UXO technicians) and implementation of applicable safety requirements for handling, storage, and demolition/demilitarization of MEC. All exclusion areas where removal is taking place would be restricted for explosive safety purposes and only authorized personnel would be allowed in the exclusion zone. Noise and dust generation from MEC demilitarization is a short-term concern for the workers, but would be managed through a health and safety program. An additional hazard to workers during implementation is

working in rough terrain in a tropical and vegetated climate, which also would be managed through established health and safety program.

- Alternative 2 has essentially no impact to the physical environment of the island since the only vegetation clearance would be associated with keeping vegetation from obscuring the signs. Because vegetation clearance across the island would be performed as part of Alternative 4, it has a very high impact on the island's physical environment relative to the other alternatives and also has the potential to cause runoff to the surrounding bay. Erosion control measures could be implemented to reduce the potential for runoff to reach the bay, but hurricanes or severe rains would overwhelm even the best erosion control measures. In addition, in the absence of vegetation with such a thin veneer of soil above bedrock, as would exist under Alternative 4, even with erosion control measures in place, it would not take much soil erosion to potentially permanently alter the ability for vegetation to grow, thereby potentially limiting the ability for restoration to be effective.
- A sustainability analysis of Alternatives 2, 3, and 4 was conducted using the SiteWiseTM tool (see Appendix G). Alternative 2 would have a low environmental footprint in terms of projected GHG emissions and energy consumption. Alternatives 3 and 4 include activities during the initial MEC clearance activities, and the travel for site inspections over the estimated 30-year LTM period lead. The environmental footprint associated with Alternative 3 is less than Alternative 4 because it includes a smaller area subject to the initial MEC clearance activities and LTM inspections.
- Alternative 2 could be implemented immediately after a ROD is finalized because it is mostly administrative. Alternatives 3 and 4 would take approximately 7 to 9 months to achieve the RAOs because of their increased field effort.

11.3.6 Implementability

While Alternative 1 is technically implementable, gaining regulatory acceptance is unlikely because of the potential MEC that may remain on site and the lack of means to control exposure to them through this alternative. Therefore, the implementability of this alternative is the lowest.

Alternative 2 is the most implementable alternative because it is technically and administratively feasible and the services, equipment, and materials required to execute the alternative are readily available.

Alternatives 3 and 4 would be moderately more difficult to implement than Alternative 2. The resources and technologies to implement the required vegetation removal MEC clearance activities are commonly used and available. However, access to the site is logistically more difficult because it is an island, and erosion and sediment controls must be installed and maintained to manage increased runoff from the site due to the remedial action. The implementability of Alternatives 3 and 4 are also impacted by the cultural resource identified on site, which is expected to be of significant size, and the implementability of Alternative 4 is further impacted by the re-vegetation of the subtropical dry forest. Alternative 4 has a low administrative feasibility score because it may not be widely favored due its destruction of the vegetation on the island and the potential for runoff (if sediment controls are breached) to impact the surrounding waters.

11.3.7 Cost

Alternative 2 is the most cost effective with a present-worth cost of $2,079,000. The present-worth cost of Alternative 3 is $3,090,000 and the present-worth cost of Alternative 4 is $5,444,000.

The cost estimates, provided in **Appendix H,** are rough order of magnitude estimates (+50 percent/-30 percent level accuracy) that have been developed strictly for comparing the remedial alternatives. The final costs of the project and the resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, the implementation schedule, and other variables. Therefore, final project costs may vary from the cost estimates. Because of these factors, project feasibility and

funding needs should be reviewed carefully before specific financial decisions are made or project budgets are established to help ensure proper project evaluation and adequate funding.

TABLE 11-1
Detailed Evaluation of Remedial Action Alternatives
UXO 18 Remedial Investigation/Feasibility Study
Atlantic Fleet Weapons Training Area - Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Land Use Controls and MEC Inspections	Alternative 3 Limited MEC Removal, Land Use Controls, and MEC Inspections	Alternative 4 MEC Removal, Land Use Controls, and MEC Inspections
Overall Protection to Human Health and the Environment				
Reduce explosive hazard associated with MEC to be compatible with current and future land use and reduce the potential for unauthorized access to the site.	Will not meet RAOs. No reduction in risk of exposure to MEC for areas not inspected during previous investigations. No monitoring would occur to determine if warning signs are operational and if MEC has been exposed through erosion.	This alternative will meet RAOs because the previous work removed MEC from accessible areas and LUCs/LTM will discourage trespasser access and remove any MEC found due to erosion.	This alternative will meet RAOs because previous work removed MEC from accessible areas and additional MEC removal (if present) from the ground surface and near surface in areas with an intended future recreational use will be conducted and LUCs/LTM will guide access and remove any MEC found due to erosion.	This alternative will meet RAOs because it removes any remaining MEC from the ground surface and near surface across the entire island, implements LUCs to discourage site access with a monitoring program to perform MEC inspections (and removal if found) in accessed areas and ensure warning signs are operational.
Compliance with ARARs				
Location-specific ARARs	Complies with ARARs.	Complies with ARARs.	Complies with ARARs.	Complies with ARARs.
Action-specific ARARs	Not applicable. No action-specific ARARs.	Complies with ARARs.	Complies with ARARs.	Complies with ARARs.
Chemical-specific ARARs	Not applicable. No chemical-specific ARARs.	Not applicable. No chemical-specific ARARs.	Not applicable. No chemical-specific ARARs.	Not applicable. No chemical-specific ARARs.
Long-Term Effectiveness and Permanence				
Magnitude of Residual Risks	Because the previous investigations identified a low number of scattered MEC (that were subsequently removed), it is anticipated any MEC remaining at the site is sporadic and in areas less accessible. Therefore, the magnitude of residual risk is low.	Because the previous investigations identified a low number of scattered MEC (that were subsequently removed), it is anticipated any MEC remaining at the site is sporadic and in areas less accessible. Therefore, the magnitude of residual risk is low.	As noted previously, it is anticipated that there is very little remaining MEC and that they would be in relatively inaccessible areas. Therefore, the reduction in magnitude of residual risk associated with Alternative 3 is negligible compared to Alternative 2.	As noted previously, it is anticipated that there is very little remaining MEC and that they would be in relatively inaccessible areas. Therefore, the reduction in magnitude of residual risk associated with Alternative 4 is negligible compared to Alternative 2.
Adequacy and Reliability of Controls	Because there would be no LUCs or LTM, adequacy and reliability of controls would be insufficient.	LUCs would reliably reduce the potential for exposure to MEC through educational signs. Monitoring and maintenance of signs and periodic inspections of the accessed portions of the island to ensure MEC is not exposed through erosion will ensure the LUCs provide sufficient controls.	Same as Alternative 2.	Same as Alternative 2.
Reduction of Toxicity, Mobility, or Volume through Treatment				
Reduction of Toxicity, Mobility, or Volume through Treatment	None due to no active remediation.	Amount of reduction would be based on whether MEC is found during periodic inspections of accessed areas.	Higher than Alternative 2 due to additional MEC removal from recreational areas (although little additional MEC is anticipated based on previous findings); however lower Alternative 4.	Highest for alternatives due to potential additional MECremoval across island (although little additional MEC is anticipated based on previous findings).
Short-Term Effectiveness				
Short-term Risks to Workers During Remedial Action	Not applicable.	Implementation of Alternative 2 would be very safe because it would not involve exposure of workers to MEC and could be managed with UXO avoidance support and normal health and safety procedures.	Relative to Alternative 2, implementation of MEC clearance from recreational areas poses significantly higher safety hazards to workers due to physical hazards of vegetation clearance, transporting equipment to and from the island, and explosive and health hazards associated with any MEC identified. The hazards are less than those in Alternative 4 due to smaller area covered by the remedial action. These hazards could be managed with standard health and safety procedures, the use of qualified personnel (e.g., UXO technicians), and implementation of applicable safety requirements for handling, storage, and demolition/demilitarization of MEC.	Relative to Alternatives 2 and 3, implementation of island-wide MEC clearance poses significantly higher safety hazards to workers due to physical hazards of vegetation clearance, transporting equipment to and from the island, and explosive and health hazards associated with any MEC identified. These hazards could be managed with standard health and safety procedures, the use of qualified personnel (e.g., UXO technicians) and implementation of applicable safety requirements for handling, storage, and demolition/demilitarization of MEC.

TABLE 11-1
Detailed Evaluation of Remedial Action Alternatives
UXO 18 Remedial Investigation/Feasibility Study
Atlantic Fleet Weapons Training Area - Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Land Use Controls and MEC Inspections	Alternative 3 Limited MEC Removal, Land Use Controls, and MEC Inspections	Alternative 4 MEC Removal, Land Use Controls, and MEC Inspections
Short-term Risks to Community During Remedial Action	Not applicable.	Negligible; signs have already been installed and will only require maintenance and periodic replacement. Replacement of signs will not prevent the public from using the general area near the signs (Blue Beach and water surrounding Cayo la Chiva). Replacement posts can be installed practicing anomaly avoidance, thereby minimizing the potential for an explosive hazard.	Minimal; the general work area would be closed to the public during the MEC removal activities, including reducing access to Blue Beach and the water surrounding Cayo la Chiva. Potential impacts, including explosive hazard, noise, and residue dust from munitions detonated, would be minimized using standard controls. Minimal impact to the community from traffic to transport materials to the site.	Minimal; the general work area would be closed to the public during the MEC removal activities, including reducing access to Blue Beach and the water surrounding Cayo la Chiva. Potential impacts, including explosive hazard, noise, and residue dust from munitions detonated, would be minimized using standard controls. Minimal impact to the community from traffic to transport materials to the site.
Potential environmental impacts of remedial action and effectiveness and reliability of mitigation measures during implementation	None.	Minimal vegetation clearance to ensure signs are not obscured.	Moderate disturbance of land during construction activities (i.e., vegetation clearance, MEC clearance). Additionally, increased potential for runoff from island to surrounding waters. Erosion control measures would be implemented to reduce the potential for runoff to reach the bay. Areas addressed through this alternative would remain open for access, which may contribute to erosion.	Significant disturbance of land during construction activities (i.e., vegetation clearance, MEC clearance). Additionally, increased potential for runoff from island to surrounding waters. Erosion control measures would be implemented to reduce the potential for runoff to reach the bay. Site restoration activities (i.e., planting of appropriate native species) would encourage re-establishment of vegetation. However, in the absence of vegetation with such a thin veneer of soil above bedrock, as would exist under Alternative 4, even with erosion control measures in place, it would not take much soil erosion to potentially permanently alter the ability for vegetation to grow, thereby potentially limiting the ability for restoration to be effective.
Time until protection is achieved	Protection will not be achieved.	Immediate; permanent warning signs have been installed.	Immediate; permanent warning signs have been installed. Within an estimated 5 to 6 months vegetation and MEC clearance activities will be completed as well	Immediate; permanent warning signs have been installed. Within an estimated 7 to 9 months vegetation and MEC clearance activities will be completed as well. However, vegetation restoration could take years.
Environmental Footprint (In terms of GHG emissions and energy consumption; **Appendix G**)	Low.	Low (relative to the other alternatives).	Medium (relative to the other alternatives).	High (relative to the other alternatives).
Implementability				
Technical feasibility	Technically feasible.	Services and materials are readily available; easily implementable. Work of this type has been successfully performed on Vieques.	Services and materials are available but logistically more challenging than Alternative 2. Accessing the island will pose a daily challenge for transporting personnel and materials to the island. However, vegetation and MEC clearance work of this type has been successfully performed elsewhere on Vieques.	Services and materials are available but logistically more challenging than Alternative 3. Accessing the island will pose a daily challenge for transporting personnel and materials to the island. Significantly more erosion control measures necessary due to island-wide vegetation clearance.
Administrative feasibility. Future recreational use of the site is only possible (feasible) if the safety of future site users is adequately ensured.	Administratively impractical, so overall implementability is poor.	Feasible.	Feasible. Administratively practical, but challenges regarding long-term erosion control, visitor safety, and cultural resource protection may hinder widespread support. It is assumed that Alternative 3 will be accepted by the land owner, as it will help facilitate to-be-determined recreational uses of the island.	Although at first glance may appear administratively feasible, unlikely to receive widespread agency support due to the island-wide vegetation destruction, potential for significant erosion that could permanently alter the island ecosystem, and potential for runoff to affect the surrounding waters, especially given the low explosive hazard believed to currently exist. It is assumed that Alternative 4 will be accepted by the land owner, as it will help facilitate to-be-determined recreational uses of the island.

TABLE 11-1
Detailed Evaluation of Remedial Action Alternatives
UXO 18 Remedial Investigation/Feasibility Study
Atlantic Fleet Weapons Training Area - Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Land Use Controls and MEC Inspections	Alternative 3 Limited MEC Removal, Land Use Controls, and MEC Inspections	Alternative 4 MEC Removal, Land Use Controls, and MEC Inspections
Availability of services, equipment, and materials	Not applicable.	Readily available.	Readily available.	Munitions response services, equipment, and materials readily available; however, site restoration equipment and materials would have to be procured.
Cost				
Cost (See Tables H-1 through H-7 for Cost Breakdown)	$0	$2,079,000	$3,090,000	$5,444,000

TABLE 11-2
Comparative Analysis of Remedial Alternatives
UXO 18 Remedial Investigation/Feasibility Study
Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Criterion	Alternative 1 No Action	Alternative 2 Land Use Controls and MEC Inspections	Alternative 3 Limited MEC Removal, Land Use Controls, and MEC Inspections	Alternative 4 MEC Removal, Land Use Controls, and MEC Inspections
Threshold Criterion				
Overall protection of human health and the environment	✘	✓	✓	✓
Compliance with ARARs	✓	✓	✓	✓
Compliance with Chemical-Specific ARARs	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Compliance with Action-Specific ARARs	Not Applicable	✓	✓	✓
Compliance with Location-Specific ARARs	✓	✓	✓	✓
Balancing Criterion				
Long-term effectiveness and permanence	◒	◔	◔	◔
Magnitude of Residual Risk	◔	◔	◔	◔
Adequacy and Reliability of Controls	○	◒	◔	●
Reduction of toxicity, mobility, or volume through treatment	○	◒	◔	●
Treatment Process Used and Materials Treated	○	●	●	●
Amount of Hazardous Materials Destroyed or Treated	○	◒	◔	●
Degree of Expected Reductions in Toxicity, Mobility, and Volume	○	◒	◔	●
Degree to Which Treatment is Irreversible	○	●	●	●
Type and Quantity of Residual Remaining After Treatment	○	◔	◔	◔
Short-term effectiveness	○	●	◔	◕
Short-term Risks to Community During Remedial Action	Not Applicable	●	◔	◔
Short-term Risks to Workers During Remedial Action	Not Applicable	●	◒	◕
Environmental Impacts	●	●	◔	○
Time Until Remedial Action Objectives are Achieved	○	●	◔	◕
Implementability	○	●	◔	◕
Technical Feasibility	●	●	◒	◕
Administrative Feasibility	○	●	●	◕
Availability of Services, Equipment, and Materials	Not Applicable	●	●	◔
Cost (Total Present Value)	**$ -**	**$ 2,079,000**	**$ 3,090,000**	**$ 5,444,000**

Individual criterion scores: ○ not met ◕ poor ◒ satisfactory ◔ good ● excellent

✓ **criterion met**

✘ **criterion not met**

SECTION 12

Summary and Conclusions of FS

The FS evaluated remedial alternatives against the seven NCP criteria for potential MEC at UXO 18. The two modifying criteria (community and Commonwealth acceptance) will be evaluated following the Proposed Plan public comment period.

The following summaries and major conclusions based on information presented within the FS evaluation are intended to highlight the relative advantages/ disadvantages and key tradeoffs among the alternatives. These key tradeoffs coupled with risk management decisions will serve as the basis for the alternatives proposed in the proposed plan (and ultimately selected in the ROD):

- Alternative 1– *No Action* is not protective of human health and does not meet any of the Balancing Criteria. However, this alternative is used solely as a basis of comparison for the other alternatives.
- Alternative 2- *Land Use Controls and MEC Inspections* is protective of human health through discouraging access to the site and performing MEC inspections and removal (if found) in the areas observed to be accessed. Because only five isolated MEC have been identified on the island, this site has a relatively low explosive hazard associated with it. This alternative will allow the natural site features, predominantly dense vegetation, to remain uncut and serve as a deterrent to accessing much of the island. The LUC maintenance coupled with the LTM inspections and 5-year reviews will ensure that the LUCs are sufficiently deterring access to the site and verify that MEC is not exposed on the ground surface in the areas readily accessible.
- Alternative 3 – *Limited MEC Removal, Land Use Controls, and MEC Inspections* involves targeted vegetation and MEC removal from areas that are identified by the Land Administrator for future recreational use; because there is currently no documented plan for the island it is assumed the area will be approximately 1 acre. Because this alternative will promote public access to the island, restricted areas (including in areas where MEC removal has not been conducted and where cultural resources are located) will be subject to unintentional and intentional access. Therefore, any reduction in MEC hazard due to removal may be at least partially offset by increased accessibility to other areas on the island. Because MEC may still be present at the site following the MEC removal, the same LUCs, LTM, and 5-year reviews identified for Alternative 2 must be employed and maintained for Alternative 3. Compared with Alternative 2, Alternative 3 has a higher impact to the island's physical environment and potential exposure of cultural resources that would be mitigated to the extent possible during execution of this alternative.
- Alternative 4 - *MEC Removal, Land Use Controls, and MEC Inspections* involves significant vegetation removal and the potential for increased runoff to the surrounding bay. Further, until the vegetation re-establishes, there is the potential for increased public access to the island, including in areas where cultural resources are located. Therefore, any reduction in MEC hazard due to removal may be at least partially offset by increased accessibility. Because MEC may still be present at the site following the MEC removal, the same LUCs, LTM, and 5-year reviews identified for Alternatives 2 and 3 must be employed and maintained for Alternative 4. Compared with Alternative 2 and 3, Alternative 4 has a higher impact to the island's physical environment and potential exposure of cultural resources that would be mitigated to the extent possible during execution of this alternative.

SECTION 13

References

CH2M HILL. 2006. Final Munitions and Explosives of Concern Master Work Plan, Former Vieques Naval Training Range, Vieques, Puerto Rico. December.

CH2M HILL, 2007. Final East Vieques Background Soil Inorganics Investigation Report, Former Vieques Naval Training Range, Vieques, Puerto Rico. October.

CH2M HILL, 2008. Expanded Range Assessment and Phase II Site Inspection Work Plan, Former Vieques Naval Training Range, Vieques, Puerto Rico. September.

CH2M HILL, 2010a. Preliminary Inspection of Cayo La Chiva, Former Vieques Naval Training Range, Vieques, Puerto Rico. Technical Memorandum. January.

CH2M HILL. 2010b. Master Standard Operating Procedures, Protocols, and Plans, Environmental Restoration Program, Vieques, Puerto Rico. February.

CH2M HILL. 2010c. Master Ecological Risk Assessment Protocol for Vieques Environmental Restoration Program – Update 1 (Addendum). Draft. August.

CH2M HILL. 2013. Final Master Sampling and Analysis Plan East Vieques Terrestrial UXO Sites. Atlantic Fleet Weapons Training Area – Vieques, Former Vieques Naval Training Range, Vieques, Puerto Rico. April.

CH2M HILL. 2014. Time Critical Removal Action Work Plan for Munitions Response Site UXO 17, Potential Area of Concern (PAOC EE). April.

Chief of Naval Operations (CNO). 1999. Navy policy for conducting ecological risk assessments. Memorandum from Chief of Naval Operations to Commander, Naval Facilities Engineering Command. Ser N453E/9U595355. April 5.

Naval Facilities Engineering Command (NAVFAC). 2003. Navy guidance for conducting ecological risk assessments. http://web.ead.anl.gov/ecorisk/. February.

TEC. 2002. Environmental Assessment for Proposed Cessation of Navy and Marine Corps Training at Vieques Nav al Training Range (VNTR), Vieques Island, Puerto Rico. November.

U.S. Army Corps of Engineers (USACE). 2009. Interim Guidance 09-02, Implementation of Incremental Sampling (IS) of Soil for the Military Munitions Response Program. July. U.S. Environmental Protection Agency (EPA). 1989. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response. EPA/540/1-89/002. December.

USEPA. 1997. Exposure Factors Handbook. Office of Research and Development. EPA/600/P-95/002F. August.

USEPA. 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. EPA/540/G-89/004. October.

USEPA. 2000a. A Guide to Developing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. July.

USEPA. 2000b. Institutional Controls: A Site Manager's Guide to Identifying, Evaluating and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups. EPA 540-F-00-005. September.

USEPA. 2001. Risk Assessment Guidance for Superfund (RAGS); Volume I - Human Health Evaluation Manual (Part D, Standardized Planning, Reporting and Review of Superfund Risk Assessments). Final. December.

USEPA. 2004. Risk Assessment Guidance for Superfund, Volume I: HHEM (Part E, Supplemental Guidance for Dermal Risk Assessment). Final. EPA/540/R-99/005. July.

USEPA. 2008. Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites. EPA 542-R-08-002. April.

USEPA. 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). EPA-540-R-070-002. OSWER 9285.7.82. January.

USEPA 2012. EPA Federal Facilities Forum Issue Paper: Site Characterization for Munitions Constituents. EPA-505-S-11-001. January.

USEPA. 2014. Memorandum, Subject: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 6, 2014.

Appendix A
Data Validation Reports

VALIDATA
Chemical Services, Inc.
2634 Nutwood Trace, Duluth, GA 30097
(770) 232-0130
(770) 232-5082 (Fax)
www.datavalidator.com

DATA VALIDATION SUMMARY REPORT

COMPANY:	CH2M HILL, Inc.
SITE NAME:	East Vieques Terrestrial UXO Sites, Vieques Island, PR
CTO / PROJECT NO.:	CTO-0005 / 424191
CONTRACTED LAB:	APPL, Inc.
QA/QC LEVEL:	EPA Level IV
EPA SOW/METHODS:	SW-846
VALIDATION GUIDELINES:	*Master Sampling and Analysis Plan for East Vieques Terrestrial UXO Sites, Vieques Puerto Rico, Master SAP Addendum 2, USEPA Region II Modifications*
SAMPLE MATRICES:	Soil and Water
TYPES OF ANALYSES:	Semivolatile Organics (SVOA-Hexachloroethane only), Explosives, Perchlorate, Picric Acid, Total Metals, Total Hexavalent Chromium
SDG NUMBER:	70987

SAMPLES:

Client Sample #	Lab Sample #	Matrix	PAH	Explosives
VE-UXO18-01SS03-0001	AY81984	Soil	X	X
VE-UXO18-01SS02-0001	AY81985	Soil	X	X
VE-UXO18-01SS01-0001	AY81986	Soil	X	X
VE-UXO18-01SS01P-0001	AY81987	Soil	X	X
VE-UXO18-EB02-061313	AY81988	Water	X	X
VE-UXO18-01SS02-0001MS	AY81985MS	Soil	X	X
VE-UXO18-01SS02-0001MSD	AY81985MSD	Soil	X	X

Client Sample #	Lab Sample #	Matrix	Perchlorate	Picric Acid
VE-UXO18-01SS03-0001	AY81984	Soil	X	X
VE-UXO18-01SS02-0001	AY81985	Soil	X	X
VE-UXO18-01SS01-0001	AY81986	Soil	X	X
VE-UXO18-01SS01P-0001	AY81987	Soil	X	X
VE-UXO18-EB02-061313	AY81988	Water	X	X
VE-UXO18-01SS02-0001MS	AY81985MS	Soil	X	X

Client Sample #	Lab Sample #	Matrix	Perchlorate	Picric Acid
VE-UXO18-01SS02-0001MSD	AY81985MSD	Soil	X	X

Client Sample #	Lab Sample #	Matrix	Total Metals*	Total Hex. Cr
VE-UXO18-01SS03-0001	AY81984	Soil	X	X
VE-UXO18-01SS03-0001DL	AY81984DL	Soil	X	
VE-UXO18-01SS02-0001	AY81985	Soil	X	X
VE-UXO18-01SS02-0001DL	AY81985DL	Soil	X	
VE-UXO18-01SS01-0001	AY81986	Soil		X
VE-UXO18-01SS01P-0001	AY81987	Soil	X	X
VE-UXO18-01SS01P-0001DL	AY81987DL	Soil	X	
VE-UXO18-EB02-061313	AY81988	Water	X	X
VE-UXO18-01SS02-0001MS	AY81985MS	Soil	X	X
VE-UXO18-01SS02-0001MSD	AY81985MSD	Soil	X	X
VE-UXO18-01SS02-0001MD	AY81985MD	Soil		X

* - Total Metals consisted of 14 analytes reported from method 6010C and 8 analytes reported from method 6020A.

SUFFIX CODES: DL = DILUTION, MD = MATRIX DUPLICATE, MS = MATRIX SPIKE, MSD = MATRIX SPIKE DUPLICATE

DATA REVIEWER(S): Thomas B. Granat, Theresa Tipe

SECONDARY REVIEWER(S): Kevin C. Harmon, Amy L. Hogan

Data Qualifier Definitions

J	-	The associated numerical value is an estimated quantity.
J+	-	The associated numerical value is an estimated quantity, potentially biased high.
J-	-	The associated numerical value is an estimated quantity, potentially biased low.
R	-	The data are unusable (the compound/analyte may or may not be present). Resampling and reanalysis are necessary for verification.
U	-	The compound/analyte was analyzed for, but not detected. The associated numerical value is the sample quantitation limit.
UJ	-	The compound/analyte was analyzed for, but not detected. The sample quantitation limit is an estimated quantity.

DATA QUALIFICATION SUMMARY

APPL, Inc. – 70987 - Organics & Inorganics

POLYNUCLEAR AROMATIC HYDROCARBONS (PAH – Hexachloroethane only)

SUMMARY

I.) General:

The analyses for Polynuclear Aromatic Hydrocarbons (PAH) were performed by GC/MS according to SW-846 Method 8270D-SIM.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualifications.

MAJOR ISSUES

There were no major problems observed for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) GC/MS Tuning:

All GC/MS Tuning criteria were met. No action was required.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met. No action was required.

Initial Calibration Verification:

All Initial Calibration Verification criteria were met. No action was required.

Continuing Calibration:

All Continuing Calibration criteria were met. No action was required.

IV.) Blanks:

Method Blanks:

There were no detections in the method blanks associated with this fraction of the SDG. No action was required.

Equipment Blank:

There were no detections in the equipment blank associated with this fraction of the SDG. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Laboratory Control Samples (LCS):

Two LCSs were analyzed by the laboratory for this SDG. All LCS criteria were met. No action was required.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were performed on SDG sample VE-UXO18-01SS02-0001, for the preparation batch containing the soil samples for this SDG. All MS / MSD criteria were met. No action was required.

MS / MSD analyses data were not submitted for the water matrix fraction of the SDG. The only associated SDG sample was a field QC. Data qualification based on the absence of MS / MSD data was not required, so no action was taken.

VIII.) Field Duplicates:

One set of field duplicate samples (VE-UXO18-01SS01-0001/ VE-UXO18-01SS01P-0001) was identified for this SDG. There were no calculable Relative Percent Differences (RPDs). No action was required.

IX.) TCL Compound Identification:

All TCL Compound Identification criteria were met. No action was required.

X.) Compound Quantitation and Reported Limit of Quantitation / Detection (LOQ/LOD):

All LOQ/LOD criteria were met. No action was required.

XI.) System Performance:

All System Performance criteria were met. No action was required.

EXPLOSIVES

SUMMARY

I.) General:

The analyses for Explosives were performed by HPLC according to SW-846 Method 8330B.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualifications.

MAJOR ISSUES

There were no major problems observed for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was required.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met. No action was required.

Initial Calibration Verification:

All Initial Calibration Verification criteria were met. No action was required.

Continuing Calibration:

All Continuing Calibration criteria were met. No action was required.

IV.) Blanks:

Method Blanks:

There were no detections in the method blanks associated with this fraction of the SDG. No action was required.

Equipment Blank:

There were no detections in the equipment blank associated with this fraction of the SDG. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Laboratory Control Samples (LCS):

Two LCS sets were analyzed by the laboratory for this SDG. In the water LCS/LCSD, the HMX Percent Recovery (%R) was 79.9% which was outside the QC limits of 80 – 100%. The HMX %R rounded up to 2 significant figures meet the QC recovery criteria. All other LCS / LCSD recovery criteria were met. No action was required.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were performed on SDG sample VE-UXO18-01SS02-0001, for the preparation batch containing the soil samples for this SDG. All MS / MSD criteria were met. No action was required.

MS / MSD analyses data were not submitted for the water matrix fraction of the SDG. The only associated SDG sample was a field QC. Data qualification based on the absence of MS / MSD data was not required, so no action was taken.

VIII.) Field Duplicates:

One set of field duplicate samples (VE-UXO18-01SS01-0001/ VE-UXO18-01SS01P-0001) was identified for this SDG. There were no calculable Relative Percent Differences (RPDs). No action was required.

IX.) TCL Compound Identification:

All TCL Compound Identification criteria were met. No action was required.

X.) Compound Quantitation and Reported Limit of Quantitation / Detection (LOQ/LOD):

All LOQ/LOD criteria were met. No action was required.

XI.) System Performance:

All System Performance criteria were met. No action was required.

PERCHLORATE

SUMMARY

I.) General:

The analyses for Perchlorate were performed by HPLC according to SW-846 Method 6850.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualifications.

MAJOR ISSUES

There were no major problems observed for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was required.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met. No action was required.

Initial Calibration Verification:

All Initial Calibration Verification criteria were met. No action was required.

Continuing Calibration:

All Continuing Calibration criteria were met. No action was required.

IV.) Blanks:

Method Blanks:

There were no detections in the method blanks associated with this fraction of the SDG. No action was required.

Equipment Blank:

There were no detections in the equipment blank associated with this fraction of the SDG. No action was required.

V.) Laboratory Control Samples (LCS):

Two LCS sets were analyzed by the laboratory for this SDG. All LCS criteria were met. No action was required.

VI.) LC/MS Ratio:

All LC/MS Ratio criteria were met. No action was required.

VII.) Interference Check Sample:

All Interference Check Sample criteria were met. No action was required.

VIII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were performed on SDG sample VE-UXO18-01SS02-0001, for the preparation batch containing the soil samples for this SDG. The Percent Recoveries (%Rs) were 74.2% and 76.7%, which were below the 80-120% QC limits. Data qualification based on MS / MSD criteria alone was not required, so no action was taken

MS / MSD analyses data were not submitted for the water matrix fraction of the SDG. The only associated SDG sample was a field QC. Data qualification based on the absence of MS / MSD data was not required, so no action was taken.

IX.) Field Duplicates:

One set of field duplicate samples (VE-UXO18-01SS01-0001/ VE-UXO18-01SS01P-0001) was identified for this SDG. There were no calculable Relative Percent Differences (RPDs). No action was required.

X.) Internal Standards Performance (ISTD):

All ISTD criteria were met. No action was required.

XI.) TCL Compound Identification:

All TCL Compound Identification criteria were met. No action was required.

XII.) Compound Quantitation and Reported Limit of Quantitation / Detection (LOQ/LOD):

All LOQ/LOD criteria were met. No action was required.

XIII.) System Performance:

All System Performance criteria were met. No action was required.

PICRIC ACID

SUMMARY

I.) General:

The analyses for Picric Acid were performed by HPLC according to SW-846 Method 8321A.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualifications.

MAJOR ISSUES

There were no major problems observed for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was required.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met. No action was required.

Initial Calibration Verification:

All Initial Calibration Verification criteria were met. No action was required.

Continuing Calibration:

All Continuing Calibration criteria were met. No action was required.

IV.) Blanks:

Method Blanks:

There were no detections in the method blanks associated with this fraction of the SDG. No action was required.

Equipment Blank:

There were no detections in the equipment blank associated with this fraction of the SDG. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Laboratory Control Samples (LCS):

One LCS and one LCS / LCSD set were analyzed by the laboratory for this SDG. All LCS criteria were met. No action was required.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were performed on SDG sample VE-UXO18-01SS02-0001, for the preparation batch containing the soil samples for this SDG. All MS / MSD criteria were met. No action was required.

MS / MSD analyses data were not submitted for the water matrix fraction of the SDG. The only associated SDG sample was a field QC. Data qualification based on the absence of MS / MSD data was not required, so no action was taken.

VIII.) Field Duplicates:

One set of field duplicate samples (VE-UXO18-01SS01-0001/ VE-UXO18-01SS01P-0001) was identified for this SDG. There were no calculable Relative Percent Differences (RPDs). No action was required.

IX.) TCL Compound Identification:

All TCL Compound Identification criteria were met. No action was required.

X.) Compound Quantitation and Reported Limit of Quantitation / Detection (LOQ/LOD):

All LOQ/LOD criteria were met. No action was required.

XI.) System Performance:

All System Performance criteria were met. No action was required.

TOTAL METALS

SUMMARY

I.) General:

The analyses for Total Metals were performed using SW-846 Methods 6010C and 6020A.

II.) Overall Assessment of Data:

All laboratory data were acceptable with qualification.

SDG sample VE-UXO18-01SS01-0001 was not analyzed for metals due to limited volume received by the laboratory. The client was notified by the laboratory.

MAJOR ISSUES

There were no major problems observed for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

Initial Calibration Blanks:

All Tuning, Initial and Continuing Calibration criteria were met. No action was required.

III.) LOD Standards:

All LOD criteria were met. No action was required.

IV.) Blanks:

Preparation Blank Results:

The following analytes were detected in the soil preparation blank PBS:

Analyte	Concentration
nickel	0.086 mg/kg
chromium	0.042 mg/kg

All nickel and chromium results in the associated SDG samples were greater than the LOD and greater than 10X the blank concentration; therefore, no action was required. The associated samples were VE-UXO18-01SS03-0001, VE-UXO18-01SS02-0001, and VE-UXO18-01SS01P-0001.

The following analytes were detected in the water preparation blank PBW:

Analyte	Concentration
sodium	146 ug/L
antimony	0.18 ug/L
chromium	0.24 ug/L
selenium	0.37 ug/L

The only associated sample was equipment blank VE-UXO18-EB02-061313; therefore, no action was required.

Equipment Blanks:

The following analytes were detected in equipment blank sample VE-UXO18-EB02-061313:

Analyte	Concentration
antimony	0.21 ug/L
arsenic	0.11 ug/L
chromium	0.30 ug/L

Analyte	Concentration
selenium	0.61 ug/L
thallium	0.19 ug/L

All arsenic and chromium results in the associated SDG samples were greater than the LOD and greater than 10X the blank concentration; therefore, no action was required.

The concentration of antimony in the equipment blank was less than the LOD but greater than the DL; therefore, the positive antimony result in sample VE-UXO18-01SS03-0001, which was less than the LOD, was qualified as undetected (U) with the result raised to the LOD.

The concentration of selenium in the equipment blank was greater than the LOD; therefore, the positive selenium results in samples VE-UXO18-01SS03-0001 and VE-UXO18-01SS02-0001, which were greater than the LOD but less than 10X the blank concentration, were qualified as estimated biased high (J+). The positive selenium result for sample VE-UXO18-01SS01P-0001, which was less than the LOD, was qualified as undetected (U) with the result raised to the LOD.

The concentration of thallium in the equipment blank was less than the LOD but greater than the DL; therefore, the positive thallium result in sample VE-UXO18-01SS03-0001, which was greater than the LOD but less than 10X the blank concentration, was qualified as estimated biased high (J+). The positive thallium results for samples VE-UXO18-01SS02-0001 and VE-UXO18-01SS01P-0001, which were less than the LOD, were qualified as undetected (U) with the results raised to the LOD.

Calibration Blanks:

The following continuing calibration blank results were associated with the SDG samples:

Blank ID	Analyte	Concentration
CCB2 7/10/13	magnesium	13.2 ug/L
CCB3 7/10/13	magnesium	23.6 ug/L
CCB3 7/10/13	aluminum	30.6 ug/L
CCB3 7/10/13	iron	12.3 ug/L
CCB3 7/12/13	selenium	0.23 ug/L

Since all results for magnesium, aluminum, and iron were positive in the associated SDG samples and were greater than the LOD, no action was required for these analytes. The selenium concentration in the CCB was equal to the DL but less than the LOD; therefore, the positive selenium result for SDG sample VE-UXO18-01SS01P-0001, which was less than the LOD, was qualified as undetected (U) with the result raised to the LOD. The other two selenium results were positive in the associated SDG samples and were greater than the LOD; therefore, no action was required.

V.) ICP Interference Check Sample Results:

All Interference Percent Recovery criteria were met. No action was required.

VI.) ICP Serial Dilution Analysis:

Note: Per Region II guidance on homogeneity, non-SMI soil sample MS/MSD and serial dilution outlier qualifications were applied to the parent sample only. Water samples and SMI soil samples are considered to be homogeneous and any qualification based on MS/MSD or serial dilution outliers are applied to all associated preparation batch samples.

Serial Dilution Analysis was performed on SDG sample VE-UXO18-01SS02-0001. The following Percent Differences (%Ds) exceeded the 15% QC limit:

barium	17.3%
iron	17.2%
manganese	15.7%

All positive results for the listed analytes in sample VE-UXO18-01SS02-0001 original concentrations were greater than 50X DL; therefore, were qualified as estimated (J).

Serial Dilution Analysis data was not submitted for the aqueous sample for this fraction of the SDG. The only aqueous sample in the SDG was a field blank; therefore, no action was taken for the water sample.

VII.) Laboratory Control Samples (LCS):

Two LCS samples were analyzed for this fraction of the SDG. All LCS criteria were met. No action was required.

VIII.) Matrix Spike / Matrix Spike Duplicate (MS/MSD):

Note: Per Region II guidance on homogeneity, non-SMI soil sample MS/MSD and serial dilution outlier qualifications were applied to the parent sample only. Water samples and SMI soil samples are considered to be homogeneous and any qualification based on MS/MSD or serial dilution outliers are applied to all associated preparation batch samples.

Matrix Spike / Matrix Spike Duplicate analyses were performed on SDG sample VE-UXO18-01SS02-0001, for the preparation batch containing the soil samples for this SDG. A total of twenty-three %Rs were outside the QC limits for the soil sample. Since soil parent sample VE-UXO18-01SS02-0001 is not an SMI sample, the outliers were qualified as estimated (J) in the parent sample only.

Analyte	MS, %R	MSD, %R
aluminum	264%	269%
barium	74.0%	77.8%
beryllium	76.2%	71.4%
calcium	38%	-304%
copper		76.4%
iron	308%	270%
lead	67.1%	63.3%
magnesium	78.3%	70.3%
nickel	69.2%	65.0%
sodium	77.5%	71.4%
vanadium	74.9%	69.2%
zinc	65.2%	61.8%

Matrix Spike / Matrix Spike Duplicate analyses were performed on client sample VE-UXO12-EB01-062013 from SDG 71042, for the preparation batch containing the water sample for this SDG. All MS / MSD Percent Recovery (%R) and Relative Percent Difference (RPD) criteria were met for the water samples. The sample chosen for the water samples was a field QC sample, and therefore not considered a relevant sample. The only associated sample in this SDG was a field QC; therefore, no action was required.

IX.) Field Duplicates:

One set of field duplicate samples (VE-UXO18-01SS01-0001/ VE-UXO18-01SS01P-0001) was identified for this SDG. There were no calculable Relative Percent Differences (RPDs) since sample VE-UXO18-01SS01-0001 was not analyzed due to limited sample volume. No action was required.

X.) Internal Standards Recovery (ISTD):

All ISTD criteria were met. No action was required.

XI.) Sample Result, Calculation/Transcription Verification:

The initial analysis results for calcium for samples VE-UXO18-01SS03-0001, VE-UXO18-01SS02-0001, and VE-UXO18-01SS01P-0001 exceeded the linear calibration range. A 20X dilution analysis was performed for the sample with all calibration criteria met. The Form Is for the samples is a composite of the overall best set of results, so no action was required.

XII.) Quarterly Verification of Instrumental Parameters:

All criteria were met. No action was taken.

TOTAL HEXAVALENT CHROMIUM

SUMMARY

I.) General:

The analyses for Total Hexavalent Chromium were performed using SW-846 Method 7196A.

II.) Overall Assessment of Data:

All laboratory data were acceptable with qualifications.

MAJOR ISSUES

There were no major problems observed for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

The 29 hours between sample collection and sample analysis for SDG aqueous sample VE-UXO18-EB02-061313 exceeded the 24 hour QC limit. The results for hexavalent chromium in the aqueous SDG sample, which was non-detect, was qualified as estimated (UJ) since the holding time is past the QC limit but is within 2X the limit.

II.) Calibration:

All Initial and Continuing Calibration criteria were met. No action was required.

III.) Blanks:

There were no results in the calibration or preparation blanks associated with this fraction of the SDG. No action was required.

There were no results in the equipment blank associated with this fraction of the SDG. No action was required.

IV.) Laboratory Control Samples (LCS):

Two LCS / LCSD sets were analyzed for this fraction of the SDG. All LCS criteria were met. No action was required.

V.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

Note: Per Region II guidance on homogeneity, non-SMI soil sample MS/MSD and serial dilution outlier qualifications were applied to the parent sample only. Water samples and SMI soil samples are considered to be homogeneous and any qualification based on MS/MSD or serial dilution outliers are applied to all associated preparation batch samples.

MS / MSD analyses were performed on SDG sample VE-UXO18-01SS02-0001, for the preparation batch containing the soil samples for this SDG. All MS / MSD criteria were met. No action was required.

MS / MSD analyses data were not submitted for the water matrix fraction of the SDG. The only associated SDG sample was a field QC. Data qualification based on the absence of MS / MSD data was not required, so no action was taken.

VI.) Field Duplicates:

One set of field duplicate samples (VE-UXO18-01SS01-0001/ VE-UXO18-01SS01P-0001) was identified for this SDG. There were no calculable Relative Percent Differences (RPDs). No action was required.

VII.) Sample Result, Calculation/Transcription Verification:

All criteria were met. No action was necessary.

Appendix A

Qualified Form Is

EPA 8270D LL SOILS

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS03-0001

APPL ID: AY81984

Sample Collection Date: 06/12/13

QCG: #SIMDC-130620A-179058

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
(Solid Concentrations and Limits have been adjusted to reflect 20.4 Percent Moisture.)								
8270D-SIM	HEXACHLOROETHANE	2.10 U	6.3	2.10	1.10	ug/kg	06/20/13	06/25/13
8270D-SIM	SURROGATE: 2-FLUORBIPHENYL (S)	64.5	45-105			%	06/20/13	06/25/13
8270D-SIM	SURROGATE: NITROBENZENE-D5 (S)	69.7	35-100			%	06/20/13	06/25/13
8270D-SIM	SURROGATE: TERPHENYL-D14 (S)	72.1	30-125			%	06/20/13	06/25/13

Quant Method: SIMH.M
Run #: 0625L011
Instrument: Linus
Sequence: L130620
Dilution Factor: 1
Initials: LF

Printed: 07/15/13 12:39:49 PM
APPL-F1-SC-MCRes/MCPQL-REG MDLs

TBG 9-10-13

EPA 8270D LL SOILS

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS02-0001

APPL ID: AY81985

Sample Collection Date: 06/12/13

QCG: #SIMDC-130620A-179058

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
(Solid Concentrations and Limits have been adjusted to reflect 18.4 Percent Moisture.)								
8270D-SIM	HEXACHLOROETHANE	2.00 U	6.1	2.00	1.10	ug/kg	06/20/13	06/25/13
8270D-SIM	SURROGATE: 2-FLUORBIPHENYL (S)	67.4	45-105			%	06/20/13	06/25/13
8270D-SIM	SURROGATE: NITROBENZENE-D5 (S)	77.7	35-100			%	06/20/13	06/25/13
8270D-SIM	SURROGATE: TERPHENYL-D14 (S)	72.1	30-125			%	06/20/13	06/25/13

Quant Method: SIMH.M
Run #: 0625L014
Instrument: Linus
Sequence: L130620
Dilution Factor: 1
Initials: LF

Printed: 07/15/13 12:39:49 PM
APPL-F1-SC-MCRes/MCPQL-REG MDLs

TBG 9-10-13

EPA 8270D LL SOILS

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS01-0001

APPL ID: AY81986

Sample Collection Date: 06/12/13

QCG: #SIMDC-130620A-179058

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
(Solid Concentrations and Limits have been adjusted to reflect 11.4 Percent Moisture.)								
8270D-SIM	HEXACHLOROETHANE	1.90 U	5.6	1.90	1.00	ug/kg	06/20/13	06/25/13
8270D-SIM	SURROGATE: 2-FLUORBIPHENYL (S)	72.6	45-105			%	06/20/13	06/25/13
8270D-SIM	SURROGATE: NITROBENZENE-D5 (S)	81.1	35-100			%	06/20/13	06/25/13
8270D-SIM	SURROGATE: TERPHENYL-D14 (S)	81.2	30-125			%	06/20/13	06/25/13

Quant Method: SIMH.M
Run #: 0625L015
Instrument: Linus
Sequence: L130620
Dilution Factor: 1
Initials: LF

Printed: 07/15/13 12:39:49 PM
APPL-F1-SC-MCRes/MCPQL-REG MDLs

TBG 9-10-13

EPA 8270D LL SOILS

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS01P-0001

APPL ID: AY81987

Sample Collection Date: 06/12/13

QCG: #SIMDC-130620A-179058

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
(Solid Concentrations and Limits have been adjusted to reflect 12.1 Percent Moisture.)								
8270D-SIM	HEXACHLOROETHANE	1.90 U	5.7	1.90	1.00	ug/kg	06/20/13	06/25/13
8270D-SIM	SURROGATE: 2-FLUORBIPHENYL (S)	60.5	45-105			%	06/20/13	06/25/13
8270D-SIM	SURROGATE: NITROBENZENE-D5 (S)	67.4	35-100			%	06/20/13	06/25/13
8270D-SIM	SURROGATE: TERPHENYL-D14 (S)	66.8	30-125			%	06/20/13	06/25/13

Quant Method: SIMH.M
Run #: 0625L016
Instrument: Linus
Sequence: L130620
Dilution Factor: 1
Initials: LF

Printed: 07/15/13 12:39:49 PM
APPL-F1-SC-MCRes/MCPQL-REG MDLs

TB6 9-10-13

EPA 8270D LL WATER

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-EB02-061313

APPL ID: AY81988

Sample Collection Date: 06/13/13

QCG: #SIMDC-130617A-179057

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
8270D-LL	HEXACHLOROETHANE	0.10 U	0.2	0.10	0.07	ug/L	06/17/13	06/25/13
8270D-LL	SURROGATE: 2-FLUORBIPHENYL (S)	67.2	50-110			%	06/17/13	06/25/13
8270D-LL	SURROGATE: NITROBENZENE-D5 (S)	72.9	40-110			%	06/17/13	06/25/13
8270D-LL	SURROGATE: TERPHENYL-D14 (S)	80.2	50-135			%	06/17/13	06/25/13

Quant Method: SIMH.M
Run #: 0625L008
Instrument: Linus
Sequence: L130620
Dilution Factor: 1
Initials: LF

Printed: 07/15/13 12:39:49 PM
APPL-F1-SC-MCRes/MCPQL-REG MDLs

TBG 9-10-13

EPA 8330B EXPLOSIVES-SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS03-0001

APPL ID: AY81984

Sample Collection Date: 06/12/13

QCG: #833BS-130624A-179126

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.200 U	0.50	0.200	0.079	mg/kg	06/24/13	07/03/13
EPA 8330B	1,3-DINITROBENZENE	0.200 U	0.45	0.200	0.063	mg/kg	06/24/13	07/03/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/24/13	07/03/13
EPA 8330B	2,4-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/24/13	07/03/13
EPA 8330B	2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/24/13	07/03/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/24/13	07/03/13
EPA 8330B	2-NITROTOLUENE	0.200 U	0.50	0.200	0.066	mg/kg	06/24/13	07/03/13
EPA 8330B	3-NITROTOLUENE	0.200 U	0.50	0.200	0.071	mg/kg	06/24/13	07/03/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/24/13	07/03/13
EPA 8330B	4-NITROTOLUENE	0.200 U	0.50	0.200	0.080	mg/kg	06/24/13	07/03/13
EPA 8330B	HMX	0.200 U	0.50	0.200	0.080	mg/kg	06/24/13	07/03/13
EPA 8330B	NITROBENZENE	0.200 U	0.50	0.200	0.075	mg/kg	06/24/13	07/03/13
EPA 8330B	NITROGLYCERIN	0.200 U	0.50	0.200	0.085	mg/kg	06/24/13	07/03/13
EPA 8330B	PETN	1.000 U	2.50	1.000	0.579	mg/kg	06/24/13	07/03/13
EPA 8330B	RDX	0.200 U	0.50	0.200	0.080	mg/kg	06/24/13	07/03/13
EPA 8330B	TETRYL	0.200 U	0.50	0.200	0.091	mg/kg	06/24/13	07/03/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	99.5	70-130			%	06/24/13	07/03/13

Quant Method: W130702.M
Run #: 0703_0000014
Instrument: Waldorf
Sequence: 130702
Dilution Factor: 1
Initials: PY

Printed: 07/08/13 4:30:56 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-10-13

EPA 8330B EXPLOSIVES-SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS02-0001

APPL ID: AY81985

Sample Collection Date: 06/12/13

QCG: #833BS-130624A-179126

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.200 U	0.50	0.200	0.079	mg/kg	06/24/13	07/03/13
EPA 8330B	1,3-DINITROBENZENE	0.200 U	0.45	0.200	0.063	mg/kg	06/24/13	07/03/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/24/13	07/03/13
EPA 8330B	2,4-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/24/13	07/03/13
EPA 8330B	2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/24/13	07/03/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/24/13	07/03/13
EPA 8330B	2-NITROTOLUENE	0.200 U	0.50	0.200	0.066	mg/kg	06/24/13	07/03/13
EPA 8330B	3-NITROTOLUENE	0.200 U	0.50	0.200	0.071	mg/kg	06/24/13	07/03/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/24/13	07/03/13
EPA 8330B	4-NITROTOLUENE	0.200 U	0.50	0.200	0.080	mg/kg	06/24/13	07/03/13
EPA 8330B	HMX	0.200 U	0.50	0.200	0.080	mg/kg	06/24/13	07/03/13
EPA 8330B	NITROBENZENE	0.200 U	0.50	0.200	0.075	mg/kg	06/24/13	07/03/13
EPA 8330B	NITROGLYCERIN	0.200 U	0.50	0.200	0.085	mg/kg	06/24/13	07/03/13
EPA 8330B	PETN	1.000 U	2.50	1.000	0.579	mg/kg	06/24/13	07/03/13
EPA 8330B	RDX	0.200 U	0.50	0.200	0.080	mg/kg	06/24/13	07/03/13
EPA 8330B	TETRYL	0.200 U	0.50	0.200	0.091	mg/kg	06/24/13	07/03/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	101	70-130			%	06/24/13	07/03/13

Quant Method: W130702.M
Run #: 0703_0000015
Instrument: Waldorf
Sequence: 130702
Dilution Factor: 1
Initials: PY

Printed: 07/08/13 4:30:56 PM
APPL-F1-SC-NoMC-REG MDLs

TB6 9-10-13

EPA 8330B EXPLOSIVES-SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS01-0001

APPL ID: AY81986

Sample Collection Date: 06/12/13

QCG: #833BS-130624A-179126

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.200 U	0.50	0.200	0.079	mg/kg	06/24/13	07/03/13
EPA 8330B	1,3-DINITROBENZENE	0.200 U	0.45	0.200	0.063	mg/kg	06/24/13	07/03/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/24/13	07/03/13
EPA 8330B	2,4-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/24/13	07/03/13
EPA 8330B	2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/24/13	07/03/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/24/13	07/03/13
EPA 8330B	2-NITROTOLUENE	0.200 U	0.50	0.200	0.066	mg/kg	06/24/13	07/03/13
EPA 8330B	3-NITROTOLUENE	0.200 U	0.50	0.200	0.071	mg/kg	06/24/13	07/03/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/24/13	07/03/13
EPA 8330B	4-NITROTOLUENE	0.200 U	0.50	0.200	0.080	mg/kg	06/24/13	07/03/13
EPA 8330B	HMX	0.200 U	0.50	0.200	0.080	mg/kg	06/24/13	07/03/13
EPA 8330B	NITROBENZENE	0.200 U	0.50	0.200	0.075	mg/kg	06/24/13	07/03/13
EPA 8330B	NITROGLYCERIN	0.200 U	0.50	0.200	0.085	mg/kg	06/24/13	07/03/13
EPA 8330B	PETN	1.000 U	2.50	1.000	0.579	mg/kg	06/24/13	07/03/13
EPA 8330B	RDX	0.200 U	0.50	0.200	0.080	mg/kg	06/24/13	07/03/13
EPA 8330B	TETRYL	0.200 U	0.50	0.200	0.091	mg/kg	06/24/13	07/03/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	101	70-130			%	06/24/13	07/03/13

Quant Method: W130702.M
Run #: 0703_0000017
Instrument: Waldorf
Sequence: 130702
Dilution Factor: 1
Initials: PY

Printed: 07/08/13 4:30:56 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-10-13

EPA 8330B EXPLOSIVES-SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS01P-0001

APPL ID: AY81987

Sample Collection Date: 06/12/13

QCG: #833BS-130624A-179126

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.200 U	0.50	0.200	0.079	mg/kg	06/24/13	07/03/13
EPA 8330B	1,3-DINITROBENZENE	0.200 U	0.45	0.200	0.063	mg/kg	06/24/13	07/03/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/24/13	07/03/13
EPA 8330B	2,4-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/24/13	07/03/13
EPA 8330B	2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/24/13	07/03/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/24/13	07/03/13
EPA 8330B	2-NITROTOLUENE	0.200 U	0.50	0.200	0.066	mg/kg	06/24/13	07/03/13
EPA 8330B	3-NITROTOLUENE	0.200 U	0.50	0.200	0.071	mg/kg	06/24/13	07/03/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/24/13	07/03/13
EPA 8330B	4-NITROTOLUENE	0.200 U	0.50	0.200	0.080	mg/kg	06/24/13	07/03/13
EPA 8330B	HMX	0.200 U	0.50	0.200	0.080	mg/kg	06/24/13	07/03/13
EPA 8330B	NITROBENZENE	0.200 U	0.50	0.200	0.075	mg/kg	06/24/13	07/03/13
EPA 8330B	NITROGLYCERIN	0.200 U	0.50	0.200	0.085	mg/kg	06/24/13	07/03/13
EPA 8330B	PETN	1.000 U	2.50	1.000	0.579	mg/kg	06/24/13	07/03/13
EPA 8330B	RDX	0.200 U	0.50	0.200	0.080	mg/kg	06/24/13	07/03/13
EPA 8330B	TETRYL	0.200 U	0.50	0.200	0.091	mg/kg	06/24/13	07/03/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	101	70-130			%	06/24/13	07/03/13

Quant Method: W130702.M
Run #: 0703_0000018
Instrument: Waldorf
Sequence: 130702
Dilution Factor: 1
Initials: PY

Printed: 07/08/13 4:30:56 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-10-13

EPA 8330B EXPLOSIVES-WATER

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-EB02-061313

APPL ID: AY81988

Sample Collection Date: 06/13/13

QCG: #833BW-130617A-179143

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.300 U	0.50	0.300	0.130	ug/L	06/17/13	06/18/13
EPA 8330B	1,3-DINITROBENZENE	0.300 U	0.50	0.300	0.131	ug/L	06/17/13	06/18/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.300 U	0.50	0.300	0.133	ug/L	06/17/13	06/18/13
EPA 8330B	2,4-DINITROTOLUENE	0.300 U	0.50	0.300	0.125	ug/L	06/17/13	06/18/13
EPA 8330B	2,6-DINITROTOLUENE	0.300 U	0.50	0.300	0.125	ug/L	06/17/13	06/18/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.300 U	0.50	0.300	0.125	ug/L	06/17/13	06/18/13
EPA 8330B	2-NITROTOLUENE	0.300 U	0.50	0.300	0.126	ug/L	06/17/13	06/18/13
EPA 8330B	3-NITROTOLUENE	0.300 U	0.50	0.300	0.133	ug/L	06/17/13	06/18/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.300 U	0.50	0.300	0.100	ug/L	06/17/13	06/18/13
EPA 8330B	4-NITROTOLUENE	0.300 U	0.50	0.300	0.133	ug/L	06/17/13	06/18/13
EPA 8330B	HMX	0.300 U	0.50	0.300	0.115	ug/L	06/17/13	06/18/13
EPA 8330B	NITROBENZENE	0.300 U	0.50	0.300	0.126	ug/L	06/17/13	06/18/13
EPA 8330B	NITROGLYCERIN	0.300 U	0.50	0.300	0.130	ug/L	06/17/13	06/18/13
EPA 8330B	PETN	1.500 U	2.50	1.500	0.607	ug/L	06/17/13	06/18/13
EPA 8330B	RDX	0.300 U	0.50	0.300	0.123	ug/L	06/17/13	06/18/13
EPA 8330B	TETRYL	0.300 U	0.50	0.300	0.133	ug/L	06/17/13	06/18/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	83.6	70-130			%	06/17/13	06/18/13

Quant Method: W130403.M
Run #: 0618_0000008
Instrument: Waldorf
Sequence: 130403
Dilution Factor: 1
Initials: PY

Printed: 07/08/13 6:03:43 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-10-13

EPA 6850 SOIL - 10G EXTRACTION

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS03-0001

APPL ID: AY81984

Sample Collection Date: 06/12/13

QCG: #6850CT05-130624-179288

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 6850	PERCHLORATE	4.00 U	6.0	4.00	2.00	ug/Kg	06/24/13	07/08/13

Quant Method: QTLMFL2
Run #: T707_046.d
Instrument: AGIL_6460
Sequence: TQ070713
Dilution Factor: 1
Initials: RP

Printed: 07/12/13 2:45:19 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-10-13

EPA 6850 SOIL - 10G EXTRACTION

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS02-0001

APPL ID: AY81985

Sample Collection Date: 06/12/13

QCG: #6850CT05-130624-179288

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 6850	PERCHLORATE	4.00 U	6.0	4.00	2.00	ug/Kg	06/24/13	07/08/13

Quant Method: QTLMFL2
Run #: T707_047.d
Instrument: AGIL_6460
Sequence: TQ070713
Dilution Factor: 1
Initials: RP

Printed: 07/12/13 2:45:19 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-10-13

EPA 6850 SOIL - 10G EXTRACTION

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS01-0001

APPL ID: AY81986

Sample Collection Date: 06/12/13

QCG: #6850CT05-130624-179288

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 6850	PERCHLORATE	4.00 U	6.0	4.00	2.00	ug/Kg	06/24/13	07/08/13

Quant Method: QTLMFL2
Run #: T707_052.d
Instrument: AGIL_6460
Sequence: TQ070713
Dilution Factor: 1
Initials: RP

Printed: 07/12/13 2:45:19 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-10-13

EPA 6850 SOIL - 10G EXTRACTION

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS01P-0001

APPL ID: AY81987

Sample Collection Date: 06/12/13

QCG: #6850CT05-130624-179288

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 6850	PERCHLORATE	4.00 U	6.0	4.00	2.00	ug/Kg	06/24/13	07/08/13

Quant Method: QTLMFL2
Run #: T707_053.d
Instrument: AGIL_6460
Sequence: TQ070713
Dilution Factor: 1
Initials: RP

Printed: 07/12/13 2:45:19 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-10-13

Perchlorate

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-EB02-061313

APPL ID: AY81988

Sample Collection Date: 06/13/13

QCG: #6850-130620A-179289

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 6850	PERCHLORATE	0.400 U	0.60	0.400	0.200	ug/L	06/20/13	07/08/13

Quant Method: QTLMFL2
Run #: T707_067.d
Instrument: AGIL_6460
Sequence: TQ070713
Dilution Factor: 1
Initials: RP

Printed: 07/12/13 2:45:19 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-10-13

EPA 8321A Picric Acid-Soil

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni
Project: 424191.FI.FK.04 Vieques CTO 005
Sample ID: VE-UXO18-01SS03-0001
Sample Collection Date: 06/12/13

ARF: 70987
APPL ID: AY81984
QCG: #PICS-130624A-179235

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	120.00 U	200.0	120.00	60.00	ug/kg	06/24/13	07/10/13
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	99.5	50-150			%	06/24/13	07/10/13

Quant Method: 83PIC709.M
Run #: L709_041.D
Instrument: AGIL_1100
Sequence: LQ070913
Dilution Factor: 1
Initials: MP

Printed: 07/11/13 3:28:29 PM
APPL-F1-SC-NoMC-REG MDLs

TDG 9-10-13

EPA 8321A Picric Acid-Soil

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS02-0001

APPL ID: AY81985

Sample Collection Date: 06/12/13

QCG: #PICS-130624A-179235

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	120.00 U	200.0	120.00	60.00	ug/kg	06/24/13	07/10/13
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	101	50-150			%	06/24/13	07/10/13

Quant Method: 83PIC709.M
Run #: L709_042.D
Instrument: AGIL_1100
Sequence: LQ070913
Dilution Factor: 1
Initials: MP

Printed: 07/11/13 3:28:29 PM
APPL-F1-SC-NoMC-REG MDLs

TDG 9-10-13

EPA 8321A Picric Acid-Soil

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS01-0001

APPL ID: AY81986

Sample Collection Date: 06/12/13

QCG: #PICS-130624A-179235

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	120.00 U	200.0	120.00	60.00	ug/kg	06/24/13	07/10/13
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	101	50-150			%	06/24/13	07/10/13

Quant Method: 83PIC709.M
Run #: L709_043.D
Instrument: AGIL_1100
Sequence: LQ070913
Dilution Factor: 1
Initials: MP

Printed: 07/11/13 3:28:29 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-10-13

EPA 8321A Picric Acid-Soil

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS01P-0001

APPL ID: AY81987

Sample Collection Date: 06/12/13

QCG: #PICS-130624A-179235

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	120.00 U	200.0	120.00	60.00	ug/kg	06/24/13	07/10/13
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	101	50-150			%	06/24/13	07/10/13

Quant Method: 83PIC709.M
Run #: L709_072.D
Instrument: AGIL_1100
Sequence: LQ070913
Dilution Factor: 1
Initials: MP

Printed: 07/11/13 3:28:29 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-10-13

EPA 8321A Picric Acid-Water

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-EB02-061313

APPL ID: AY81988

Sample Collection Date: 06/13/13

QCG: #PICW-130618A-179225

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	0.12 U	0.2	0.12	0.06	ug/L	06/18/13	07/09/13
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	93.5	50-150			%	06/18/13	07/09/13

Quant Method: 83PIC709.M
Run #: L709_017.D
Instrument: AGIL_1100
Sequence: LQ070913
Dilution Factor: 1
Initials: MP

Printed: 07/11/13 3:28:29 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-10-13

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS03-0001

APPL ID: AY81984

Sample Collection Date: 06/12/13

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
(Solid Concentrations and Limits have been adjusted to reflect 20.4 Percent Moisture.)									
6010C/3050B	ALUMINUM (AL)	9720	13	5.0	2.5	mg/kg	1	07/09/13	07/10/13
6020A/3050B	ANTIMONY (SB)	1.3 ~~0.87 J~~ U	1.30	1.300	0.630	mg/Kg	5	07/12/13	07/13/13 EBL
6020A/3050B	ARSENIC (AS)	4.8	3.10	1.900	0.500	mg/Kg	5	07/12/13	07/13/13
6010C/3050B	BARIUM (BA)	43.3	0.63	0.500	0.094	mg/kg	1	07/09/13	07/10/13
6010C/3050B	BERYLLIUM (BE)	0.090 J	0.25	0.250	0.055	mg/kg	1	07/09/13	07/10/13
6020A/3050B	CADMIUM (CD)	0.25 J	0.63	0.500	0.190	mg/Kg	5	07/12/13	07/13/13
6010C/3050B	CALCIUM (CA)	229000	251	201.0	126.0	mg/kg	20	07/09/13	07/10/13
6020A/3050B	CHROMIUM (CR)	11.4	3.10	1.300	0.220	mg/Kg	5	07/12/13	07/13/13
6020A/3050B	COBALT (CO)	2.4	0.63	0.500	0.130	mg/Kg	5	07/12/13	07/13/13
6010C/3050B	COPPER (CU)	13.6	0.63	0.500	0.120	mg/kg	1	07/09/13	07/10/13
6010C/3050B	IRON (FE)	7710	6.3	5.00	1.10	mg/kg	1	07/09/13	07/10/13
6010C/3050B	LEAD (PB)	2.0	0.63	0.500	0.200	mg/kg	1	07/09/13	07/10/13
6010C/3050B	MAGNESIUM (MG)	12300	6.3	5.00	1.60	mg/kg	1	07/09/13	07/10/13
6010C/3050B	MANGANESE (MN)	315	0.63	0.500	0.160	mg/kg	1	07/09/13	07/10/13
6010C/3050B	NICKEL (NI)	3.8	0.63	0.500	0.085	mg/kg	1	07/09/13	07/10/13
6010C/3050B	POTASSIUM (K)	2350	126	63.0	17.0	mg/kg	1	07/09/13	07/10/13
6020A/3050B	SELENIUM (SE)	0.98 ~~J~~ J+	1.30	0.630	0.250	mg/Kg	5	07/12/13	07/13/13 EBL
6020A/3050B	SILVER (AG)	0.310 U	0.63	0.310	0.130	mg/Kg	5	07/12/13	07/13/13
6010C/3050B	SODIUM (NA)	494	126	63.0	14.0	mg/kg	1	07/09/13	07/10/13
6020A/3050B	THALLIUM (TL)	0.55 ~~J~~ J+	0.63	0.310	0.130	mg/Kg	5	07/12/13	07/13/13 EBL
6010C/3050B	VANADIUM (V)	14.6	0.63	0.500	0.130	mg/kg	1	07/09/13	07/10/13
6010C/3050B	ZINC (ZN)	23.7	6.3	5.00	1.40	mg/kg	1	07/09/13	07/10/13

J = Estimated value.

Printed: 07/17/13 12:24:14 PM

PL-F1-SC-MCRes/MCPQL-REG MDLs

TBG 9-10-13

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS02-0001

APPL ID: AY81985

Sample Collection Date: 06/12/13

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
(Solid Concentrations and Limits have been adjusted to reflect 18.4 Percent Moisture.)									
6010C/3050B	ALUMINUM (AL)	4470 J	12	4.9	2.5	mg/kg	1	07/09/13	07/10/13 MSH
6020A/3050B	ANTIMONY (SB)	1.200 U	1.20	1.200	0.610	mg/Kg	5	07/12/13	07/13/13
6020A/3050B	ARSENIC (AS)	2.2 J	3.10	1.800	0.490	mg/Kg	5	07/12/13	07/13/13
6010C/3050B	BARIUM (BA)	49.0 J	0.61	0.490	0.092	mg/kg	1	07/09/13	07/10/13 MSL
6010C/3050B	BERYLLIUM (BE)	0.250 U J	0.25	0.250	0.054	mg/kg	1	07/09/13	07/10/13 MSL
6020A/3050B	CADMIUM (CD)	0.32 J	0.61	0.490	0.180	mg/Kg	5	07/12/13	07/13/13
6010C/3050B	CALCIUM (CA)	238000 J	245	196.0	123.0	mg/kg	20	07/09/13	07/10/13 MSL
6020A/3050B	CHROMIUM (CR)	9.2	3.10	1.200	0.210	mg/Kg	5	07/12/13	07/13/13
6020A/3050B	COBALT (CO)	2.5	0.61	0.490	0.120	mg/Kg	5	07/12/13	07/13/13
6010C/3050B	COPPER (CU)	13.0 J	0.61	0.490	0.120	mg/kg	1	07/09/13	07/10/13 MSL
6010C/3050B	IRON (FE)	3740 J	6.1	4.90	1.00	mg/kg	1	07/09/13	07/10/13 MSH
6010C/3050B	LEAD (PB)	0.490 U J	0.61	0.490	0.200	mg/kg	1	07/09/13	07/10/13 MSL
6010C/3050B	MAGNESIUM (MG)	4780 J	6.1	4.90	1.60	mg/kg	1	07/09/13	07/10/13 MSL
6010C/3050B	MANGANESE (MN)	184 J	0.61	0.490	0.160	mg/kg	1	07/09/13	07/10/13 SD
6010C/3050B	NICKEL (NI)	2.5 J	0.61	0.490	0.083	mg/kg	1	07/09/13	07/10/13 MSL
6010C/3050B	POTASSIUM (K)	1060	123	61.0	17.0	mg/kg	1	07/09/13	07/10/13
6020A/3050B	SELENIUM (SE)	0.75 J+	1.20	0.610	0.250	mg/Kg	5	07/12/13	07/13/13 EBL
6020A/3050B	SILVER (AG)	0.310 U	0.61	0.310	0.120	mg/Kg	5	07/12/13	07/13/13
6010C/3050B	SODIUM (NA)	627 J	123	61.0	14.0	mg/kg	1	07/09/13	07/10/13 MSL
6020A/3050B	THALLIUM (TL)	0.31 ~~0.26 J~~ U	0.61	0.310	0.120	mg/Kg	5	07/12/13	07/13/13 EBL
6010C/3050B	VANADIUM (V)	7.0 J	0.61	0.490	0.120	mg/kg	1	07/09/13	07/10/13 MSL
6010C/3050B	ZINC (ZN)	21.3 J	6.1	4.90	1.40	mg/kg	1	07/09/13	07/10/13 MSL

J = Estimated value.

Printed: 07/17/13 12:24:14 PM

PL-F1-SC-MCRes/MCPQL-REG MDLs

TBG 9-10-13

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-01SS01P-0001

APPL ID: AY81987

Sample Collection Date: 06/12/13

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
(Solid Concentrations and Limits have been adjusted to reflect 12.1 Percent Moisture.)									
6010C/3050B	ALUMINUM (AL)	3630	11	4.6	2.3	mg/kg	1	07/09/13	07/10/13
6020A/3050B	ANTIMONY (SB)	1.100 U	1.10	1.100	0.570	mg/Kg	5	07/12/13	07/13/13
6020A/3050B	ARSENIC (AS)	2.2 J	2.80	1.700	0.460	mg/Kg	5	07/12/13	07/13/13
6010C/3050B	BARIUM (BA)	34.5	0.57	0.460	0.085	mg/kg	1	07/09/13	07/10/13
6010C/3050B	BERYLLIUM (BE)	0.230 U	0.23	0.230	0.050	mg/kg	1	07/09/13	07/10/13
6020A/3050B	CADMIUM (CD)	0.18 J	0.57	0.460	0.170	mg/Kg	5	07/12/13	07/13/13
6010C/3050B	CALCIUM (CA)	265000	228	182.0	114.0	mg/kg	20	07/09/13	07/10/13
6020A/3050B	CHROMIUM (CR)	6.3	2.80	1.100	0.200	mg/Kg	5	07/12/13	07/13/13
6020A/3050B	COBALT (CO)	2.4	0.57	0.460	0.110	mg/Kg	5	07/12/13	07/13/13
6010C/3050B	COPPER (CU)	8.1	0.57	0.460	0.110	mg/kg	1	07/09/13	07/10/13
6010C/3050B	IRON (FE)	2680	5.7	4.60	0.97	mg/kg	1	07/09/13	07/10/13
6010C/3050B	LEAD (PB)	0.460 U	0.57	0.460	0.180	mg/kg	1	07/09/13	07/10/13
6010C/3050B	MAGNESIUM (MG)	3630	5.7	4.60	1.50	mg/kg	1	07/09/13	07/10/13
6010C/3050B	MANGANESE (MN)	110	0.57	0.460	0.150	mg/kg	1	07/09/13	07/10/13
6010C/3050B	NICKEL (NI)	1.9	0.57	0.460	0.077	mg/kg	1	07/09/13	07/10/13
6010C/3050B	POTASSIUM (K)	827	114	57.0	16.0	mg/kg	1	07/09/13	07/10/13
6020A/3050B	SELENIUM (SE)	0.57 ~~0.53 J~~ U	1.10	0.570	0.230	mg/Kg	5	07/12/13	07/13/13 CCBL
6020A/3050B	SILVER (AG)	0.280 U	0.57	0.280	0.110	mg/Kg	5	07/12/13	07/13/13
6010C/3050B	SODIUM (NA)	452	114	57.0	13.0	mg/kg	1	07/09/13	07/10/13
6020A/3050B	THALLIUM (TL)	0.28 ~~0.23 J~~ U	0.57	0.280	0.110	mg/Kg	5	07/12/13	07/13/13 EBL
6010C/3050B	VANADIUM (V)	5.1	0.57	0.460	0.110	mg/kg	1	07/09/13	07/10/13
6010C/3050B	ZINC (ZN)	10.1	5.7	4.60	1.30	mg/kg	1	07/09/13	07/10/13

J = Estimated value.

Printed: 07/17/13 12:24:14 PM

PL-F1-SC-MCRes/MCPQL-REG MDLs

TBG 9-10-13

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni
Project: 424191.FI.FK.04 Vieques CTO 005
Sample ID: VE-UXO18-EB02-061313
Sample Collection Date: 06/13/13

ARF: 70987
APPL ID: AY81988

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
6010C/3010A	ALUMINUM (AL)	80.0U	100	80.0	27.4	ug/L	1	06/25/13	06/28/13
6020A/3015^	ANTIMONY (SB)	0.21J	1.0	0.50	0.14	ug/L	1	06/25/13	07/09/13
6020A/3015^	ARSENIC (AS)	0.11J	0.5	0.20	0.09	ug/L	1	06/25/13	07/09/13
6010C/3010A	BARIUM (BA)	4.00U	5.0	4.00	0.75	ug/L	1	06/25/13	06/28/13
6010C/3010A	BERYLLIUM (BE)	1.00U	2.0	1.00	0.24	ug/L	1	06/25/13	06/28/13
6020A/3015^	CADMIUM (CD)	0.10U	0.2	0.10	0.02	ug/L	1	06/25/13	07/09/13
6010C/3010A	CALCIUM (CA)	50.0U	100	50.0	27.5	ug/L	1	06/25/13	06/28/13
6020A/3015^	CHROMIUM (CR)	0.30J	0.5	0.20	0.07	ug/L	1	06/25/13	07/09/13
6020A/3015^	COBALT (CO)	0.40U	1.0	0.40	0.13	ug/L	1	06/25/13	07/09/13
6010C/3010A	COPPER (CU)	4.00U	5.0	4.00	1.71	ug/L	1	06/25/13	06/28/13
6010C/3010A	IRON (FE)	25.0U	50	25.0	9.0	ug/L	1	06/25/13	06/28/13
6010C/3010A	LEAD (PB)	4.00U	5.0	4.00	1.58	ug/L	1	06/25/13	06/28/13
6010C/3010A	MAGNESIUM (MG)	30.0U	50	30.0	12.9	ug/L	1	06/25/13	06/28/13
6010C/3010A	MANGANESE (MN)	4.00U	5.0	4.00	1.23	ug/L	1	06/25/13	06/28/13
6010C/3010A	NICKEL (NI)	3.00U	5.0	3.00	0.42	ug/L	1	06/25/13	06/28/13
6010C/3010A	POTASSIUM (K)	500.0U	1000	500.0	125.0	ug/L	1	06/25/13	06/28/13
6020A/3015^	SELENIUM (SE)	0.61J	1.0	0.40	0.10	ug/L	1	06/25/13	07/09/13
6020A/3015^	SILVER (AG)	0.10U	0.2	0.10	0.03	ug/L	1	06/25/13	07/09/13
6010C/3010A	SODIUM (NA)	500.0U	1000	500.0	111.1	ug/L	1	06/25/13	06/28/13
6020A/3015^	THALLIUM (TL)	0.19J	0.2	0.20	0.10	ug/L	1	06/25/13	07/09/13
6010C/3010A	VANADIUM (V)	4.00U	5.0	4.00	0.97	ug/L	1	06/25/13	06/28/13
6010C/3010A	ZINC (ZN)	20.0U	50	20.0	13.7	ug/L	1	06/25/13	06/28/13

J = Estimated value.

Printed: 07/15/13 4:04:06 PM
PL-F1-SC-MCRes/MCPQL-REG MDLs

TBG 9-10-13

Wet Lab Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

Sample ID: VE-UXO18-01SS03-0001
Sample Collection Date: 06/12/13

APPL ID: AY81984
ARF: 70987

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
(Solid Concentrations and Limits have been adjusted to reflect 20.4 Percent Moisture.)									
EPA 7196A/30	HEXAVALENT CHROMIUM	5.00 U	13.0	5.00	2.90	mg/kg	10	06/17/13	06/24/13
WalkBlk	TOTAL ORGANIC CARBON	68000	250.0	190.00	130.00	mg/Kg	1	06/20/13	06/20/13

Printed: 07/15/13 12:53:06 PM

APPL-F1-SC-MCRes/MCPQL-REG MDLs

TBG 9-10-13

Wet Lab Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

Sample ID: VE-UXO18-01SS02-0001
Sample Collection Date: 06/12/13

APPL ID: AY81985
ARF: 70987

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
(Solid Concentrations and Limits have been adjusted to reflect 18.4 Percent Moisture.)									
EPA 7196A/30	HEXAVALENT CHROMIUM	12.00 U	31.0	12.00	7.00	mg/kg	25	06/17/13	06/24/13
WalkBlk	TOTAL ORGANIC CARBON	64000	250.0	180.00	120.00	mg/Kg	1	06/20/13	06/20/13

Printed: 07/15/13 12:53:07 PM

APPL-F1-SC-MCRes/MCPQL-REG MDLs

TBG 9-10-13

Wet Lab Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

Sample ID: VE-UXO18-01SS01-0001

Sample Collection Date: 06/12/13

APPL ID: AY81986

ARF: 70987

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
(Solid Concentrations and Limits have been adjusted to reflect 11.4 Percent Moisture.)									
EPA 7196A/30	HEXAVALENT CHROMIUM	4.50 U	11.0	4.50	2.60	mg/kg	10	06/17/13	06/24/13
WalkBlk	TOTAL ORGANIC CARBON	48000	230.0	170.00	110.00	mg/Kg	1	06/20/13	06/20/13

Printed: 07/15/13 12:53:07 PM

APPL-F1-SC-MCRes/MCPQL-REG MDLs

TB6 9-10-13

Wet Lab Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

Sample ID: VE-UXO18-01SS01P-0001
Sample Collection Date: 06/12/13

APPL ID: AY81987
ARF: 70987

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
(Solid Concentrations and Limits have been adjusted to reflect 12.1 Percent Moisture.)									
EPA 7196A/30	HEXAVALENT CHROMIUM	4.60 U	11.0	4.60	2.60	mg/kg	10	06/17/13	06/24/13

Printed: 07/15/13 12:53:07 PM

APPL-F1-SC-MCRes/MCPQL-REG MDLs

TBG 9-10-13

Wet Lab Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

Sample ID: VE-UXO18-EB02-061313

Sample Collection Date: 06/13/13

APPL ID: AY81988

ARF: 70987

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
SW846 7196A	HEXAVALENT CHROMIUM	0.010 U J	0.02	0.010	0.006	mg/L	1	06/14/13	06/14/13 HT

Printed: 07/15/13 12:55:11 PM

APPL-F1-SC-NoMC-REG MDLs

TPG 9-10-13

Appendix B

Support Documentation

3.0
70987/70988

ELECTRONIC CHAIN OF CUSTODY RECORD

APPL, Inc.
908 N Temperance Ave
Clovis, CA 93611

Phone: (559) 275-2175
Fax: (559) 275-4422
C.O.C. 20130613-SMI-SS-APPL-01

Report to: PLEASE PRINT
Company Name: CH2MHILL
Phone: 703.376.5301
Address: 15010 Conference Dr. ; 200
Chantilly, VA 20151
Fax: 703.376.5801
Attn: Mike Zamboni

Invoice to: PLEASE PRINT
Company Name: See Contact
Phone:
Address:
Fax:
Attn:

Project Name/Number: Terrestrial UXO Site Sampling/424191.FI.FK.04
Purchase Order Number: 951152
Sampler (Print): not required
Sampler (Signature): not required

Date Shipped: 6/13/13
Carrier: FedEx
Waybill No.: 799990756650
Comments:

Analysis Requested/Method Number: Add. 2 MS #26-0848 Permeating prior to analysis; SW-846 8330 LM + HO + PETN no 8330A; SW-846-8321; SW-846 8650; SW-846 8330 Add. 2 Worksheet #15-3 Rpt; SW-846 8330A Add. 2 Worksheet #15-3 Rpt; SW-846 3060A 7196A; SW-846 8040D; Walkley Black; ASTM D1498; SW-846 8270D SIM 16 PAHs (see Add. 2 WS#15-1)

Sample Identification	Location	Date Collected	Time Collected	Time Zone	No. of Containers	Aq	Sed.	Soil		Add. 2 MS #26-0848 Permeating prior to analysis	SW-846 8330 LM + HO + PETN no 8330A	SW-846-8321	SW-846 8650	SW-846 8330 Add. 2 Worksheet #15-3 Rpt	SW-846 8330A Add. 2 Worksheet #15-3 Rpt	SW-846 3060A 7196A	SW-846 8040D	Walkley Black	ASTM D1498	SW-846 8270D SIM 16 PAHs (see Add. 2 WS#15-1)		Comments
VE-UXO18-01SS03-0001		6/12/13	10:05	AST	1			✓			X	X	X	X	X	X	X	X	X			
VE-UXO18-01SS02-0001		6/12/13	10:35	AST	1			✓			X	X	X	X	X	X	X	X	X			
VE-UXO18-01SS02-0001-MS		6/12/13	10:35	AST	1			✓			X	X	X	X	X	X						matrix spike
VE-UXO18-01SS02-0001-SD		6/12/13	10:35	AST	1			✓			X	X	X	X	X	X						matrix spike duplicate
VE-UXO18-01SS01-0001		6/12/13	10:45	AST	1			✓			X	X	X	X	X	X	X	X	X			
VE-UXO18-01SS01P-0001		6/12/13	10:50	AST	1			✓			X	X	X	X	X	X						
VE-UXO18-01SMI01-0613		6/12/13	12:05	AST	1			✓		X	X	X	X	X	X	X	X	X	X			
VE-UXO18-01SMI01T-0613		6/12/13	12:05	AST	1			✓		X	X	X	X	X	X	X						
VE-UXO18-01SMI01TT-0613		6/12/13	12:05	AST	1			✓		X	X	X	X	X	X	X						
VE-UXO18-01SMI02-0613		6/12/13	13:00	AST	1			✓		X	X	X	X	X	X	X	X	X	X			
VE-UXO18-01SMI02-0613-MS		6/12/13	13:00	AST	1			✓		X	X	X	X	X	X	X						matrix spike

Shuttle Temperature:

Turnaround Requested: Check one
☑ Stan 28 days ☐ One week ☐ 24/48 Hrs. ☐ Other

Sample Disposal:
~~☐ Return to client~~ ~~☐ Disposal by Lab (30 day retention)~~ not applicable

Relinquished by sampler:	Date 6/13/13	Time 13:00	Received by:	Relinquished by:	Date	Time	Received by:
Relinquished by:	Date	Time	Received by:	Relinquished by:	Date 6/14/13	Time 11:35	Received at lab by:

White: Return to client with report Yellow: Laboratory Copy Pink: Sampler

Note: The first sampled date of the ARF will be used as the COC number unless indicated otherwise.

APPL, Inc.
908 N Temperance Ave
Clovis, CA 93611

ELECTRONIC CHAIN OF CUSTODY RECORD

Phone: (559) 275-2175
Fax: (559) 275-4422
C.O.C. 20130613-SMI-SS-APPL-02

Report to: PLEASE PRINT
Company Name: CH2MHILL Phone: 703.376.5301
Address: 15010 Conference Dr. ; 200
Chantilly, VA 20151 Fax: 703.376.5801
Attn: Mike Zamboni

Invoice to: PLEASE PRINT
Company Name: See Contact Phone:
Address: Fax:
Attn:

Project Name/Number: Terrestrial UXO Site Sampling/424191.FI.FK.04
Purchase Order Number: 951152
Sampler (Print): not required
Sampler (Signature): not required

Date Shipped: 6/13/13
Carrier: FedEx
Waybill No.: 799990756650
Comments:

Sample Identification	Location	Date Collected	Time Collected	Time Zone	No. of Containers	Aq	Sed.	Soil		Add. 2 WS 825-5 SIM Processing prior to analysis	SW-846 8330B Lab + NO + PETN no 8270A	SW-846-8321	SW-846 8850	SW-846 8270D Add. 2 Worksheet # 15-0 Spk	SW-846 8270A Add. 2 Worksheet # 15-0 Spk	SW-846 3630A, 7196A	SW-846 9040D	Wadley Black	ASTM D1498	SW-846 8270D SIM 16 PAHs (see Add. 2 WS#15-1)		Comments
VE-UXO18-01SMI02-0613-SD		6/12/13	13:00	AST	1			✓			X	X	X	X	X	X						matrix spike duplicate
VE-UXO18-EB01-061313		6/13/13	12:00	AST	5	✓					X	X	X	X	X	X						equipment blank-SMI
VE-UXO18-EB02-061313		6/13/13	12:15	AST	5	✓					X	X	X	X	X	X						equipment blank-SS
									✓													
									✓													
									✓													
									✓													
									✓													

Shuttle Temperature:

Turnaround Requested: Check one
☑ Stan 28 days ☐ One week ☐ 24/48 Hrs. ☐ Other

Sample Disposal:
~~☐ Return to client~~ ~~☐ Disposal by Lab (30 day retention)~~ not applicable

	Date	Time	Received by:	Relinquished by:	Date	Time	Received by:
Relinquished by sampler:	6/13/13	1300					
Relinquished by:					6/14/13	11:35	Received at lab by:

White: Return to client with report Yellow: Laboratory Copy Pink: Sampler

Note: The first sampled date of the ARF will be used as the COC number unless indicated otherwise.

COOLER RECEIPT FORM

1) Project: 424191.FI.FK.04 Vieques CTO 005 Date Received: 6/14/13
2) Coolers: Number of Coolers: 1
3) YES NO Were coolers and samples screened for radioactivity?
4) YES NO Were custody seals on outside of cooler? How many? 2 Date on seal? 6/13/13
5) Name on seal? See Label
6) YES NO NA Were custody seals unbroken and intact at the time of arrival?
7) YES NO Did the cooler come with a shipping slip (air bill, etc.)? Carrier name: Fed Ex
8) Shipping slip numbers: 1) 7999 9075 6650 2) 3)
9) YES NO NA Was the shipping slip scanned into the database?
10) YES NO NA If cooler belongs to APPL, has it been logged into the ice chest database?
11) Describe type of packing in cooler (bubble wrap, popcorn, type of ice, etc.): bubble bag, Ziploc in wet ice
12) YES NO NA For hand delivered samples was sufficient ice present to start the cooling process?
13) YES NO Was a temperature blank included in the cooler?
14) Serial number of certified NIST thermometer used: A39267 Correction factor: 0
15) Cooler temp(s): 1) 3.0°C 2) 3) 4) 5) 6) 7) 8)

CUSTODY SEAL
DATE 6/13/13
SIGNATURE

Chain of custody:
16) YES NO Was a chain of custody received?
17) YES NO Were the custody papers signed in the appropriate places?
18) YES NO Was the project identifiable from custody papers?
19) YES NO Did the chain of custody include date and time of sampling?
20) YES NO Is location where sample was taken listed on the chain of custody?

Sample Labels:
21) YES NO Were container labels in good condition?
22) YES NO Was the client ID on the label?
23) YES NO Was the date of sampling on the label?
24) YES NO Was the time of sampling on the label?
25) YES NO Did all container labels agree with custody papers?

Sample Containers:
26) YES NO Were all containers sealed in separate bags?
27) YES NO Did all containers arrive unbroken?
28) YES NO Was there any leakage from samples?
29) YES NO Were any of the lids cracked or broken?
30) YES NO Were correct containers used for the tests indicated?
31) YES NO Was a sufficient amount of sample sent for tests indicated?
32) YES NO NA Were bubbles present in volatile samples? If yes, the following were received with air bubble
Larger than a pea:
Smaller than a pea:

Preservation & Hold time:
33) YES NO NA Was a sufficient amount of holding time remaining to analyze the samples?
34) YES NO NA Do the sample containers contain the same preservative as what is stated on the COC?
35) YES NO NA Was the pH taken of all non-VOA preserved samples and written on the sample container?
36) YES NO NA Was the pH of acid preserved non-VOA samples < 2?
37) YES NO NA Was the pH of sodium hydroxide preserved samples for Cyanide > 12 and Sulfide >9?
38) YES NO NA Unpreserved VOA Vials received?
39) YES NO NA Are unpreserved VOA vials noted in the ADD TEST FIELD on the ARF?

Lab notified if pH was not adequate:
Deficiencies: Received pH and Hex Chrome greater than 24 hours from collection time

Signature of personnel receiving samples: Jenny Tu Second reviewer: [illegible]
Signature of project manager notified: Renie Date and Time of notification: 6-17-13
Name of client notified: Date and Time of notification:
Information given to client:
by whom (Initials):

F:\Forms\Worksheet - CoolerReceipt.doc Revision 19, May 21, 2013

Chue Moua

From: Cynthia Clark [cclark@applinc.com]
Sent: Wednesday, June 19, 2013 12:36 PM
To: 'Chue Moua'; 'Leonard Fong'; 'APPL - Extractions'
Subject: changes to CH2m Hill Vieques ARF 70987

Per client request, I have added 8270-SIM analysis to sample AY81987 (VE-UXO18-01SS01P-0001).

Please remember that all the PAH samples on this ARF need Hexacloroethane only reported

Sincerely,

Cynthia Clark, Project Manager

APPL, Inc.
908 North Temperance Ave., Clovis, CA 93611
Phone: 559-275-2175
Fax: 559-275-4422
cclark@applinc.com
www.applinc.com

This is a PRIVATE and CONFIDENTIAL message. If you are not the intended recipient, please delete without copying and kindly advise us by e-mail of the mistake in delivery. NOTE: Regardless of content, this e-mail shall not operate to bind APPL, Inc. to any order or other contract unless pursuant to explicit written agreement or government initiative expressly permitting the use of e-mail for such purpose.

APPL - Receiving

From: Cynthia Clark [cclark@applinc.com]
Sent: Friday, June 14, 2013 11:46 AM
To: 'APPL - Receiving'; 'Chue Moua'; 'Renee Patterson'
Cc: 'extractions'; 'APPL - MIS'
Subject: FW: Vieques Soil Samples to be received 06/14/13
Attachments: 20130613_VQS_SMI_SS_COC_airbill_appl_01.pdf; CTF_samples rec at APPL 061413.doc

Importance: High

Here is the COC and change memo for samples to be received tomorrow.
Please log the SS and SMI samples on two different ARFs.
Please add comments for a PE sample to the SMI ARF. I think we will need a lab triplicate added to the SMI ARF as well.

Please add PAHs to the samples listed in the attached memo. The COC says they only sent 1 jar. If that is the case, please mark all those samples as limited volume. For the samples listed in the memo, please put "PAH$ HCA only" in the add test field.

VE-UXO18-EB02-061313 goes with SS samples
VE-UXO18-EB01-061313 goes with SMI samples

Sincerely,

Cynthia Clark, Project Manager

APPL, Inc.
908 North Temperance Ave., Clovis, CA 93611
Phone: 559-275-2175
Fax: 559-275-4422
cclark@applinc.com
www.applinc.com

This is a PRIVATE and CONFIDENTIAL message. If you are not the intended recipient, please delete without copying and kindly advise us by e-mail of the mistake in delivery. NOTE: Regardless of content, this e-mail shall not operate to bind APPL, Inc. to any order or other contract unless pursuant to explicit written agreement or government initiative expressly permitting the use of e-mail for such purpose.

From: Juliana.Dean@ch2m.com [mailto:Juliana.Dean@ch2m.com]
Sent: Friday, June 14, 2013 9:57 AM
To: cclark@applinc.com
Subject: Vieques Soil Samples

Hi Cynthia,

Attached are the COCs for samples shipped yesterday. There is one major issue. Almost all of these samples should be marked for SVOCs (hexachloroethane) but they are not. Could you let me know if you receive extra samples marked for SVOCs? I've attached the CTF memo, in case you do have enough volume.

Thank you!

Juliana Dean

Chemist I

MEMORANDUM **CH2MHILL**

Corrections to COCs

TO: Cynthia Clark, APPL

COPIES: File
Data Validation Package
Laboratory Package, Samples to be received 6/14/13

FROM: Juliana Dean
Project Chemist

DATE: June 14, 2013

This memo is to document corrections made to entries on the Chains of Custody (COC) and for Vieques, UXO Soil Sampling, CTO-005.

The corrections include changes to the requested analysis on the COC:

Sample ID	Date Collected	Time Collected	Analysis to be Added	SDG
VE-UXO18-01SS01-0001	6/12/2013	10:45	SW-846 8270D_SIM (Hexachloroethane only)	Not yet assigned
VE-UXO18-01SS02-0001	6/12/2013	10:35	SW-846 8270D_SIM (Hexachloroethane only)	Not yet assigned
VE-UXO18-01SS02-0001-MS	6/12/2013	10:35	SW-846 8270D_SIM (Hexachloroethane only)	Not yet assigned
VE-UXO18-01SS02-0001-SD	6/12/2013	10:35	SW-846 8270D_SIM (Hexachloroethane only)	Not yet assigned
VE-UXO18-01SS03-0001	6/12/2013	10:05	SW-846 8270D_SIM (Hexachloroethane only)	Not yet assigned
VE-UXO18-EB02-061313	6/13/2013	12:15	SW-846 8270D_SIM (Hexachloroethane only)	Not yet assigned

Sample receipt information

ARF: 70987

Project: 424191.F1.FK.04 Vieques CTO 005

Sample Receipt Information:

The samples were received on June 14, 2013, at 3.0°C. The samples were assigned Analytical Request Form (ARF) number 70987. The sample numbers and requested analyses were compared to the chain of custody and email communications. Limited sample volume was received for all soil samples. PAH Hexachloroethane analysis was added to five samples and the MS/MSD. No other exception was encountered.

Sample Table

CLIENT ID	APPL ID	Matrix	Date Sampled	Date Received
VE-UXO18-01SS03-0001	AY81984	SOIL	06/12/13	06/14/13
VE-UXO18-01SS02-0001	AY81985	SOIL	06/12/13	06/14/13
VE-UXO18-01SS01-0001	AY81986	SOIL	06/12/13	06/14/13
VE-UXO18-01SS01P-0001	AY81987	SOIL	06/12/13	06/14/13
VE-UXO18-EB02-061313	AY81988	WATER	06/13/13	06/14/13

Percent moisture was determined using CLP 4.0.

The samples and blanks were screened for J-value responses between the detection limit (DL) and limit of quantitation (LOQ).

APPL's laboratory control limits generated in house statistically do not meet the control limits listed in DoD QSM 4.2 for all analytes. Laboratory control spike recoveries for this project meet all control limits listed in the DoD QSM 4.2 except where noted. A copy of our in house generated control limits is available upon request. In addition, a copy of our LOQ control limits, established using 7 data points, are also available upon request.

Only the portion of the injection log relative to these samples is included. A full sequence log is available upon request.

Measurement uncertainty can be reported upon request.

EPA Method 8270D

Hexachloroethane

Sample Preparation:

The water sample was extracted according to EPA method 3510C and the soils according to EPA method 3550B. All holding times were met.

Sample Analysis Information:

The sample was analyzed for Hexachloroethane according to EPA Method 8270D using an Agilent GC/MS in selective ion monitoring mode.

Quality Control/Assurance

Spike Recovery

Laboratory Control Spikes (LCS) were used for quality assurance. All spike recovery criteria were met.

Sample VE-UXO18-01SS02-0001 was designated by the client for MS/MSD analysis. All spike recovery acceptance criteria were met.

Method blanks

No target analyte was detected above one-half the limit of quantitation (LOQ) in the method blanks.

Surrogates

Surrogate recoveries are summarized on the form 2 & 8. All surrogates had acceptable recoveries.

Calibration

The initial and continuing calibrations were performed according to the method. All method acceptance criteria were met.

Tuning:

The instrument was tuned using DFTPP. All method criteria were met.

Internal Standards

The internal standard area counts were compared to the mid-point of the initial calibration according to method 8270. All method criteria were met.

Summary:

No problem was encountered. The data generated are acceptable.

EPA Method 8330B
Explosives

Sample Preparation:

The soil samples were dried and extracted according to EPA method 8330B, without using incremental sampling procedures. The water sample was extracted according to the EPA 3535A method. All holding times were met.

Analysis:

The samples were analyzed according to EPA Method 8330B using an Agilent 1290 HPLC with DA detector. Manual integrations were performed in accordance with APPL's SOP. The following analytes were manually integrated in the calibration standards: HMX, Nitroglycerin and PETN. PETN was manually integrated in the LCS. Chromatograms of before and after manual integration are enclosed.

Quality Control/Assurance:

Spike Recovery

Laboratory Control Spikes (LCS/LCSD) were used for quality assurance. In the LCSD for the water extraction, HMX recovered below the lower control limit of 80% at 79.9%. All other spike acceptance criteria were met.

Sample VE-UXO18-01SS02-0001 was designated by the client for MS/MSD analysis. All recoveries were acceptable.

Method blanks:

No target analyte was detected above one-half the limit of quantitation (LOQ) in the method blanks.

Surrogates:

Surrogate recoveries are summarized on the form 2 & 8. All surrogates had acceptable recoveries.

Calibration:

The initial and continuing calibrations and second source (ICV) were analyzed according to the method. All calibration criteria were met.

Summary:

No other analytical problem was encountered. The data generated are acceptable.

EPA Method 6850

Perchlorate LC/MS

Sample Preparation:

The soil and water samples were prepared according to the method. All holding times were met. Insufficient volume was available to perform the client requested 10g extraction for sample VE-UXO18-01SS03-0001. The client was notified and a 1g extraction was performed for this sample.

Sample Analysis Information:

The samples were analyzed according to the EPA 6850 method and the DoD Perchlorate Handbook, Revision 1, Change 1, August 2007, using an Agilent 6460 LC-Triple Quad Mass Spec (ESI).

Quality Control/Assurance

Spikes and Duplicates:

Laboratory Control Spikes (LCS/LCSD) and an Interference Check Samples were used for quality assurance. All LCS and ICS recoveries met acceptance criteria.

Sample VE-UXO18-01SS02-0001 was designated by the client for MS/MSD analysis. Perchlorate recovered below the lower control limit of 80% at 74.2% and 76.7%.

Blanks:

The blanks did not contain Perchlorate at or above one-half the limit of quantitation (LOQ).

Calibrations:

Calibrations were performed according to the method.

Internal Standards:

The area counts of the sample Internal Standards were compared to the average area counts of the initial calibration. All internal standards were within the 50%D acceptance criteria.

Summary:

No other problem was encountered. Data generated are acceptable.

EPA Method 8321A
Picric Acid

Sample Preparation:

The soil samples were dried and extracted according to EPA method 8330B, without using incremental sampling procedures. The water sample was extracted according to the EPA 3535A method. All holding times were met.

Analysis:

The samples were analyzed according to EPA Method 8321A using an Agilent 1100 HPLC with Mass Spec detector and an Agilent 1290 HPLC with DA detector. Manual integrations were performed in accordance with APPL's SOP. The following analytes were manually integrated in the calibration standards: Picric Acid and 4-Nitrophenol. 4-Nitrophenol was manually integrated in sample VE-UXO18-01SS03-0001 and the MS/MSD. Picric Acid was manually integrated in the LCS, MS, and MSD. Chromatograms of before and after manual integration are enclosed.

Quality Control/Assurance:

Spike Recovery

Laboratory Control Spikes (LCS/LCSD) were used for quality assurance. All spike acceptance criteria was met.

Sample VE-UXO18-01SS02-0001 was designated by the client for MS/MSD analysis. All acceptance criteria were met.

Method blanks:

No target analyte was detected above one-half the limit of quantitation (LOQ) in the method blanks.

Surrogates:

Surrogate recoveries are summarized on the Form 2 & 8. All surrogates had acceptable recoveries. The surrogates were analyzed on a separate run sequence, since the surrogates require different instrument parameters than picric acid.

Calibration:

The initial and continuing calibrations and second source were analyzed according to the method. All calibration criteria were met.

Summary:

No other analytical problem was encountered.

EPA Methods 6010C and 6020A
Metals

Digestion Information:

The soil samples were digested according to EPA method 3050B. The water sample was digested according to EPA method 3010A. All holding times were met. Sample VE-UXO18-01SS01-0001 was not digested for metals analysis. Limited volume was received for this sample and all volume was exhausted by other departments performing the requested analyses. The client was notified.

Analysis Information:

Samples:

The samples were analyzed according to EPA method 6010C using a Perkin Elmer Optima 5300DV ICP and according to EPA method 6020A using an Agilent 7700x ICP-MS.

Calibrations:

Calibrations were performed according to the methods for the initial calibration and the initial calibration verification. The initial calibration verification is prepared from a second source standard. All calibration acceptance criteria were met.

Blanks:

No target analyte was detected above one-half the limit of quantitation (LOQ) in the method blanks.

Spikes:

Laboratory Control Spikes (LCS), matrix spikes (MS/MSD), post-digestion spikes (PDS), and dilution tests (DT) were used for quality assurance. All acceptance criteria were met in the LCS.

Sample VE-UXO18-01SS02-0001 was designated by the client for MS/MSD analysis. Twelve analytes recovered outside acceptance criteria in the MS/MSD. Eleven analytes were applicable for the DT, five of which recover outside acceptance criteria. Sixteen of the analytes were applicable for the PDS, six of which recover outside acceptance criteria.

For the water analytical batch, sample VE-UXO12-EB01-062013 was selected by the laboratory for MS/MSD analysis, which is included with in APPL report 71042.

Internal Standards

All acceptance criteria were met in the internal standards.

Summary:

No other analytical exception is noted.

Inorganic Analyses

EPA Method 7196A, 9045D, and Walkley-Black

Sample Preparation Information:

The water sample was prepared according to the EPA method 7196A. The soil sample was digested according to EPA method 3060A.

Analysis Information:

Samples:

The samples were analyzed for hexavalent chromium according to EPA method 7196A using a Thermo Electron Genesys 10uv Spectrophotometer. Dilutions were performed on 7196A soil samples due to dark appearance matrix. The soil was also analyzed for total organic carbon by the Walkley-Black method and for pH by EPA method 9045D. The soil was received after the EPA recommended holding time for pH, and the water was received after the EPA recommended holding time for hexavalent chromium. All other holding times were met.

Calibrations:

Calibrations were performed according to the methods for the initial calibration and the initial calibration verification. The initial calibration verification is prepared from a second source standard.

Blanks:

No target compound was detected at or above one-half the LOQ in the method blanks.

Spikes:

Laboratory Control Spikes (LCS/LCSD), matrix spikes (MS/MSD), and sample duplicate (DUP) were used for quality assurance. All acceptance criteria were met.

Sample VE-UXO18-01SS02-0001 was designated by the client for MS/MSD analysis. All MS/MSD and DUP recoveries were acceptable.

Summary:

No other analytical exception is noted. All data are acceptable.

METALS BLANK

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Method	Analyte	Result	LOQ	LOD	DL	Units	Prep Date	Analysis Date	QC Group
6010C	ALUMINUM (AL)	4.0 U	10	4.0	2.0	mg/kg	07/09/13	07/10/13	#6010C-130709A-AY81985
6010C	BARIUM (BA)	0.400 U	0.50	0.400	0.075	mg/kg	07/09/13	07/10/13	#6010C-130709A-AY81985
6010C	BERYLLIUM (BE)	0.200 U	0.20	0.200	0.044	mg/kg	07/09/13	07/10/13	#6010C-130709A-AY81985
6010C	CALCIUM (CA)	8.0 U	10	8.0	5.0	mg/kg	07/09/13	07/10/13	#6010C-130709A-AY81985
6010C	COPPER (CU)	0.400 U	0.50	0.400	0.094	mg/kg	07/09/13	07/10/13	#6010C-130709A-AY81985
6010C	IRON (FE)	4.00 U	5.0	4.00	0.85	mg/kg	07/09/13	07/10/13	#6010C-130709A-AY81985
6010C	LEAD (PB)	0.400 U	0.50	0.400	0.160	mg/kg	07/09/13	07/10/13	#6010C-130709A-AY81985
6010C	MAGNESIUM (MG)	4.00 U	5.0	4.00	1.29	mg/kg	07/09/13	07/10/13	#6010C-130709A-AY81985
6010C	MANGANESE (MN)	0.400 U	0.50	0.400	0.130	mg/kg	07/09/13	07/10/13	#6010C-130709A-AY81985
6010C	NICKEL (NI)	0.086 J	0.50	0.400	0.068	mg/kg	07/09/13	07/10/13	#6010C-130709A-AY81985
6010C	POTASSIUM (K)	50.0 U	100	50.0	13.9	mg/kg	07/09/13	07/10/13	#6010C-130709A-AY81985
6010C	SODIUM (NA)	50.0 U	100	50.0	11.1	mg/kg	07/09/13	07/10/13	#6010C-130709A-AY81985
6010C	VANADIUM (V)	0.400 U	0.50	0.400	0.100	mg/kg	07/09/13	07/10/13	#6010C-130709A-AY81985
6010C	ZINC (ZN)	4.00 U	5.0	4.00	1.15	mg/kg	07/09/13	07/10/13	#6010C-130709A-AY81985
6020A	ANTIMONY (SB)	0.200 U	0.20	0.200	0.100	mg/Kg	07/12/13	07/13/13	#6020A-130712A-AY81985
6020A	ARSENIC (AS)	0.300 U	0.50	0.300	0.080	mg/Kg	07/12/13	07/13/13	#6020A-130712A-AY81985
6020A	CADMIUM (CD)	0.080 U	0.10	0.080	0.030	mg/Kg	07/12/13	07/13/13	#6020A-130712A-AY81985
6020A	CHROMIUM (CR)	0.042 J	0.50	0.200	0.035	mg/Kg	07/12/13	07/13/13	#6020A-130712A-AY81985
6020A	COBALT (CO)	0.080 U	0.10	0.080	0.020	mg/Kg	07/12/13	07/13/13	#6020A-130712A-AY81985
6020A	SELENIUM (SE)	0.100 U	0.20	0.100	0.040	mg/Kg	07/12/13	07/13/13	#6020A-130712A-AY81985
6020A	SILVER (AG)	0.050 U	0.10	0.050	0.020	mg/Kg	07/12/13	07/13/13	#6020A-130712A-AY81985
6020A	THALLIUM (TL)	0.050 U	0.10	0.050	0.020	mg/Kg	07/12/13	07/13/13	#6020A-130712A-AY81985
6010C	ALUMINUM (AL)	80.0 U	100	80.0	27.4	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	BARIUM (BA)	4.00 U	5.0	4.00	0.75	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	BERYLLIUM (BE)	1.00 U	2.0	1.00	0.24	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	CALCIUM (CA)	50.0 U	100	50.0	27.5	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	COPPER (CU)	4.00 U	5.0	4.00	1.71	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	IRON (FE)	25.0 U	50	25.0	9.0	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	LEAD (PB)	4.00 U	5.0	4.00	1.58	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	MAGNESIUM (MG)	30.0 U	50	30.0	12.9	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	MANGANESE (MN)	4.00 U	5.0	4.00	1.23	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238

J = Estimated value.

Metals SC-Blank-REG MDLs
Printed: 07/17/13 12:29:25 PM

METALS BLANK

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Method	Analyte	Result	LOQ	LOD	DL	Units	Prep Date	Analysis Date	QC Group
6010C	POTASSIUM (K)	500.0 U	1000	500.0	125.0	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	SODIUM (NA)	146 J	1000	500.0	111.1	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	VANADIUM (V)	4.00 U	5.0	4.00	0.97	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	ZINC (ZN)	20.0 U	50	20.0	13.7	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6020A	ANTIMONY (SB)	0.18 J	1.0	0.50	0.14	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238
6020A	ARSENIC (AS)	0.20 U	0.5	0.20	0.09	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238
6020A	CADMIUM (CD)	0.10 U	0.2	0.10	0.02	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238
6020A	CHROMIUM (CR)	0.24 J	0.5	0.20	0.07	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238
6020A	COBALT (CO)	0.40 U	1.0	0.40	0.13	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238
6020A	SELENIUM (SE)	0.37 J	1.0	0.40	0.10	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238
6020A	SILVER (AG)	0.10 U	0.2	0.10	0.03	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238
6020A	THALLIUM (TL)	0.20 U	0.2	0.20	0.10	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238

J = Estimated value.

Metals SC-Blank-REG MDLs
Printed: 07/15/13 4:01:46 PM

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70987

Sample ID: VE-UXO18-EB02-061313

APPL ID: AY81988

Sample Collection Date: 06/13/13

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
6010C/3010A	ALUMINUM (AL)	80.0U	100	80.0	27.4	ug/L	1	06/25/13	06/28/13
6020A/3015^	ANTIMONY (SB)	0.21J	1.0	0.50	0.14	ug/L	1	06/25/13	07/09/13
6020A/3015^	ARSENIC (AS)	0.11J	0.5	0.20	0.09	ug/L	1	06/25/13	07/09/13
6010C/3010A	BARIUM (BA)	4.00U	5.0	4.00	0.75	ug/L	1	06/25/13	06/28/13
6010C/3010A	BERYLLIUM (BE)	1.00U	2.0	1.00	0.24	ug/L	1	06/25/13	06/28/13
6020A/3015^	CADMIUM (CD)	0.10U	0.2	0.10	0.02	ug/L	1	06/25/13	07/09/13
6010C/3010A	CALCIUM (CA)	50.0U	100	50.0	27.5	ug/L	1	06/25/13	06/28/13
6020A/3015^	CHROMIUM (CR)	0.30J	0.5	0.20	0.07	ug/L	1	06/25/13	07/09/13
6020A/3015^	COBALT (CO)	0.40U	1.0	0.40	0.13	ug/L	1	06/25/13	07/09/13
6010C/3010A	COPPER (CU)	4.00U	5.0	4.00	1.71	ug/L	1	06/25/13	06/28/13
6010C/3010A	IRON (FE)	25.0U	50	25.0	9.0	ug/L	1	06/25/13	06/28/13
6010C/3010A	LEAD (PB)	4.00U	5.0	4.00	1.58	ug/L	1	06/25/13	06/28/13
6010C/3010A	MAGNESIUM (MG)	30.0U	50	30.0	12.9	ug/L	1	06/25/13	06/28/13
6010C/3010A	MANGANESE (MN)	4.00U	5.0	4.00	1.23	ug/L	1	06/25/13	06/28/13
6010C/3010A	NICKEL (NI)	3.00U	5.0	3.00	0.42	ug/L	1	06/25/13	06/28/13
6010C/3010A	POTASSIUM (K)	500.0U	1000	500.0	125.0	ug/L	1	06/25/13	06/28/13
6020A/3015^	SELENIUM (SE)	0.61J	1.0	0.40	0.10	ug/L	1	06/25/13	07/09/13
6020A/3015^	SILVER (AG)	0.10U	0.2	0.10	0.03	ug/L	1	06/25/13	07/09/13
6010C/3010A	SODIUM (NA)	500.0U	1000	500.0	111.1	ug/L	1	06/25/13	06/28/13
6020A/3015^	THALLIUM (TL)	0.19J	0.2	0.20	0.10	ug/L	1	06/25/13	07/09/13
6010C/3010A	VANADIUM (V)	4.00U	5.0	4.00	0.97	ug/L	1	06/25/13	06/28/13
6010C/3010A	ZINC (ZN)	20.0U	50	20.0	13.7	ug/L	1	06/25/13	06/28/13

J = Estimated value.

Printed: 07/15/13 4:03:52 PM

PL-F1-SC-MCRes/MCPQL-REG MDLs

A.P.P.L. INC.

9

ICP SERIAL DILUTION

CLIENT SAMPLE NO.

VE-UXO18-01SS02-0001

Lab Name: A.P.P.L. INC.

Contract: CH2M Hill

ARF No.: 70987

SDG: 70987

Matrix: soil

Analysis Date: 07/10/13

Concentration Units: mg/kg

Analyte	Initial Sample Result (I)	C	Serial Dilution Result (S)	C	%D	Q	M
Aluminum (Al)	3646		4022		10.3		M
Barium (Ba)	39.95		46.87		17.3		M
Copper (Cu)	10.58		10.95		3.50		
Iron (Fe)	3052		3577		17.2		M
Potassium (K)	865.3		833.6		3.66		
Magnesium (Mg)	3899		4208		7.93		
Manganese (Mn)	149.9		173.5		15.7		M
Vanadium (V)	5.67		6.434		13.5		M

Comments:

07/10/13 13:31 AY81985S01

07/10/13 13:51 AY81985S01-1/5

A.P.P.L. INC.
3
BLANKS

Lab Name: A.P.P.L. INC. Contract: CH2M Hill

ARF No.: 70987 SDG: 70987

Preparation Blank Matrix (soil/water): soil

Preparation Blank Concentration Units (ug/L or mg/kg): mg/kg

Analysis Date: 07/10/13

Analyte	Initial Calibration Blank (ug/L)		Continuing Calibration Blank (ug/L)						Preparation Blank		M
		C	1	C	2	C	3	C		C	
	12:01		12:24		13:22		14:10		12:34		
Aluminum (Al)	100.00	U	24.80	J	100.00	U	30.60	J	10.00	U	P
Barium (Ba)	5 00	U	5.00	U	5.00	U	5.00	U	.50	U	P
Beryllium (Be)	2.00	U	.62	J	2.00	U	2.00	U	.20	U	P
Calcium (Ca)	100.00	U	100.00	U	100.00	U	172.00	*	10.00	U	*
Copper (Cu)	5.00	U	5.00	U	5.00	U	5.00	U	.50	U	P
Iron (Fe)	50.00	U	17.80	J	50.00	U	12.30	J	5.00	U	P
Potassium (K)	1000.00	U	1000.00	U	1000.00	U	1000.00	U	100.00	U	P
Magnesium (Mg)	50.00	U	23.10	J	13.20	J	23.60	J	5.00	U	P
Manganese (Mn)	5.00	U	5.00	U	5.00	U	5.00	U	.50	U	P
Sodium (Na)	1000.00	U	1000.00	U	1000.00	U	1000.00	U	100.00	U	P
Nickel (Ni)	5.00	U	1.16	J	5.00	U	5.00	U	.09	J	P
Lead (Pb)	5.00	U	5.00	U	5.00	U	5.00	U	.50	U	P
Vanadium (V)	5.00	U	5.00	U	5.00	U	5.00	U	.50	U	P
Zinc (Zn)	50.00	U	50.00	U	50.00	U	50.00	U	5.00	U	P

* not bracketing sample.
DRA 7/15/13

A.P.P.L. INC.
3
BLANKS

Lab Name: A.P.P.L. INC. Contract: CH2M Hill

ARF No.: 70987 SDG: 70987

Preparation Blank Matrix (soil/water): soil

Preparation Blank Concentration Units (ug/L or mg/kg): mg/Kg

Analysis Date: 07/12/13

Analyte	Initial Calibration Blank (ug/L)		Continuing Calibration Blank (ug/L)						Preparation Blank		M
		C	1	C	2	C	3	C		C	
	15:34		15:58		17:14		07:38		07:43		
Silver (Ag)	.50	U	.50	U	.50	U	.50	U	.10	U	P
Arsenic (As)	2.50	U	2.50	U	2.50	U	2.50	U	.50	U	P
Cadmium (Cd)	.50	U	.50	U	.50	U	.50	U	.10	U	P
Cobalt (Co)	.50	U	.50	U	.50	U	.50	U	.10	U	P
Chromium (Cr)	2.50	U	2.50	U	2.50	U	2.50	U	.04	J	P
Antimony (Sb)	1.00	U	1.00	U	1.00	U	1.00	U	.20	U	P
Selenium (Se)	1.00	U	1.00	U	1.00	U	.23	J	.20	U	P
Thallium (Tl)	.50	U	.50	U	.50	U	.50	U	.10	U	P

Matrix Spike Recoveries

METALS

APPL ID: **130709S-81985 MS - 179341**

Sample ID: AY81985

Client ID: VE-UXO18-01SS02-0001

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Method	Compound Name	Spike Lvl mg/kg	Matrix Res mg/kg	SPK Res mg/kg	DUP Res mg/kg	SPK % Recovery	DUP % Recovery	RPD	RPD Max	Recovery Limits	Extract Date-Spk	Analysis Date-Spk	Extract Date-Dup	Analysis Date-Dup	QC Group	QC Sample
EPA 6010C	ALUMINUM (AL)	421	3650	4760	4700	264 #	249 #	1.3	20	80-120	07/09/13	07/10/13	07/09/13	07/10/13	179341	AY81985
EPA 6010C	BARIUM (BA)	52.6	40.0	78.9	80.9	74.0 #	77.8 #	2.5	20	80-120	07/09/13	07/10/13	07/09/13	07/10/13	179341	AY81985
EPA 6010C	BERYLLIUM (BE)	10.5	ND	8.0	7.5	76.2 #	71.4 #	6.5	20	80-120	07/09/13	07/10/13	07/09/13	07/10/13	179341	AY81985
EPA 6010C	CALCIUM (CA)	5260	194000	196000	178000	38.0 #	-304 #	9.6	20	80-120	07/09/13	07/10/13	07/09/13	07/10/13	179341	AY81985
EPA 6010C	COPPER (CU)	52.6	10.6	54.2	50.8	82.9	76.4 #	6.5	20	80-120	07/09/13	07/10/13	07/09/13	07/10/13	179341	AY81985
EPA 6010C	IRON (FE)	211	3050	3700	3620	308 #	270 #	2.2	20	80-120	07/09/13	07/10/13	07/09/13	07/10/13	179341	AY81985
EPA 6010C	LEAD (PB)	52.6	ND	35.3	33.3	67.1 #	63.3 #	5.8	20	80-120	07/09/13	07/10/13	07/09/13	07/10/13	179341	AY81985
EPA 6010C	MAGNESIUM (MG)	5260	3900	8020	7600	78.3 #	70.3 #	5.4	20	80-120	07/09/13	07/10/13	07/09/13	07/10/13	179341	AY81985
EPA 6010C	MANGANESE (MN)	52.6	150	197	202	89.4	98.9	2.5	20	80-120	07/09/13	07/10/13	07/09/13	07/10/13	179341	AY81985
EPA 6010C	NICKEL (NI)	52.6	2.0	38.4	36.2	69.2 #	65.0 #	5.9	20	80-120	07/09/13	07/10/13	07/09/13	07/10/13	179341	AY81985
EPA 6010C	POTASSIUM (K)	1050	865	1810	1720	90.0	81.4	5.1	20	80-120	07/09/13	07/10/13	07/09/13	07/10/13	179341	AY81985
EPA 6010C	SODIUM (NA)	5260	512	4590	4270	77.5 #	71.4 #	7.2	20	80-120	07/09/13	07/10/13	07/09/13	07/10/13	179341	AY81985
EPA 6010C	VANADIUM (V)	52.6	5.7	45.1	42.1	74.9 #	69.2 #	6.9	20	80-120	07/09/13	07/10/13	07/09/13	07/10/13	179341	AY81985
EPA 6010C	ZINC (ZN)	105	17.4	85.9	82.3	65.2 #	61.8 #	4.3	20	80-120	07/09/13	07/10/13	07/09/13	07/10/13	179341	AY81985
EPA 6020A	ANTIMONY (SB)	51.0	0.33	44.2	44.0	86.0	85.6	0.5	20	80-120	07/12/13	07/13/13	07/12/13	07/13/13	179337	AY81985
EPA 6020A	ARSENIC (AS)	51.0	1.8	48.2	47.1	91.0	88.8	2.3	20	80-120	07/12/13	07/13/13	07/12/13	07/13/13	179337	AY81985
EPA 6020A	CADMIUM (CD)	10.2	0.26	9.7	9.2	92.5	87.6	5.3	20	80-120	07/12/13	07/13/13	07/12/13	07/13/13	179337	AY81985
EPA 6020A	CHROMIUM (CR)	51.0	7.5	54.5	52.4	92.2	88.0	3.9	20	80-120	07/12/13	07/13/13	07/12/13	07/13/13	179337	AY81985

= Recovery is outside QC limits.

Comments:

Matrix Spike Recoveries

METALS

APPL ID: **130712S-81985 MS - 179337**

Sample ID: AY81985

Client ID: VE-UXO18-01SS02-0001

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Method	Compound Name	Spike Lvl mg/Kg	Matrix Res mg/Kg	SPK Res mg/Kg	DUP Res mg/Kg	SPK % Recovery	DUP % Recovery	RPD	RPD Max	Recovery Limits	Extract Date-Spk	Analysis Date-Spk	Extract Date-Dup	Analysis Date-Dup	QC Group	QC Sample
EPA 6020A	COBALT (CO)	51.0	2.0	46.1	44.6	86.5	83.5	3.3	20	80-120	07/12/13	07/13/13	07/12/13	07/13/13	179337	AY81985
EPA 6020A	SELENIUM (SE)	51.0	0.61	44.2	44.2	85.5	85.5	0.0	20	80-120	07/12/13	07/13/13	07/12/13	07/13/13	179337	AY81985
EPA 6020A	SILVER (AG)	20.4	0.034	17.6	17.1	86.1	83.7	2.9	20	80-120	07/12/13	07/13/13	07/12/13	07/13/13	179337	AY81985
EPA 6020A	THALLIUM (TL)	51.0	0.21	47.1	45.5	91.9	88.8	3.5	20	80-120	07/12/13	07/13/13	07/12/13	07/13/13	179337	AY81985

= Recovery is outside QC limits.

Comments:

Wet Lab Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

Sample ID: VE-UXO18-EB02-061313
Sample Collection Date: 06/13/13 1215

APPL ID: AY81988
ARF: 70987

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
SW846 7196A	HEXAVALENT CHROMIUM	0.010 U	0.02	0.010	0.006	mg/L	1	06/14/13	06/14/13 1705

Printed: 07/15/13 12:55:11 PM

APPL-F1-SC-NoMC-REG MDLs

Appendix C

Data Validation Checklists

Hexachloroethane only

YES NO N/A

E - The concentration of this analyte exceeds the calibration range of the instrument.

A - Indicates a Tentatively Identified Compound (TIC) is a suspected adol-condensation product.

X,Y,Z- Laboratory defined flags. The data reviewer must change these qualifiers during validation so that the data user may understand their impact on the data.

I. PACKAGE COMPLETENESS AND DELIVERABLES

CASE NUMBER: 70987 LAB: APPL, Inc.

SITE NAME: E. Vieques UXO Sites

1.0 Data Completeness and Deliverables

1.1 Has all data been submitted in CLP deliverable format? [✓] ___ ___

ACTION: If not, note the effect on review of the data in the data assessment narrative.

2.0 Cover Letter, SDG Narrative

2.1 Is a laboratory narrative or cover letter present? [✓] ___ ___

2.2 Are case number and SDG number(s) contained in the narrative or cover letter? [✓] ___ ___

	YES	NO	N/A

II. SEMIVOLATILE ANALYSES

1.0 Traffic Reports and Laboratory Narrative *VCS-1

1.1 Are the Traffic Report Forms present for all samples? [✓] ___ ___

ACTION: If no, contact lab for replacement of missing or illegible copies.

1.2 Do the Traffic Reports or Lab Narrative indicate any problems with sample receipt, condition of samples, analytical problems or special notations affecting the quality of the data? ✓ [ ] ___

Insufficient sample to analyze VE-UX018-015501-0001 for metals

ACTION: If any sample analyzed as a soil, other than TCLP, contains 50%-90% water, all data should be flagged as estimated ("J"). If a soil sample, other than TCLP, contains more than 90% water, all non-detects data are qualified as unusable (R), and detects are flagged "J".

ACTION: If samples were not iced, or if the ice was melted upon arrival at the laboratory and the cooler temperature was elevated (10°C), flag all positive results "J" and all non-detects "UJ".

2.0 Holding Times

2.1 Have any semivolatile technical holding times, determined from date of collection to date of extraction, been exceeded? ___ [✓] ___

Continuous extraction of water samples for semivolatile analysis must be started within **7** days of the date of collection. Soil/sediment samples must be extracted within **14** days of collection. Extracts must be analyzed within

YES NO N/A

40 days of the date of extraction.

Table of Holding Time Violations

(See Traffic Report)

Sample ID	Sample Matrix	Date Sampled	Date Lab Received	Date Extracted	Date Analyzed

ACTION: If technical holding times are exceeded, flag all positive results as estimated ("J") and sample quantitation limits as estimated ("UJ"), and document in the narrative that holding times were exceeded.

If analyses were done more than 14 days beyond holding time, either on the first analysis or upon re analysis, the reviewer must use professional judgement to determine the reliability of the data and the effects of additional storage on the sample results. At a minimum, all results should be qualified "J", but the reviewer may determine that non-detect data are unusable ("R"). If holding times are exceeded by more than 28 days, all non-detect data are unusable (R).

	YES	NO	N/A
3.0 Surrogate Recovery (Form II/Equivalent)			
3.1 Have the semi volatile surrogate recoveries been listed on CLP Surrogate Recovery forms (Form II) for each of the following matrices:			
a. Low Water	[✓]	___	___
b. Low/Med Soil	[✓]	___	___
3.2 If so, are all the samples listed on the appropriate Surrogate Recovery Summary forms for each matrix:			
a. Low Water	[✓]	___	___
b. Low/Med Soil	[✓]	___	___
ACTION: If CLP deliverables are unavailable, document the effect(s) in data assessments. In some cases the lab may have to be contacted to obtain the data necessary to complete the validation.			
3.3 Were outliers marked correctly with an asterisk?	[ ]	___	✓
ACTION: Circle all outliers in red.			
3.4 Were two or more base neutral OR acid surrogate recoveries out of specification for any sample or method blank (Reviewer should use lab in house recovery limits. Use surrogate recovery limits from USEPA National Functional Guidlines January 2005 page 130, if in house limits are not available. See Method 8000B-43 or 80000C-24).	[ ]	✓	___
Note: Examine lab in house limits for reasonableness.			
If yes, were samples re-analyzed?	[ ]	___	✓

	YES	NO	N/A
Were method blanks re-analyzed?	[ ]	✓	___

ACTION: If all surrogate recoveries are > 10% but two within the base-neutral or acid fraction do not meet method specifications, <u>for the affected fraction only (i.e. either base-neutral or acid compounds):</u>

1. Flag all positive results as estimated ("J").

2. Flag all non-detects as estimated detection limits ("UJ") when recoveries are less than the lower acceptance limit.

3. If recoveries are greater than the upper acceptance limit, do not qualify non-detects.

If any base-neutral <u>or</u> acid surrogate has a recovery of < 10%:

1. Positive results for the fraction with < 10% surrogate recovery are qualified with "J".

2. Non-detects for that fraction should be qualified as unusable (R) .

NOTE: Professional judgement should be used to qualify data that have method blank surrogate recoveries out of specification in both original and reanalyses. Check the internal standard areas.

3.5 Are there any transcription/calculation errors between raw data and Form II?	___	[✓]	___

ACTION: If large errors exist, call lab for explanation/resubmittal, make any necessary corrections and document

YES NO N/A

effect in data assessments.

4.0 Matrix Spikes (Form III/Equivalent)

4.1 Have the semivolatile Matrix Spike and Matrix Spike Duplicate/or duplicate unspiked Sample recoveries been listed on the Recovery Form (Form III)? [✓] ___ ___

NOTE: Method 3500B/page 4 states the spiking compounds:

Base/neutrals	Acids
1,2,4-Trichlorobenzene	Pentachlorophenol
Acenaphthene	Phenol
2,4-Dinitrotoluene	2-Chlorophenol
Pyrene	4-Chloro-3-methylphenol
N-Nitroso-di-n-propylamine	4-Nitrophenol
1,4-Dichlorobenzene	

Note: Some projects may require the spiking of specific compounds of interest.

Note: See Method 8270D-sec 8.4.2 for deciding on whether to prepare and analyze duplicate samples or a martix spike/matrix spike duplicate. If samples are expected to contain target analytes, then laboratory may use one matrix spike and a duplicate analysis of an unspiked field sample. If samples are not expected to contain target analytes, laboratory should use a matrix spike and matrix spike duplicate pair.

4.2 Were matrix spikes analyzed at the required frequency for each of the following matrices:

a. Low Water [ ] ✓ ___

b. Low Solid [✓] ___ ___

c. Med Solid [ ] ___ ✓

YES NO N/A

ACTION: If any matrix spike data are missing, take the action specified in 3.2 above. It may be necessary to contact the lab to obtain the required data.

NOTE: If the data has not been reported on CLP equivalent form, then the laboratory must provide the information necessary to evaluate the spike recoveries in the MS and MSD. The required data which should have been provided by the lab include the analytes and concentrations used for spiking, background concentrations of the spiked analytes (i.e., concentrations in unspiked sample), methods and equations used to calculate the QC acceptance criteria for the spiked analytes, percent recovery data for all spiked analytes.

The data reviewer must verify that all reported equations and percent recoveries are correct before proceeding to the next section.

4.3 Were matrix spikes performed at concentration equal to 100ug/L for acid compounds, and 200ug/l for base compounds (Method 3500B-4), or those specified in project plan. [✓] ___ ___

4.4 How many semivolatile spike recoveries are outside Laboratory in house MS/MSD recovery limits (use recovery limits values in Method 8270D-43&44 Table 6 if in house values not available).

Water	Solids
0 out of 0	0 out of 2

YES NO N/A

4.5 How many RPD's for matrix spike and matrix spike duplicate recoveries are outside QC limits?

Water: 0 out of 0

Solids: 0 out of 1

ACTION: Circle all outliers with red pencil.

ACTION: No action is taken on MS/MSD data alone. However, using informed professional judgement, the data reviewer may use the matrix spike and matrix spike duplicate results in conjunction with other QC criteria to determine the need for some qualification of the data.

4.6 Was a Laboratory Control Sample (LCS) analyzed with each analytical batch? [✓] ___ ___

NOTE: When the results of the matrix spike analysis indicate a potential problem due to the sample matrix itself, the LCS results are used to verify that the laboratory can perform the analysis in a clean matrix.

5.0 Blanks (Form IV/Equivalent) *VCS-2

5.1 Is the Method Blank Summary (Form IV) present? [✓] ___ ___

5.2 Frequency of Analysis:

Has a reagent/method blank analysis been reported per 20 samples of similar matrix, or concentration level, and for each extraction batch? [✓] ___ ___

5.3 Has a method blank been analyzed either after

	YES	NO	N/A
the calibration standard or at any other time during the analytical shift for each GC/MS system used ?	[✓]	___	___

ACTION: If any method blank data are missing, call lab for explanation/resubmittal. If not available, use professional judgement to determine if the associated sample data should be qualified.

5.4 Chromatography: review the blank raw data - chromatograms (RICs), quant reports or data system printouts and spectra.

	YES	NO	N/A
Is the chromatographic performance (baseline stability) for each instrument acceptable for the semivolatiles?	[✓]	___	___

ACTION: Use professional judgement to determine the effect on the data.

6.0 Contamination

NOTE: "Water blanks", "drill blanks" and "distilled water blanks" are validated like any other sample and are not used to qualify the data. Do not confuse them with the other QC blanks discussed below.

	YES	NO	N/A
6.1 Do any method/instrument/reagent blanks have positive results for target analytes and/or TICs? When applied as described below, the contaminant concentration in these blanks are multiplied by the sample dilution factor and corrected for percent moisture where necessary.	___	[✓]	___
6.2 Do any field/rinse/ blanks have positive results for target analytes and/or TICs (if required, see section 10 below)?	___	[✓]	___

YES NO N/A

ACTION: Prepare a list of the samples associated with each of the contaminated blanks. (Attach a separate sheet.)

NOTE: All field blank results associated to a particular group of samples (may exceed one per case) must be used to qualify data. Blanks may not be qualified because of contamination in another blank. Field Blanks must be qualified for outlying surrogates, poor spectra, instrument performance or calibration QC problems.

ACTION: Follow the directions in the table below to qualify sample results due to contamination. Use the largest value from all the associated blanks. If gross contamination exists, all data in the associated samples should be qualified as unusable (R).

YES NO N/A

Blank Action for Semivolatile Analyses

Blank Type	Blank Result	Sample Result	Action for Samples
Method, Field	Detects	Not detected	No qualification required
	< CRQL *	< CRQL	Report CRQL value with a U
		≥ CRQL	No qualification required
	= CRQL *	< CRQL	Report CRQL value with a U
		≥ CRQL	No qualification required
	> CRQL *	< CRQL	Report CRQL value with a U
		≥ CRQL and < blank contamination	Report concentration of sample with a U
		≥ CRQL and ≥ blank contamination	No qualification required

NOTE: Analytes qualified "U" for blank contamination are still considered as "hits" when qualifying for calibration criteria.

NOTE: If the laboratory did not report TIC analyses, check the project plans to verify whether or not it was required.

6.3 Are there field/rinse/equipment blanks associated with every sample? [✓] ___ ___

ACTION: For low level samples, note in data assessment that there is no associated field/rinse/equipment blank. Exception: samples taken from a drinking water tap do not have associated field blanks.

6.4 Was a instrument blank analyzed after each sample/dilution which contained a target compound

	YES	NO	N/A
that exceeded the initial calibration range.	[ ]	___	✓
6.5 Does the instrument blank have positive results for target analytes and/or TICs?	___	[✓]	___

Note: Use professional judgement to determine if carryover occurred and qualify analytes accordingly.

7.0 GC/MS Apparatus and Materials

	YES	NO	N/A
7.1 Did the lab use the proper gas chromatographic column for analysis of semivolatiles by Method 8270D? Check raw data, instrument logs or contact the lab to determine what type of column was used. The method requires the use of 30 m x 0.25 mm ID (or 0.32 mm ID), silicone-coated, fused silica, capillary column.	[✓]	___	___

ACTION: If the specified column, or equivalent, was not used, document the effects in the data assessment. Use professional judgement to determine the acceptability of the data.

8.0 GC/MS Instrument Performance Check (Form V/Equivalent)

	YES	NO	N/A
8.1 Are the GC/MS Instrument Performance Check Forms (Form V) present for decafluorotriphenylphosphine (DFTPP)?	[✓]	___	___

NOTE: The performance solution should also contain 4,4-DDT, pentachlorophenol, and benzidine to verify injection port inertness and column performance. The degradation of DDT to DDE and DDD must be less than 20% total and the response of pentachlorophenol and benzidine should be within normal ranges for these compounds (based upon lab experience) and show no peak degradation or tailing before samples are analyzed. (see section 5.5

	YES	NO	N/A
page 8270D-12).			
8.2 Are the enhanced bar graph spectrum and mass/charge (m/z) listing for the DFTPP provided for each twelve hour shift?	[✓]	___	___
8.3 Has an instrument performance check solution been analyzed for every twelve hours of sample analysis per instrument?	[✓]	___	___

ACTION: List date, time, instrument ID, and sample analyses for which no associated GC/MS tuning data are available.

DATE	TIME	INSTRUMENT	SAMPLE NUMBERS
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

ACTION: If lab cannot provide missing data, reject ("R") all data generated outside an acceptable twelve hour calibration interval.

ACTION: If mass assignment is in error, flag all associated sample data as unusable (R).

8.4 Have the ion abundances been normalized to m/z 198?	[✓]	___	___
8.5 Have the ion abundance criteria been met for each instrument used?	[✓]	___	___

ACTION: List all data which do not meet ion abundance criteria (attach a separate sheet).

	YES	NO	N/A
ACTION: If ion abundance criteria are not met, take action specified in section 3.2			
8.6 Are there any transcription/calculation errors between mass lists and Form Vs? (Check at least two values but if errors are found, check more.)	___	[✓]	___
8.7 Have the appropriate number of significant figures (two) been reported?	[✓]	___	___
ACTION: If large errors exist, call lab for explanation/resubmittal, make necessary corrections and document effect in data assessments.			
8.8 Are the spectra of the mass calibration compound acceptable?	[✓]	___	___
ACTION: Use professional judgement to determine whether associated data should be accepted, qualified, or rejected.			
9.0 Target Analytes			
9.1 Are the Organic Analysis Data Sheets (Form I) present with required header information on each page, for each of the following:			
a. Samples and/or fractions as appropriate	[✓]	___	___
b. Matrix spikes and matrix spike duplicates	[✓]	___	___
c. Blanks	[✓]	___	___
9.2 Has any special cleanup, such as GPC, been performed on all soil/sediment sample extracts (see section 7.2, page 8270D-14)?	[✓]	___	___

	YES	NO	N/A
ACTION: If data suggests that extract cleanup was not performed, use professional judgement. Make note in the data assessment narrative.			
9.3 Are the Reconstructed Ion Chromatograms, mass spectra for the identified compounds, and the data system printouts (Quant Reports) included in the sample package for each of the following?			
a. Samples and/or fractions as appropriate	[✓]	___	___
b. Matrix spikes and matrix spike duplicates (Mass spectra not required)	[✓]	___	___
c. Blanks	[✓]	___	___
ACTION: If any data are missing, take action specified in 3.2 above.			
9.4 Are the response factors shown in the Quant Report?	[✓]	___	___
9.5 Is chromatographic performance acceptable with respect to:			
Baseline stability?	[✓]	___	___
Resolution?	[✓]	___	___
Peak shape?	[✓]	___	___
Full-scale graph (attenuation)?	[✓]	___	___
Other:_____	[ ]	___	___
ACTION: Use professional judgement to determine the acceptability of the data.			
9.6 Are the lab-generated standard mass spectra of identified semivolatile compounds present for			

	YES	NO	N/A
each sample?	[✓]	___	___

ACTION: If any mass spectra are missing, take action specified in 3.2 above. If the lab does not generate their own standard spectra, make a note in the data assessment narrative. If spectra are missing, reject all positive data.

9.7 Is the RRT of each reported compound within 0.06 RRT units of the standard RRT in the continuing calibration?	[✓]	___	___
9.8 Are all ions present in the standard mass spectrum at a relative intensity greater than 10% (of the most abundant ion) also present in the sample mass spectrum?	[✓]	___	___
9.9 Do the relative intensities of the characteristic ions in the sample agree within ± 30% of the corresponding relative intensities in the reference spectrum?	[✓]	___	___

ACTION: Use professional judgement to determine acceptability of data. If it is determined that incorrect identifications were made, all such data should be rejected (R), flagged "N" (Presumptive evidence of the presence of the compound) or changed to not detected (U) at the calculated detection limit. In order to be positively identified, the data must comply with the criteria listed in 9.7, 9.8, and 9.9.

ACTION: When sample carry-over is a possibility, professional judgement should be used to determine if instrument cross-contamination has affected any positive compound identification.

	YES	NO	N/A

10.0 Tentatively Identified Compounds (TIC)

10.1 If Tentatively Identified Compounds were required for this project, are all Form Is, Part B present; and do listed TICs include scan number or retention time, estimated concentration and "JN" qualifier?

NOTE: Review sampling reports to determine if the lab was required to identify non target analytes (refer to section 7.6.2,page 8270D-21).

	YES	NO	N/A
10.2 Are the mass spectra for the tentatively identified compounds and associated "best match" spectra included in the sample package for each of the following:	[✓]	___	___
a. Samples and/or fractions as appropriate	[✓]	___	___
b. Blanks	[✓]	___	___

ACTION: If any TIC data are missing, take action specified in 3.2 above.

ACTION: Add "JN" qualifier only to analytes identified by CAS #.

	YES	NO	N/A
10.3 Are any target compounds from one fraction listed as TIC compounds in another (e.g., an acid compound listed as a base neutral TIC)?	___	[✓]	___

ACTION: i. Flag with "R" any target compound listed as a TIC.

ii. Make sure all rejected compounds are properly reported in the other fraction.

10.4 Are all ions present in the reference mass spectrum with a relative intensity greater than 10% (of the most abundant ion) also present in the

	YES	NO	N/A
sample mass spectrum?	✓		
10.5 Do TIC and "best match" standard relative ion intensities agree within ± 20%?	✓		

ACTION: Use professional judgement to determine acceptability of TIC identifications. If it is determined that an incorrect identification was made, change the identification to "unknown" or to some less specific identification (example: "C3 substituted benzene") as appropriate and remove "JN". Also, when a compound is not found in any blank, but is a suspected artifact of a common laboratory contaminant, the result should be qualified as unusable, "R."

11.0 Compound Quantitation and Reported Detection Limits

	YES	NO	N/A
11.1 Are there any transcription/calculation errors in Form I results? Check at least two positive values. Verify that the correct internal standard, quantitation ion, and RRF were used to calculate Form I result. Were any errors found?		✓	

NOTE: Structural isomers with similar mass spectra, but insufficient GC resolution (i.e. percent valley between the two peaks > 25%) should be reported as isomeric pairs. The reviewer should check the raw data to ensure that all such isomers were included in the quantitation (i.e., add the areas of the two coeluting peaks to calculate the total concentration).

	YES	NO	N/A
11.2 Are the method detection limits adjusted to reflect sample dilutions and, for soils, sample moisture?	✓		

YES NO N/A

ACTION: If errors are large, call lab for explanation/resubmittal, make any necessary corrections and document effect in data assessments.

ACTION: When a sample is analyzed at more than one dilution, the lowest detection limits are used (unless a QC exceedance dictates the use of the higher detection limit from the diluted sample data). Replace concentrations that exceed the calibration range in the original analysis by crossing out the "E" and it's associated value on the original Form I (if present) and substituting the data from the analysis of the diluted sample. Specify which Form I is to be used, then draw a red " X" across the entire page of all Form I's that should not be used, including any in the summary package.

12.0 Standards Data (GC/MS)

12.1 Are the Reconstructed Ion Chromatograms, and data system printouts (Quant, Reports) present for initial and continuing calibration? [✓] ___ ___

ACTION: If any calibration standard data are missing, take action specified in 3.2 above.

13.0 GC/MS Initial Calibration (Form VI/Equivalent) *-VCS-3

13.1 Is the Initial Calibration Form (Form VI/ Equivalent) present and complete for the semivolatile fraction? [✓] ___ ___

ACTION: If any calibration forms or standard row data are missing, take action specified in 3.2 above.

13.2 Are all base neutral or acid RRFs > 0.050? [✓] ___ ___

YES NO N/A

Check the **average RRFs** of the four System Performance Check Compounds (SPCCs): N-nitroso-di-n-propylamine, hexachlorocyclopentadiene, 2,4-dinitrophenol, and 4-nitrophenol. These compounds must have **average RRFs** greater than or equal to 0.05 before running samples and should not show any peak tailing.

ACTION: Circle all outliers in red.

ACTION: For any target analyte with **average RRF <0.05**

1. "R" all non-detects;

2. "J" all positive results.

13.3 Are response factors for base neutral or acid target analytes stable over the concentration range of the calibration (% Relative standard deviation [%RSD] < 20.0%)? [✓] ___ ___

NOTE: The % RSD for each individual Calibration Check Compound (CCC, Method 8270D-40 see Table 4) must be less than 30% before analysis can begin. If grater 30%, the lab must clean and recalibrate the instrument.

CALIBRATION CHECK COMPOUNDS

Base/Neutral Fraction	Acid Fraction
Acenaphthene	4-Chloro-3-methylphenol
1,4-Dichlorobenzene	2,4-Dichlorophenol
Hexachlorobutadiene	2-Nitrophenol
Diphenylamine	Phenol
Di-n-octyl phthalate	Pentachlorophenol
Fluoranthene	2,4,6-Trichlorophenol

	YES	NO	N/A
Benzo(a)pyrene			

ACTION: If the %RSD for any CCC >30% and no corrective action taken, then "J" qualify all positive hits and "UJ" qualify all non-detects.

ACTION: Circle all outliers in red.

ACTION: If the % RSD is ≥ 20.0%, qualify positive results for that analyte "J" and non-detects using professional judgement. When RSD > 90%, flag all non- detect results for that analyte "R," unusable. Alternatively, the lab should calculate first or second order regression fit of the calibration curve and select the fit which introduces the least amount of error.

NOTE: Analytes previously qualified "U" due to blank contamination are still considered as "hits" when qualifying for calibration criteria.

	YES	NO	N/A
13.4 Did the laboratory calculate the calibration curve by the least squares regression fit?	___	[✓]	___
13.5 Are there any transcription/calculation errors in the reporting of average response factors (RRF) or % RSD? (Check at least two values but if errors are found, check more.)	___	[✓]	___

ACTION: Circle Errors in red.

ACTION: If errors are large, call lab for explanation/resubmittal, make any necessary corrections and note errors in data assessments.

	YES	NO	N/A
13.5 Do the target compounds for this SDG include Pesticides?	[ ]	✓	___

	YES	NO	N/A
13.6 If the pesticide compounds include DDT, was the percent breakdown of DDT to DDD and DDE greater than 20%?			✓

ACTION: If DDT percent breakdown exceeds 20%:

i. Qualify all positive results for DDT with "J". If DDT was not detected, but DDD and DDE results are positive, qualify the quantitation limit for DDT as unusable, "R".

ii. Qualify all positive results for DDD and DDE as presumptively present at an approximate concentration "JN".

14.0 <u>GC/MS Calibration Verification (Form VII/Equivalent)</u>

14.1 Are the Calibration Verification Forms (Form VII) present and complete for all compounds of interest?	✓		
14.2 Has a calibration verification standard been analyzed for every twelve hours of sample analysis per instrument?	✓		

ACTION: List below all sample analyses that were not within twelve hours of a calibration verification analysis for each instrument used.

_____

_____

_____

ACTION: If any forms are missing or no calibration verification standard has been analyzed within twelve hours of every sample analysis,

	YES	NO	N/A
call lab for explanation/resubmittal. If continuing calibration data are not available, flag all associated sample data as unusable ("R").			
14.3 Do any of the SPCCs have an RRF <0.05?	___	[✓]	___
If YES, make a note in data assessment if the lab did not take corrective action specified in section 7.4.4, page 8270D-18.	[ ]	___	___
14.4 Do any of the CCCs have a %D between the initial and continuing RRF which exceeds 20.0%?			
ACTION: If yes, make a note in data assessment.			
14.5 Do any semivolatile compounds have a % Difference (% D) between the initial and continuing RRF which exceeds 20.0%?	___	[✓]	___
ACTION: Circle all outliers in red.			
ACTION: Qualify both positive results and non-detects for the outlier compound(s) as estimated (J). When %D is above 90%, qualify all non-detects for that analyte as "R", unusable.			
14.6 Do any semivolatile compounds have a RRF < 0.05?	___	[✓]	___
ACTION: Circle all outliers in red.			
ACTION: If RRF < 0.05, qualify as unusable ("R") associated non-detects and "J" associated positive values.			
14.7 Are there any transcription/calculation errors in the reporting of average response factors (RRF) or percent difference (%D) between initial and continuing RRFs? (Check at least two values but if errors are found, check more).	___	[✓]	___

	YES	NO	N/A

ACTION: Circle errors in red.

ACTION: If errors are large, call lab for explanation/resubmittal, make any necessary corrections and document effect(s) in the data assessments.

15.0 Internal Standards (Form VIII)

15.1 Are the internal standard areas (Form VIII) of every sample and blank within the upper and lower limits (-50% to + 100%) for each continuing calibration? [✓] ___ ___

ACTION: List each outlying internal standard below.

Sample ID	IS #	Area	LowerLimit	Upper Limit

(Attach additional sheets if necessary.)

Note: Check Table 5, 8270D-41 for associated analytes.

ACTION:

i. If the internal standard area count is outside the upper or lower limit, flag with "J" all positive results and non-detects (U values) quantitated with this internal standard.

ii. Non-detects associated with IS > 100% should not be qualified.

	YES	NO	N/A
iii. If the IS area is below the lower limit (<50%), qualify all associated non-detects (U-values) "J". If extremely low area counts are reported (<25%) or if performance exhibits a major abrupt drop off, flag all associated non-detects as unusable (R).			
15.2 Are the retention times of all internal standards within 30 seconds of the associated calibration standard?	[✓]	___	___

ACTION: Professional judgement should be used to qualify data if the retention times differ by more than 30 seconds.

16.0 Laboratory Control Samples (LCS)

	YES	NO	N/A
16.1 Were any LCS samples run in order to verify analytes which failed criteria for spike recovery?	[ ]	___	✓
16.2 Did the lab spike LCS sample spiked with the same analytes and the same concentrations as the matrix spike?	[✓]	___	___
16.3 Were the mean and standard deviation of all analytes within the QC acceptance ranges as shown in Table 6, 8270D-43?	[✓]	___	___

ACTION: If the recovery of any analyte falls out of the designated range, the analytical results for that compound is suspect and should be qualified "J" in the unspiked samples.

17.0 Field Duplicates *VCS-4

	YES	NO	N/A
17.1 Were any field duplicates submitted for semivolatile analysis?	[✓]	TBG ✓	___

YES NO N/A

ACTION: Compare the reported results for field duplicates and calculate the relative percent difference.

ACTION: Any gross variation between field duplicate results must be addressed in the reviewer narrative. However, if large differences exist, identification of field duplicates should be confirmed by contacting the sampler.

Validata Chemical Services Addendum to SVOA Checklist
Clarification of Policies Where Region II and SAP Requirements Differ
(See Numbered References in Checklist)

Analysis	Checklist Required Element	Validator Criteria and Action
SVOA (Method 8270)		
1.	Temperature <10	SAP limit <6 Use SAP limit, but qualify per Region II
2.	Blanks	Validata will qualify data in accordance with Region II approach.
3.	Initial Calibration (%RSD <20%)	SAP limit %RSD <15% Use SAP limit, but qualify per Region II
7.	Field Duplicates (compare and calculate RPD)	SAP For SB, SD and SMI <30% Validata will not qualify outliers.

YES NO N/A

PACKAGE COMPLETENESS AND DELIVERABLES

CASE NUMBER:_____ SDG# 70987

LAB: APPL, INC. SITE: E. Vieques UXO Sites

METHODS VALIDATED: SW-846 6850, 8330B, and 8321A

1.0 Introduction

1.1 The attached Standard Operating Procedure (SOP) is applicable to nitro substituted aromatic and nitro substituted amines by High Performance Liquid Chromatography (HPLC)data. Its scope is not only to facilitate the data validation process of the data reported by the contracting laboratory, but also to ensure the data is being reviewed in a uniform manner.

1.2 This SOP is based upon the quality control assurance requirements specified in analytical SW 846 Method 8330A Revision 1, January 1998, and the National Function Guidlines, January 2005.

2.0 Responsibilities

2.1 The reviewer must be knowledgeable of the analytical method and its criteria.

2.2 The reviewer must complete and/or file the following:

Data Assessment Checklist - The data reviewer evaluates Each criterion carefully and checks if data is in compliance, non-compliace or not applicable.

Data Assessment Narrative - The data reviewer must present professional judgement, address areas of concern and comment on the validity of the overall data package. The reviewer must explain the reasons for rejecting and or qualifying the data.

Telephone Record Log - All phone conservations must be transcribed by the reviewer. Upon completion of the data review, the original telephone log is attached to the data assessment narrative.

YES NO N/A

3.0 Data Completeness and Deliverables

3.1 Has all the data been submitted in CLP deliverable format? [✓] ___ ___

3.2 Have any missing deliverables been received and added to the data package? [ ] ___ [✓]

ACTION: Call lab for explanation/resubmittal of any missing deliverables. If lab cannot provide them, note the effect on review of the data in the reviewer narrative.

4.0 Cover Letter, SDG Narrative

4.1 Is a laboratory narrative or cover letter present? [✓] ___ ___

4.2 Are the case number and/or SDG number contained in the narrative or cover letter? [✓] ___ ___

5.0 Data Validation Checklist

5.1 Does this data package contain:

Water data? [✓] ___ ___

Waste data? [ ] ___ [✓]

Soil/solid data? [✓] ___ ___

6.0 Traffic Reports and Laboratory Narrative

6.1 Are traffic report and chain-of-custody forms present for all samples? [✓] ___ ___

ACTION: If no, contact lab for replacement of missing or illegible copies.

6.2 Do the traffic reports, chain-of-custody forms or SDG narrative indicate any problems with sample receipt, condition of the samples, analytical problems or

YES NO N/A

special circumstances affecting the quality of the data? ___ [✓] ___

ACTION: If any sample analyzed as a soil, contains 50%-90% water, all data should be qualified as estimated, "J." If a soil sample contains more than 90% water, non detects shall be qualified as unusable, "R."

ACTION: If samples were not iced or if the ice was melted upon arrival at the laboratory and the temperature of the cooler was elevated (> 10° C), flag all positive results "J" and all non-detects "UJ".

7.0 Special QC *-VCS1

7.1 Prior to preparation of stock solutions; acetonitrile, methanol, and water should be analyzed to determine possible interferences with analyte peaks. A different batch of solvent should be used if contamination is present.

7.2 Chromatograms are to be submitted showing that there are no interferences with analyte peaks.

Are these chromatograms present in package? [ ] ___ [✓]

Are the chromatograms free of interferences? [ ] ___ [✓]

Action: Ask lab for resubmittals. If deliverables are unavailable, judge the effect of the validity of the data. If questionable, contact SMO and note in data assessment.

8.0 Holding Times

8.1 Have any nitroaromatics and nitroamines technical holding times, determined from date of collection to date of extraction, been exceeded? ___ [✓] ___

Water and waste samples must be properly perseved (cooled to 4° +/- 2°), and nitro substituted aromatics and amines analysis must be extracted within 7 days of the date of collection. Extracts must be analyzed within 40 days of

YES NO N/A

the date of extraction. Soils and solid samples must be extracted within 14 days of collection and analyzed within 40 days of extraction.

ACTION: If technical holding times are exceeded, flag all positive results as estimated, "J," and sample quantitation limits "UJ" and document in the narrative that holding times were exceeded. If analyses were done more than 14 days beyond holding time, either on the first analysis or upon re-analysis, the reviewer must use professional judgement to determine the reliability of the data and the effects of additional storage on the sample results. At a minimum, all the data should at least be qualified "J", but the reviewer may determine that non-detects are unusable,"R." (Table 1)

Table 1. Holding Time Criteria

Matrix	Preserved	Criteria	Action	
			Detected compounds	Non-detected compounds
Aqueous	No	≤ 7 days(extraction) ≤ 40 days(analysis)	Use professional judgement	
	No	> 7 days(extraction) > 14 days(analysis)	Use professional judgement	
	Yes	≤ 7 days(extraction) ≤ 40 days(analysis)	No qualification	
	Yes	> 7 days(extraction) > 40 days(analysis)	J	UJ
	Yes/No	Grossly exceeded	J	UJ or R
Non-aqueous	No	≤ 14days(extraction) ≤ 40 days (analysis)	Use professional judgement	
	No	> 14days(extraction) >40 days(analysis)	Use professional judgement	
	Yes	≤ 14days(extraction) ≤ 40 days(analysis)	No qualification	
	Yes	> 14days(extraction) > 40 days(analysis)	J	UJ
	Yes/No	Grossly Exceeded	J	UJ or R

YES NO N/A

9.0 Surrogate Recovery (Form II)

9.1 The analyst most monitor the performance of the extraction and analytical system as well as the effectiveness of the method in dealing with each sample matrix by spiking each sample, standard and reagent water blank with one or two surrogates (e.g., analytes not expected to be present in the sample).

9.2 Were the recoveries of the surrogate spikes presented on CLP Surrogate Recovery Summary forms (Form II), or equivalent, for each of the following matrices?

a. Water/Waste [✓] ___ ___
b. Soil/Solid [✓] ___ ___

ACTION: Call lab for explanation/resubmittals. If missing deliverables or information are unavailable, document the effect in the data assessment.

9.3 Are all the pesticide samples listed on the appropriate surrogate recovery form for each of the following matrices?

a. Water [✓] ___ ___

b. Waste [ ] ___ ✓

c. Soil/Solid [✓] ___ ___

9.4 The laboratory must evaluate the surrogate data from individual samples versus the surrogate control limits developed by the laboratory. Method 8000C, Sec 9.0 details evaluating surrogate data and updating surrogate limits. If laboratory established recovery limits are not established, use surrogate recovery between 70 - 130% for all samples, including MS, MSDs, LCSs, and all blanks. Are surrogate recovery limits met? [✓] ___ ___

ACTION: Circle all outliers in red. Follow surrogate action Table 2.

YES NO N/A

9.5 Were surrogate retention times (RT) within the windows established during the initial 5-point analysis? [✓] ___ ___

ACTION: Follow surrogate action, Table 2 below.

Table 2. Surrogate Recovery Criteria

Criteria	Action	
	Detected Target Compounds	**Non-detected Target Compounds**
%R > 200%	J	Use professional judgement
130% < %R ≤ 200%	J	No qualification
70% ≤ %R ≤ 130%	No qualification	
10% ≤ %R < 70%	J	UJ
%R < 10% (sample dilution not a factor)	J	R
%R < 10% (sample dilution is a factor)	Use professional judgement	
RT out of RT window	Use professional judgement	
RT within RT window	No qualification	

9.6 Are there any transcription/calculation errors between raw data and Form II? [ ] [✓] ___

ACTION: If large errors exist, call lab for explanation/resubmittal. Make any necessary corrections and document the effect in data assessments.

10.0 Laboratory Control Sample

10.1 Is the LCS prepared, extracted, analyzed, and reported once for every 20 field samples of a similar matrix, per SDG. [✓] ___ ___

YES NO N/A

ACTION: If any Laboratory Control Sample data are missing, call the lab for explanation/ resubmittals. Make note in the data assessment.

10.2 Are raw data and percent recoveries present for all Laboratory Control samples as required by Method 8000C (section 9.5). [✓] ___ ___

Verify that QC check samples were extracted and analyzed by the same procedures used for the actual samples.

ACTION: If any Laboratory Control Sample data are missing, call the lab for explanation/ resubmittals. Make note in the data assessment.

Note: When the results for matrix spike analysis indicates a problem due to sample matrix effects, the LCS results are used to verify the laboratory can perform the analysis in a clean sample.

10.3 Were the Laboratory Control Samples analyzed for all the nitroaromatics and nitroamines analytes that the samples are analyzed for.
[✓] ___ ___

10.4 Were Laboratory Control Samples analyzed at the required concentration as specified in Method 8000C(sec 9.5)(near the middle of the calibration range) for all target analytes.
[✓] ___ ___

ACTION: If Laboratory Control Samples were not analyzed at the required concentration or the required frequency, make note in the data assessment and use professional judgement to determined the affect on the data.

10.5 Did laboratory calculate in-house performance criteria for LCS recoveries according to Method 8000C section 9.7, and were recoveries met?

[ ] ___ ✓

10.6 If in house LCS recoveries performance criteria were not generated, the laboratory should use 70 - 130% criteria, and was this criteria met? [✓] ___ ___

10.7 If LCS recovery criteria were not met, were Laboratory Control Samples re-analyzed?
[ ] ___ ✓

YES NO N/A

ACTION: If QC check samples were not re-analyzed, or a general system problem is indicated by repeated failure to meet the QC acceptance criteria specified in the method, make note in the data assessment and use Table 3 recovery actions criteria.

Table 3. LCS Recovery Actions

Criteria	Action	
	Detected Associated Compounds	Non-Detected Compounds
%R > Upper Acceptance Limit	J	No qualification
%R < Lower Acceptance Limit	J	R
Lower Acceptance Limit ≤ %R ≤ Upper Acceptance Limit	No qualifications	

11.0 Matrix Spikes (Form III)

11.1 Are all data for one matrix spike and matrix duplicate (unspiked) pair (MS/Dup) or matrix spike/matric spike duplicate (MS/MSD)present and complete for each matrix. [ ] [✓] ___

No H_2O MS/MSD for 8330B, 6850, 8321A

NOTE: For soil and waste samples showing detectable amounts of organics, the lab may substitute replicate samples in place of the matrix spike spike.

11.2 Have MS/Dup or MS/MSD results been summarized on modified CLP Form III? [✓] ___ ___

ACTION: If any data are missing take action as specified in section 3.2 above.

11.3 Were matrix spikes analyzed at the required frequency for each of the following matrices? (One MS/Dup, MS/MSD must be performed for every 20 samples of similar matrix or concentration level.

a. Water [ ] [✓] ___
b. Waste [ ] ___ [✓]
c. Soil/Solid [✓] ___ ___

ACTION: If any MS/Dup or MS/MSD data are missing,take the action specified in 3.2 above.

11.4 Were the Matrix Spike Samples spiked and analyzed for all the nitroaromatics and nitroamines analytes that the samples are analyzed for (Same analytes as LCS). [✓] ___ ___

YES NO N/A

ACTION: If no, did the lab use the optional QC acceptance criteria discussed in Method 8000C(section 9.7)?

List the criteria used and make note in data assessment.

Criteria used SAP Limits

11.5 Were Laboratory Control Samples analyzed at the required concentration as specified in Method 8000C(sec (9.5)(Same concentration as LCS) for all target analytes. [✓] ___ ___

11.6 Did laboratory calculate in-house performance criteria for matrix spike recoveries according to Method 8000C section 9.7, and were recoveries met? [ ] ___ ✓

11.7 If in house LCS recoveries performance criteria were not generated, the laboratory should use 70 - 130% criteria, and was this criteria met? [ ] ___ ✓

11.8 How many matrix spike recoveries are outside the in-house performance criteria or QC limits of 70 - 130%?

Perchlorate MS and MSD out

Water	Soil
0 out of 0	2 out of 36

11.9 How many RPDs for the Matrix Spike and Matrix Spike Duplicate (if applicable)recoveries are greater than the QC limit of 20%?

Water	Soil
0 out of 0	0 out of 18

11.8 Were the matrix spike and matrix spike duplicate recovery and RPD limits met as specified in Table 4. Note: No qualification of the data is necessary on MS and MSD data alone. Use professional judgement to use the MS and MSD results in conjunction with other QC criteria to determine the need for some qualification of the data. If any MS and MSD, percent recovery, or RPD results in the nitroaromatics and nitroamines fraction is out of specification (Table 4), use professional judgement to qualify data to include the consideration of the existence interference in the raw data. In some instances it may be determined that only the replicate or spiked samples are affected. Alternatively, the data may suggest that the laboratory is having a systematic problem with one or more analytes, thereby affecting all associated samples. Use professional judgement to determine the need for qualification of detects of non-spiked compounds.

YES NO N/A

Table 4. MS/MSD Actions for Analysis

Criteria	Action	
	Detected Associated Compounds	Non-Detected Compounds
%R or RPD > Upper Acceptance Limit	J	No qualification
20% ≤ %R < Lower Acceptance Limit	J	UJ
%R < 20%	J	Use professional judgement
Lower Acceptance Limit ≤ %R ≤ Upper Acceptance Limit	No qualifications	

12.0 Blanks (Form IV) *-VCS2

12.1 Was reagent blank data reported on CLP equivalent Method Blank Summary form(s) (Form IV)? [✓] ___ ___

12.2 Frequency of Analysis: Has a reagent blank been analyzed for every 20 (or less) samples of similar matrix or concentration or each extraction batch? [✓] ___ ___

ACTION: If any blank data are missing, take action as specified above (section 3.2). If blank data is not available, reject (R) all associated positive data. However, using professional judgement, the data reviewer may substitute field blank data for missing method blank data.

12.3 Chromatography: review the blank raw data - chromatograms, quant reports or data system printouts.

Is the chromatographic performance (baseline stability) for each instrument acceptable for nitroaromatics and nitramines? [✓] ___ ___

13.0 Contamination

YES NO N/A

NOTE: "Water blanks", "distilled water blanks" and "drilling water blanks" are validated like any other sample and are not used to qualify the data. Do not confuse them with the other QC blanks discussed below.

13.1 Do any method/instrument/reagent/cleanup blanks have positive results for nitroaromatics or nitramines?When applied as described below, the contaminant concentration in these blanks are multiplied by the sample Dilution Factor and corrected for % moisture when necessary.

___ [✓] ___

13.2Do any field/rinse blanks have positive nitroaromatics or nitramines results?

___ [✓] ___

ACTION: Prepare a list of the samples associated with each of the contaminated blanks. (Attach a separate sheet.)

NOTE: All field blank results associated to a particular group of samples (may exceed one per case or one per day) may be used to qualify data. Blanks may not be qualified because of contamination in another blank. Field blanks must be qualified for surrogate, or calibration QC problems.

ACTION: Follow the directions in Table 5 below to qualify sample results due to contamination. Use the largest value from all the associated blanks.

Table 5. Blank Contamination Criteria

YES NO N/A

Blank Type	Blank Result	Sample Result	Action for Samples
Method, Clean up, Instrument, Field	Detects	Not detected	No qualification
	< CRQL	< CRQL	Report CRQL value with a U
		≥ CRQL	Use professional judgement
	> CRQL	< CRQL	Report CRQL value with a U
		≥ CRQL and < blank contamination	Report the concentration for the sample with a U, or quanity the data as unusable R
		≥ CRQL and ≥ blank contamination	Use professional judgement
	= CRQL	< CRQL	Report CRQL value with a U
		≥ CRQL	Use professional judgement
	Gross contamination	Detects	Qualify results as unusable R

NOTE: If gross blank contamination exists(e.g., saturated peaks, "hump-o-grams," "junk" peaks), all affected positive compounds in the associated samples should be qualified as unusable "R", due to interference. Non-detected pesticide target compounds do not require qualification unless the contamination is so high that it interferes with the analyses of non-detected compounds.

13.3Are there field/rinse/equipment blanks associated with every sample? ☑ ___ ___

ACTION: For low level samples, note in data assessment that there is no associated field/rinse/ equipment blank. Exception: samples taken from a drinking water tap do not have associated field blanks.

14.0 HPLC Apparatus and Materials

YES NO N/A

14 .1 Was the proper HPLC chromatographic column used for the analysis of nitroaromatics or nitramines?

Action: Check raw data, instrument logs, or contact the lab to determine what type of columns were used. (Method 8330A, section 4.1) [✓] ___ ___

14.2 Indicate the specific type of HPLC column.

column 1: Agilent

column 2: _____

ACTION: Note any changes to the suggested materials in section 14.1 above in the data assessment. Also note the impact (positive or negative) such changes have on the analytical results.

15.0 Calibration and HPLC Performance *-VCS-3,4,5

15.1 Are the following liquid chromatograms and data systems printouts for both columns present for all samples, blanks, MS, replicates?

a. Samples [✓] ___ ___
b. All blanks [✓] ___ ___

c. Matrix spike samples [✓] ___ ___
d. 5 pt. initial calibration standards [✓] ___ ___

e. Calibration verification standards [✓] ___ ___

f. Laboratory Control samples (LCS) [✓] ___ ___

ACTION: If no, take action specified in 3.2 above.

15.2 Are data summary forms (containing calibration factors or response factors) for the initial 5 pt. calibration and daily calibration verification standards present and complete for each column and each analytical sequence? [✓] ___ ___

NOTE: External standard calibration procedures are used (Method 8000C (section 11.4.2), therefore calibration factors must be used.

ACTION: If any data are missing or it cannot be determined how the laboratory calculated calibration factors, contact the lab for explanation/resubmittals. Make necessary corrections and note any problems in the data assessment.

YES NO N/A

15.3 Are there any transcription/calculation errors between raw data and data summary forms?

___ [✓] ___

ACTION: If large errors exist, call lab for explanation/resubmittal, make necessary corrections and document the effect in data assessments.

15.4 Are standard retention time (RT) windows for each nitroaromatics and nitramines peak of interest presented on modified CLP summary forms? [✓] ___ ___

ACTION: If any data are missing, or it cannot be determined how RT windows were calculated, call the lab for explanation/resubmittals. Note any problems in the data assessment.

NOTE: Retention time windows for all nitroaromatics and nitramines are established using retention times from three calibration standards analyzed during the entire analytical sequence (Method 8000C section 11.6).

Best results are obtained using retention times which span the entire sequence; i.e., using the calibration verification/continuing calibration standards analyzed every 12 hours.

15.5 Were RT windows on the confirmation column established using three standards as described above? [✓] ___ ___

NOTE: RT windows for the confirmation column should be established using a 3 pt. calibration, preferably spanning the entire analytical sequence as described in 15.4 above. If RT windows on one column are tighter than the other, this may result in false negatives when attempting to identify compounds in the samples.

ACTION: Note potential problems, if any, in the data assessment.

15.6 Do all standard retention times in each level of the initial 5 pt. calibrations for nitroaromatics and nitramines fall within the windows established during the initial calibration sequence? [✓] ___ ___

ACTION i: If no, all samples in the entire analytical sequence are potentially affected. Check to see if three standards spanning the entire sequence were used to obtained RT windows. If the lab used three standards from the 5 pt., RT windows may be too tight. If so, RT windows should be recalculated as per Method 80000C(section 11.6).

ii. Alternatively, check to see if the chromatograms contain peaks within an expanded window surrounding the expected retention times.

YES NO N/A

If no peaks are found and the surrogates are visible, non-detects are valid. If peaks are present but cannot be discerned through pattern recognition or by using revised RT windows, qualify all positive results and non-detects as unusable, "R".

15.7 Has the linearity criteria for the initial calibration standards been satisfied for both columns? (% RSD for the calibration factors (CFs)must be < 20.0% for all analytes).

[✓] ___ ___

ACTION: If no, follow Table 6 criteria.

Table 6. Initial Calibration CF Action for Nitroaromatic and Nitramine Analysis

Criteria	Action	
	Detected Associated Compounds	Non-Detected Associatedd Compounds
% RSD > 20%	J	UJ
% RSD within allowable limits	No qualifications	

15.8 Does the calibration verification/continuing calibration standard contain the nitroaromatics or nitramines peaks of interest, analyzed on each working day, prior to sample analyses?

[✓] ___ ___

15.9 Has a calibration verification/continuing calibration standard been analyzed after every 10 samples and at the end of each analytical sequence

[✓] ___ ___

ACTION: If no, take action as specified in section 3.2 above.

15.10 Has the percent difference (%D) between the Calibration Factor (CF) of the peaks used to identify the nitroaromatics and nitramines in the CCV and the CF from these peaks in the initial calibration exceeded ± 15%.

___ [✓] ___

15.11 Has a new 5 pt. initial calibration curve been generated for those nitroaromatics and nitramines analytes which failed in the calibration verification/continuing calibration

YES NO N/A

standard (8000C, section 11.7.3), and all samples which followed the out-of-control calibration verification/standard continuing calibration standard? [✓] ___ ___

ACTION: If the %D for any analyte exceeded the ± 15% criterion and the instrument was not recalibrated for those analytes, qualify positive results for all associated samples (those which followed the out-of-control standard) "J" and sample quantitation limits "UJ". (Table 7)

15.12 Have retention time (RT) windows been properly calculated for each analyte of interest (Method 8000C, section 11.6), using RTs from the associated calibration verification/continuing standard? [✓] ___ ___

ACTION: If no, take action specified in section 3.2 above

15.13 Do all standard retention times for each calibration verification/continuing calibration standard fall within the windows established during the initial calibration sequence? [✓] ___ ___

15.14 Do all standard retention times for each mid-concentration standard (analyzed after every 10 samples) fall within the daily RT windows. [✓] ___ ___

ACTION: If the answer to either 15.12 or 15.13 above is no, check the chromatograms of all samples which followed the last in-control standard. All samples analyzed after the last in-control standard must be re-injected, if initial analysis indicated the presence of the specific analyte that exceeded the retention time criteria). If samples were not re-analyzed, document under Contract Non-compliance in the Data Assessment.

Reviewer has two options to determine how to qualify questionable sample data. First option is to determine if possible peaks are present within daily retention time window. If no possible peaks are found, non-detects are valid. If possible peaks are found (or interference), qualify positive hits as presumptively present "NJ" and non-detects are rejected "R". Second option is to use the ratio of the retention time of the analyte over the retention time of either surrogate. The passing criteria is ± 0.06 RRT units of the RRT of the standard component. Reject "R" all questionable analytes exceeding criteria, and "NJ" all other positive hits.

15.15 Has no more than 14 hours elapsed from the injection of the opening CCV and the end of the analytical sequence (closing CCV). (Table 7) [✓] ___ ___

Table 7. CCV Criteria

Criteria	Action	
	Detected Associated	Non-Detected Associated

YES NO N/A

	Compounds	Compounds
RT out of RT window	Use professional judgement (Sec 15.14)	
%D not within +/- 15%	J	UJ
Time elapsed greater than section 15.15 criteria.	R	
%D, time elapsed, RT are all within acceptable limits.	No qualifications	

15.16 Are there any transcription/calculation errors between raw data and data summary forms? ___ [✓] ___

ACTION: If large errors exists call lab for explanation/resubmittal, make any necessary corrections and document the effect in data assessments under "Conclusions".

16.0 Analytical Sequence Check (Form VIII-nitroaromatics and nitramines)

16.1 Have all samples been listed on CLP Form VIII or equivalent, and are separate forms present for each column? [✓] ___ ___

ACTION: If no, take action specified in 3.2 above.

16.2 Was the proper analytical sequence followed for each initial calibration and subsequent analyses? [✓] ___ ___

Note: Sequence is as follows: 5 point initial calibration, method blank, LCS, CCS, 10 sample extracts, CCV, 10 sample extract, and so on. The sequence must always end with a CCV. As long as the first CCV is within QC, the initial calibration does not have to be rerun.

ACTION: If no, use professional judgement to determine the severity of the effect on the data and qualify it accordingly. Generally, the effect is negligible unless the sequence was grossly altered or the calibration was also out of limits.

16.3 Were the surrogate RTs for the samples within the mean surrogate RT from the initial calibration? [✓] ___ ___

Action: If no, see "Action" in section 15.14 above

17.0 Extraction Techniques for Sample Preparation

YES NO N/A

Method 8330A permits a variety of extraction techniques to be used for sample preparation. Which extraction procedure was used?

17.1 Aqueous samples:

1. Low Level (salting-out extraction)) [ ] ___ ___
2. High-level (Sample filtration) [ ] ___ ___
3. Solid phase extraction (Method 3535) [✓] ___ ___
4. Other [ ] ___ ___

17.2 Soil and sediment samples:

1. Sonication [✓] ___ ___
2. Other [ ] ___ ___

18.0 Nitroaromatics and Nitramines Identification*-VCS6

18.1 Has CLP Form X or equivalent, showing retention time data for positive results on the two HPLC columns, been completed for every sample in which a nitroaromatics or nitramines was detected? [✓] ___ ___

ACTION: If no, take action specified in 3.2 above, or compile a list comparing the retention times for all sample hits on the two columns.

18.2 Are there any transcription/calculation errors between raw data and data summary forms (initial calibration summaries, calibration verification summaries, analytical sequence summaries. ___ [✓] ___

ACTION: If large errors exist, call lab for explanation/resubmittal, make necessary corrections and note error in the data assessment.

18.3 Are retention times (RT) of sample compounds within the established RT windows for both columns/analyses? [✓] ___ ___

ACTION: Qualify as unusable (R) all positive results which were not confirmed by second HPLC column analysis. Also qualify "R", unusable, all positive results not within RT windows unless associated standard compounds are similarly biased. The reviewer should use professional judgement to assign an appropriate quantitation limit.

YES NO N/A

18.4 Check chromatograms for false negatives, especially if RT windows on each column were established differently. Were there any false negatives? ___ [✓] ___

ACTION: Use professional judgement to decide if the compound should be reported. If there is reason to believe that peaks outside retention RT windows should be reported, make corrections to data summary forms (Form I) and note in data assessment.

18.5 Is the percent difference (%D) calculated for the positive sample results on the two HPLC columns<25.0%? [✓] ___ ___

NOTE: The method requires quantitation from one column. The second column is to confirm the presence of an analyte. It is the reviewer's responsibility to verify from the project plan what the lab was required to report. If the lab was required to report concentrations from both columns, continue with validation for % Difference. If required, but not reported, either contact the lab for results or calculate the concentrations from the calibration. If not required, skip this section. Document actions in Data Assessment.

ACTION: If the reviewer finds neither column shows interference for the positive hits, the data should be qualified as follows:

% Difference	Qualifier
0-25%	none
26-70%	"J"
71-100%	"NJ"
101-200% (No Interference)	"R"
101-200% (Interference detected)**	"NJ"
>50% (Analyte value is <CRQL)	"U"
>200%	"R"

Note: The lower of the two values is reported on Form I. If using professional judgement, the reviewer determines that he higher result was more acceptable, the reviewer should replace the value and indicate the reason for the change in the data assessment.

19.0 Compound Quantitation and Reported Detection Limits

19.1 Are there any transcription/calculation errors in Form I results? Check at least two positive values. Were any errors found? ___ [✓] ___

YES NO N/A

NOTE: Nitroaromatics and Nitramines peak results can be checked for rough agreement between quantitative results obtained on the two HPLC columns. The reviewer should use professional judgement to decide whether a much larger concentration obtained on one column versus the other indicates the presence of an interfering compound. If an interference is suspected, the lower of the two values should be reported and qualified according to section 18.5 above. This necessitates a determination of an estimated concentration on the confirmation column. The narrative should indicate that the presence of interferences has led to the quantitation of the second column confirmation results.

19.2 Are the EDLs (Estimated Detection Limits) adjusted to reflect sample dilutions and, for soils,% moisture? [✓] ___ ___

ACTION: If errors are large, call lab for explanation/resubmittal, make any necessary corrections and document effect in data assessments.

ACTION: When a sample is analyzed at more than one dilution, the lowest EDLs are used (unless a QC exceedance dictates the use of the higher EDL data from the diluted sample analysis). Replace concentrations that exceed the calibration range in the original analysis by crossing out the value on the original Form I and substituting it with data from the analysis of diluted sample. Specify which Form I is to be used, then draw a red "X" across the entire page of all Form I's that should not be used, including any in the summary package.

ACTION: EDLs affected by large, off-scale peaks should be qualified as unusable, "R". If the interference is on-scale, the reviewer can provide a modified EDL flagged "UJ" for each affected compound.

14.0 Chromatogram Quality

14.1 Were baselines stable? [✓] ___ ___

14.2 Were any electropositive displacement (negative peaks) or unusual peaks seen? ___ [✓] ___

ACTION: Note all system performance problems in the data assessment.

15.0 Field Duplicates *VCS-7

15.1 Were any field duplicates submitted for Nitroaromatics and Nitramines. [✓] ✓ TBG ___

YES NO N/A

ACTION: Compare the reported results for field duplicates and calculate the relative percent difference.

ACTION: Any gross variation between field duplicate results must be addressed in the reviewer narrative. However, if large differences exist, the identity of the field duplicates is questionable. An attempt should be made to determine the proper identification of field duplicates.

Validata Chemical Services Addendum to Explosives Checklist
Clarification of Policies Where Region II and SAP Requirements Differ
(See Numbered References in Checklist)

Analysis	Checklist Required Element	Validator Criteria and Action
Explosives (8330)		
1.	Acetonitrile, methanol and water should be analyzed prior possible interferences	Our Professional Judgment is no qualification because there is no SAP Limit.
2.	Blanks	Validata will qualify data in accordance with Region II approach.
3.	Initial Calibration (%RSD <20%)	If using ISTD calibration, %RSD <15% If using External calibration, %RSD <20%
4.	Second Source (ICV)	SAP limit %D<20%. List outliers in narrative.
	Since this element is not addressed by Region II there will be no qualification.	
5.	Continuing Calibration (%D <15%)	SAP limit %D <20% Use SAP Limit, but qualify per Region II.
6.	Column %D (<25%)	SAP limit <40% Validata will flag only J if >40%.
7.	Field Duplicates (compare and calculate RPD)	SAP For SB, SD and SMI <30% Validata will not qualify outliers.

STANDARD OPERATING PROCEDURE

Title: Evaluation of Inorganic Analyses
Data Assessment – CH2M HILL Vieques
Total Review – Metals

SOP: EPA Region II / SAP
SOP_HW-2a_ICP-AES /
SOP_HW-2b_ICP-MS

Project SDG: 70987
Metals Methods: 6010C, 6020A, 7196A
Reviewer: Tom Granat

General Validation

	YES	NO	N/A	ACTION (if no)
Chain-of-Custody				
present or on file	✓			contact Validata Project
legible	✓			manager
Cover Page				
present	✓			contact Validata P.M.
Form I's				
present and complete	✓			contact Validata P.M.
correct units (ug/L or mg/kg)	✓			contact Validata P.M.
results corrected for percent solids	✓			contact Validata P.M.
sample IDs match C-of-C and cover page	✓			contact Validata P.M.
were "less than"values coded with "U"?	✓			contact Validata P.M.
was a brief sample description in the comment section?		✓		contact Validata P.M.
were samples diluted within requirements?	✓			
If no,were dilutions on Form I's				note under Overall Assessment in Data Validation Narrative

Holding Times – from date of sample collection to date of sample analysis. Applies to aqueous samples only (apply to soil matrix at reviewer's discretion)

	YES	NO	N/A	ACTION (if no)
pH < 2 upon sample receipt	✓			positive results are estimated low (J-). Non-detects are unusable (R).
ICP Metals – waters - within 180 day Soils – within 30 days	✓			positive results are estimated low (J-). Non-detects are unusable (R)
Hex. Cr – water – 24 hours		✓		positive and non-detect results are estimated low (J-) and (UJ). If >2X limit, then positive results are estimated low (J-) and non-detect results are unusable (R)
Hex. Cr - soils – 30 days from collection to extraction, 7 days from extraction to analysis.	✓			positive results are estimated low (J-). Non-detects are unusable (R)

	YES	NO	N/A	ACTION (if no)
Raw Data – measurement readout present for:				
ICP	✓			contact Validata P.M.
Are all raw data to support all sample analyses and QC operations present for:	✓			contact Validata P.M.
Dated digestion logs present for:				
ICP	✓			contact Validata P.M.
Percent solids (soils)	✓			contact Validata P.M.

Tune Analysis – ICP-MS only – prior to calibration, the ICP-MS tuning solution must be analyzed at least five times consecutively. The solution must contain all required isotopes of Be, Mg, Co, In, and Pb.

Tuning present	✓			all results are unusable (R).
Tuning solution analyzed 5X consecutively with all required isotopes	✓			use professional judgment to qualify data. Contact Validata PM if additional information is required.
Mass calibration within 0.1 amu for all isotopes	✓			positive and non-detect results are estimated (J) and (UJ), respectively.
%RSD <5% for all analytes	✓			positive and non-detect results are estimated (J) and (UJ), respectively.

Calibration – must be present for each analysis run, instrument set-up, or every 24 hours, whichever is more frequent.

ICP – calibration present	✓			All data associated with the analysis run are unusable (R).
ICP – 5 point calibration (minimum) at least 1 at or below the CRQL	✓			All data associated with the analysis run whose results are >DL and < 2X LOD are estimated (J) .
correlation coefficient >0.995 or %RSD <30%	✓			All data associated with the analysis run are estimated (J) and (UJ).

Form II – Initial and Continuing Calibration Verification

For initial calibration verifications (ICVs) that do not meet technical criteria, the action is applied to all samples reported from that analytical run.

For continuing calibration verifications (CCVs) and CRIs that do not meet the technical criteria, the action is applied to all samples analyzed between a previous technically acceptable analysis of the QC sample and a subsequent technically acceptable analysis of the QC sample in the analytical run.

ICVs analyzed immediately after calibration	✓			use professional judgment to qualify data
Are ICP CCVS analyzed every 2 hours	✓			

	YES	NO	N/A	ACTION (if no)
Are all ICVs and CCVs within control limits:				
ICP - 90-110%	✓			See below if no
If recovery was:				ACTION:
<75%				use professional judgment to Qualify all results as unusable (R).
75-89%				positive results are estimated low (J-). Non-detects are estimated (UJ).
111-125%				positive results are estimated (J+).
>125, but <160%				use professional judgment to qualify all positive results as estimated (J+).
>160%				positive results are unusable (R).

Form III – Initial and Continuing Calibration Blanks and Preparation Blanks

For initial calibration blanks (ICBs) that do not meet technical criteria, the action is applied to all samples reported from that analytical run.
For continuing calibration blanks (CCBs) that do not meet the technical criteria, the action is applied to all samples analyzed between a previous technically acceptable analysis of a CCB and a subsequent technically acceptable analysis of a CCB in the analytical run.
For preparation blanks (PB) that do not meet the technical criteria, the action is applied to all samples prepared in the same preparation batch.

ICBs analyzed immediately after ICVs	✓			use professional judgment to qualify data
Are CCBs analyzed after every CCV	✓			
ICB/CCB < DL		✓		See below if no
If ICB / CCB:				ACTION:
>/=DL, but </=LOD				positive results </= LOD are reported as undetected (U) with the results raised to the LOD.
> LOD				positive results </= LOD are reported as undetected (U) with the results raised to the LOD.
				Results > LOD, but < Blank Value are reported as

	YES	NO	N/A	ACTION (if no)
				undetected (U) with results raised to the blank level or results are qualified as unusable (R). Use professional judgment for results > Blank Value.
</= -DL, but >/= -LOD				using professional judgment, all results between the absolute –DL and –LOD were flagged as estimated potentially biased low (J-) and all non-detects were flagged as estimated (UJ).
< -LOD				Results >/= LOD, but <10X LOD are estimated low (J-). Non-detects are estimated (UJ).
Were prep blanks analyzed for each matrix	✓	—	—	use professional judgment to qualify all results
If PB:				ACTION:
> LOD				positive results </= LOD are reported as undetected (U) with the results raised to the LOD.
				results >LOD, but <10X the Blank Value are estimated high (J+) or are unusable (R).
>/= DL, but </= LOD				positive results <LOD are reported as undetected (U) with results raised to the LOD. Using professional judgment, positive results > but less than 10X the blank were flagged as estimated biased high (J+).
< -LOD				results >/= LOD, but <10X LOD are estimated low (J-) and non-detects are estimated (UJ).

Form IV – ICP interference Check Samples – consists of two solutions to be analyzed consecutively. The ICS must not be run before the ICV/ ICB and must be immediately followed by a CCV/ CCB.

ICP-AES: the ICS must be run at the beginning and the end for each analyte and interferent reported for ICP-AES. Any required action is applied to all samples analyzed between a previously technically

	YES	NO	N/A	ACTION (if no)
acceptable ICS analysis and a subsequent technically acceptable ICS analysis in the analytical run.				
Were ICSs analyzed appropriately	✓			use professional judgment to qualify data
ICS recovery 80-120% (or +/- 2X CRQL)	✓			See below if no
If ICS (ICSAB) %R: <50%				ACTION: qualify all non-detects as unusable (R). positive results are estimated low (J-).
50-79% (or <True Value – 2X CRQL)				positive results are estimated low (J-) and non-detects are estimated (UJ).
>120% (or >True Value + 2X CRQL)				positive results are estimated high (J+).
If potential false positives exist in field samples with interferents				positive results are estimated high (J+).
If potential false negatives exist in field samples with interferents				positive results <10X /negative value/ are estimated low (J-). Non-detects are estimated (UJ).

ICP-MS: the ICS must be run at the beginning of the run for all masses used for each analyte and interferent reported for ICP-MS. Any required action is applied to all samples reported from the analytical run.

Were ICSs analyzed appropriately	✓			use professional judgment to qualify data
ICS recovery 80-120% (or +/- 3X CRQL)	✓			See below if no
If ICS %R: <50%				ACTION: qualify all data as unusable (R).
50-79% (or <True Value – 2X CRQL)				positive results are estimated low (J-) and non-detects are estimated (UJ).
>120% (or <True Value – 2X CRQL)				positive results are estimated high (J+).
If potential false positives exist in field samples with interferents				positive results are estimated high (J+).
If potential false negatives exist in field samples with interferents				positive results <10X /negative value/ are estimated low (J-). Non-detects are estimated (UJ).

	YES	NO	N/A	ACTION (if no)

Form VIII – Serial Dilution – (ICP only) a 5X dilution must be performed on a sample from each sample delivery group for each matrix. Field blanks and performance evaluation samples cannot be used. If a serial dilution does not meet criteria, action is applied to all samples of the same matrix in the sample delivery group.

Serial dilution performed per matrix for ICP		✓		use professional judgment to qualify data.*
%D < 10% for aqueous samples if original sample concentration is > 50X DL			✓	positive results are estimated (J).*
%D < 100% for aqueous samples			✓	positive results are unusable (R)*
%D <15% for soil/ sediment samples if original sample concentration is >50X DL		✓		positive results are estimated (J)*
%D < 120% for soil/ sediment samples			✓	positive results are unusable (R)*

apply the action only to the field sample used to prepare the QC sample. If it is clearly stated in the data validation materials that the samples were taken through incremental sampling or some other method guaranteeing the homogeneity of the sample group, then the entire sample group may be qualified (For Vieques project – apply to all samples in water or SMI soil Prep. Batch. SMI samples contain the "SMI" in the client sample name.)

Form V – Matrix Spike Sample Analysis – at least one pre-digestion spiked sample must be prepared and analyzed from each sample delivery group and for each matrix. Any required action is applied to all samples in the delivery group of the same matrix. When an ICP or CN matrix spike is outside the control limits, a post digestion spike (PS) is required (exception : Ag). A field blank or performance evaluation sample may not be used for spike sample analysis.

Matrix Spike (MS) sample analysis frequency criteria were met for:

ICP	✓			if no, use professional judgment to qualify all results.*
Is MS recovery between 80-120% (Ag between 75-120%) for soils Water – 80-120%		✓		See below if no

ICP - If recovery is: <30% and PS <75%)	ACTION: positive results are estimated low (J-).*
(or if no PS performed)	Non-detects are unusable (R).*
<30% and PS >/= 75%	positive and non-detect results are estimated (J) and (UJ), respectively.*

	YES	NO	N/A	ACTION (if no)
30-79% and PS < 75% (or if no PS performed)				positive results are estimated low (J-). Non-detects are estimated (UJ).*
30-79% and PS >/= 75%				positive and non-detect results are estimated (J) and (UJ), respectively.*
>120% and PS >125% (or if no PS performed)				positive results are estimated high (J+).*
>120% and PS </= 125%				positive results are estimated (J).*

Matrix Spike (MS) sample analysis frequency criteria were met for:

	YES	NO	N/A	ACTION (if no)
Hexavalent Cr	✓			if no, use professional judgment to qualify all results.*
Is MS recovery between 85-115% (soil) 80-120% (water)	✓			See below if no
If recovery is: <30%				ACTION: positive and non-detect results are estimated (J) and (UJ), respectively.*
30-84% (soil) 30-79% (water)				positive and non-detect results are estimated (J) and (UJ), respectively.*
>115% (soil) >120% (water)				positive results are estimated (J).*
If a post digestion spike was analyzed Are recoveries between 85-115%			✓	No action required based on absence or outliers
Was an insoluble spike performed (soils only Are recoveries between 85-115%			✓	No action required based on absence or outliers

apply the action only to the field sample used to prepare the QC sample. If it is clearly stated in the data validation materials that the samples were taken through incremental sampling or some other method guaranteeing the homogeneity of the sample group then the entire sample group may be qualified (For Vieques project – apply to all samples in water or SMI soil Prep. Batch. SMI samples contain the "SMI" in the client sample name.)

Form VI – Duplicate Sample Analysis – at least one duplicate sample analysis must be prepared and analyzed from each sample delivery group and for each matrix. Any required action is applied to all samples in the delivery group. A field blank or performance evaluation sample may not be used for duplicate sample analysis.

Duplicate sample analysis frequency criteria was met for:

	YES	NO	N/A	ACTION (if no)
ICP		✓		if no, use professional judgment to qualify all results*
Aqueous Samples				
RPD < 20% when sample and duplicate are > 5X LOD Hexavalent Cr RPD <30%			✓	positive results > LOD are estimated (J).*
RPD < 100% when sample and duplicate are > 5X LOD			✓	positive results > LOD are unusable (R).*
Absolute difference between sample and duplicate results is < CRQL when the sample and/or duplicate results (including non-detects) are </= 5X LOD.			✓	positive and non-detect results are estimated (J) and (UJ), respectively.*
Soil Samples				
RPD < 35% when sample and duplicate are > 5X LOD Hexavalent Cr RPD<30%	✓			positive results > LOD are estimated (J).*
RPD < 120% when sample and duplicate are > 5X LOD			✓	positive results > LOD are unusable (R)*
Absolute difference between sample and duplicate results is < 2X LOD when the sample and/or duplicate results (including non-detects) are </= 5X LOD.	✓			positive and non-detect results are estimated (J) and (UJ), respectively.*

apply the action only to the field sample used to prepare the QC sample. If it is clearly stated in the data validation materials that the samples were taken through incremental sampling or some other method guaranteeing the homogeneity of the sample group, then the entire sample group may be qualified (For Vieques project – apply to all samples in water or SMI soil Prep. Batch. SMI samples contain the "SMI" in the client sample name.)

Field Duplicates / Triplicates – field duplicate samples are collected in the field with sample collection. Report RPD or %RSD when all samples are > 5X CRQL. Action applies only to the field sample and its duplicate / triplicate

Aqueous Samples				
RPD < 20% when sample and duplicate are > 5X LOD			✓	positive results > LOD are estimated (J).
Absolute difference between sample and duplicate results is < LOD when the sample and/or duplicate results (including non-detects) are </= 5X LOD.			✓	positive and non-detect results are estimated (J) and (UJ), respectively.

	YES	NO	N/A	ACTION (if no)
Soil Samples **(SB and SD)**				
RPD < 30% when sample and duplicate are > 5X LOD			✓	positive results > LOD are estimated (J).
	Hex Cr		Metals	
Absolute difference between sample and duplicate results is < 2X LOD when the sample and/or duplicate results (including non-detects) are </= 5X LOD.	✓		✓	positive and non-detect results are estimated (J) and (UJ), respectively.
Soil Samples **(SMI only)** – field triplicate				
RPD <50% when sample and triplicates are > 5X LOD			✓	positive results > LOD are estimated (J).
Absolute difference between sample and triplicate results is < 2X LOD when the sample and/or duplicate results (including non-detects) are </= 5X LOD.			✓	positive and non-detect results are estimated (J) and (UJ), respectively.

Form VII – Laboratory Control Sample (LCS) - must be prepared and analyzed with the every sample delivery group for each matrix. For an LCS that does not meet the technical criteria, the action is applied to all samples in the same preparation batch. LCS is not addressed for Hg or Cn.

Was an LCS analyzed by ICP-AES for each analyte and for each matrix	✓			use professional judgment to qualify all results
Was an aqueous LCS analyzed by ICP-MS for each analyte	✓			use professional judgment to qualify all results
Was a soil LCS analyzed for Hg and CN			✓	use professional judgment to qualify all results
Aqueous LCS %R 80-120% Soil LCS %R 80-120% (Ag 75-120%) Hexavalent Cr 85-115%	✓			See below if no

If recovery is:	ACTION:
<40% (<20% for Ag & Sb)	positive results are estimated low (J-). Non-detects are unusable (R).
40-79%	positive and non-detect results are estimated low (J-) and (UJ), respectively.
120-150% (150-170% for Ag & Sb)	positive results are estimated high (J+).

	YES	NO	N/A	ACTION (if no)
>150% (>170% for Ag & Sb)				all results are unusable (R).
Wipe/Filter LCS %R 70-130%			✓	See below if no
If recovery is: <40% (<20% for Ag & Sb)				ACTION: positive results are estimated low (J-). Non-detects are unusable (R).
40-69%				positive and non-detect results are estimated low (J-) and (UJ), respectively.
>130%				positive results are estimated high (J+).

Form XV - Internal Standards – ICP-MS only – All samples (including QC samples) analyzed during a run, with the exception of the ICP-MS tune, must contain at least 5 of the following internal standards: Li, Sc, Y, Rh, In, Tb, Ho, Lu, and Bi. Any required action is applied to all samples (including QC samples) analyzed during run, beginning with the calibration.

Were internal standards (ISTD) used	✓			qualify all results as unusable (R).
Were at least 5 required ISTDs used	✓			qualify all analytes not bracketed by ISTD masses as unusable (R).
All analyte masses are bracketed by ISTD masses	✓			qualify all analytes not bracketed by ISTD masses as unusable (R).
Is sample % Relative Intensity (%RI) within 60-125%	✓			See below if no
If sample %RI <60% or >125% when: sample reanalyzed at a 2-fold dilution				ACTION: positive and non-detect results in the dilution analysis are estimated (J) and (UJ), respectively.
Sample not reanalyzed at a 2-fold dilution				use professional judgment to qualify sample results as estimated (J) or unusable (R).

Overall Assessment – examine raw data and verify sample results by performing a 10% spot check of all types of computations and transcriptions for all SDG forms.

	YES	NO	N/A	ACTION (if no)
Transcriptions and computations are correct	✓			check all calculations for errors.
Data were free of any anomalies (ex: baseline shifts, negative absorbances, omissions, illegibility, etc)	✓			use professional judgment to qualify data. Contact Validata Project Manager if resubmissions are required.
methods and amounts used in digestions were correct	✓			use professional judgment to qualify data. Contact Validata PM if resubmissions are required.
Did results fall within the ICP linear range either before or after being reanalyzed at a dilution.	✓			use professional judgment to qualify data. Contact Validata PM if resubmissions are required.

Assess the overall quality of the data and make professional judgments and express concerns, as well as comment on the validity of the overall data. Consider the additive nature when several QC criteria are outside of the specification parameters. Comment briefly on the data quality and make recommendations for further data qualification when appropriate.

VALIDATA
Chemical Services, Inc.
2634 Nutwood Trace, Duluth, GA 30097
(770) 232-0130
(770) 232-5082 (Fax)
www.datavalidator.com

DATA VALIDATION SUMMARY REPORT

COMPANY:	CH2M HILL, Inc.
SITE NAME:	East Vieques Terrestrial UXO Sites, Vieques Island, PR
CTO / PROJECT NO.:	CTO-0005 / 424191
CONTRACTED LAB:	APPL, Inc.
QA/QC LEVEL:	EPA Level IV
EPA SOW/METHODS:	SW-846
VALIDATION GUIDELINES:	*Master Sampling and Analysis Plan for East Vieques Terrestrial UXO Sites, Vieques Puerto Rico, Master SAP Addendum 2, USEPA Region II Modifications*
SAMPLE MATRICES:	Soil and Water
TYPES OF ANALYSES:	Explosives, Perchlorate, Picric Acid, Total Metals, Total Hexavalent Chromium
SDG NUMBER:	70988

SAMPLES:

Client Sample #	Lab Sample #	Matrix	Explosives	Perchlorate
VE-UXO18-01SMI01-0613	AY81989	Soil	X	X
VE-UXO18-01SMI01T-0613	AY81992	Soil	X	X
VE-UXO18-01SMI01TT-0613	AY81993	Soil	X	X
VE-UXO18-01SMI02-0613	AY81994	Soil	X	X
VE-UXO18-EB01-061313	AY81995	Water	X	X
VE-UXO18-01SMI01B-0613	AY81990	Soil	X	X
VE-UXO18-01SMI01C-0613	AY81991	Soil	X	X
VE-UXO18-01SMI02-0613MS	AY81994MS	Soil	X	X
VE-UXO18-01SMI02-0613MSD	AY81994MSD	Soil	X	X

Client Sample #	Lab Sample #	Matrix	Picric Acid	Total Metals*
VE-UXO18-01SMI01-0613	AY81989	Soil	X	X
VE-UXO18-01SMI01-0613DL	AY81989DL	Soil		X
VE-UXO18-01SMI01T-0613	AY81992	Soil	X	X
VE-UXO18-01SMI01T-0613DL	AY81992DL	Soil		X

Client Sample #	Lab Sample #	Matrix	Picric Acid	Total Metals*
VE-UXO18-01SMI01TT-0613	AY81993	Soil	X	X
VE-UXO18-01SMI01TT-0613DL	AY81993DL	Soil		X
VE-UXO18-01SMI02-0613	AY81994	Soil	X	X
VE-UXO18-01SMI02-0613DL	AY81994DL	Soil		X
VE-UXO18-EB01-061313	AY81995	Water	X	X
VE-UXO18-01SMI01B-0613	AY81990	Soil	X	X
VE-UXO18-01SMI01C-0613	AY81991	Soil	X	X
VE-UXO18-01SMI02-0613MS	AY81994MS	Soil	X	X
VE-UXO18-01SMI02-0613MSD	AY81994MSD	Soil	X	X

Client Sample #	Lab Sample #	Matrix	Total Hex. Cr
VE-UXO18-01SMI01-0613	AY81989	Soil	X
VE-UXO18-01SMI01T-0613	AY81992	Soil	X
VE-UXO18-01SMI01TT-0613	AY81993	Soil	X
VE-UXO18-01SMI02-0613	AY81994	Soil	X
VE-UXO18-EB01-061313	AY81995	Water	X
VE-UXO18-01SMI01B-0613	AY81990	Soil	X
VE-UXO18-01SMI01C-0613	AY81991	Soil	X
VE-UXO18-01SMI02-0613MS	AY81994MS	Soil	X
VE-UXO18-01SMI02-0613MSD	AY81994MSD	Soil	X

* - Total Metals consisted of 14 analytes reported from method 6010C and 8 analytes reported from method 6020A.

SUFFIX CODES: DL = DILUTION, MD = MATRIX DUPLICATE, MS = MATRIX SPIKE, MSD = MATRIX SPIKE DUPLICATE

DATA REVIEWER(S): Thomas B. Granat, Theresa Tipe

SECONDARY REVIEWER(S): Kevin C. Harmon, Amy L. Hogan

Data Qualifier Definitions

J	-	The associated numerical value is an estimated quantity.
J+	-	The associated numerical value is an estimated quantity, potentially biased high.
J-	-	The associated numerical value is an estimated quantity, potentially biased low.
R	-	The data are unusable (the compound/analyte may or may not be present). Resampling and reanalysis are necessary for verification.
U	-	The compound/analyte was analyzed for, but not detected. The associated numerical value is the sample quantitation limit.
UJ	-	The compound/analyte was analyzed for, but not detected. The sample quantitation limit is an estimated quantity.

DATA QUALIFICATION SUMMARY

APPL, Inc. – 70988 - Organics & Inorganics

EXPLOSIVES

SUMMARY

I.) General:

The analyses for Explosives were performed by HPLC according to SW-846 Method 8330B.

II.) Overall Assessment of Data:

The four soil sample results for explosives in the SDG were rejected due to exceeding the Region II elapsed time criteria of 14 hours between the injection of the opening CCV and the end of the analytical sequence (closing CCV). See Major Issues section below for details.

MAJOR ISSUES

I.) Continuing Calibration

The 17 hours and 58 minutes that elapsed from the injection of the opening CCV to the end of the analytical sequence (closing CCV) exceeded the Region II limit of 14 hours. Region II criteria calls for all results, detects or non-detects, to be qualified as rejected (R). The associated samples, which were all non-detects, are VE-UXO18-01SMI01-0613, VE-UXO18-01SMI01T-0613, VE-UXO18-01SMI01TT-0613, and VE-UXO18-01SMI02-0613.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was required.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met. No action was required.

Initial Calibration Verification:

All Initial Calibration Verification criteria were met. No action was required.

Continuing Calibration:

Please see Major Issues section for rejected soil results.

IV.) Blanks:

Method Blanks:

There were no detections in the method blanks associated with this fraction of the SDG. No action was required.

Equipment Blank:

There were no detections in the equipment blank associated with this fraction of the SDG. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Laboratory Control Samples (LCS):

Two LCS sets were analyzed by the laboratory for this SDG. In the water LCS/LCSD, the HMX Percent Recovery (%R) was 79.9% which was outside the QC limits of 80 – 100%. The HMX %R rounded up to 2 significant figures meet the QC recovery criteria. No action was required.

Ground LCS:

The laboratory analyzed one Ground LCS for this site (VE-UXO18), with the analyses being performed in this SDG. The 2-nitrotoluene recovery of 116 % was outside the QC limits of 46-103%. The Nitrobenzene recovery of 94.3% was outside the QC limits of 36-89%. The lab did not reanalyze the LCS sample. Since all results were non-detects, no action was required.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were performed on SDG sample VE-UXO18-01SMI02-0613, for the preparation batch containing the soil samples for this SDG. All MS / MSD criteria were met. No action was required.

MS / MSD analyses data were not submitted for the water matrix fraction of the SDG. The only associated SDG sample was a field QC. Data qualification based on the absence of MS / MSD data was not required, so no action was taken.

VIII.) Field Triplicates:

One set of field triplicate samples (VE-UXO18-01SMI01-0613 / VE-UXO18-01SMI01T-0613 / VE-UXO18-01SMI01TT-0613) was identified for this SDG. There was no calculable Percent Relative Standard Deviation (%RSD). No action was required.

Laboratory Triplicates:

One set of laboratory triplicate samples (VE-UXO18-01SMI01-0613 / VE-UXO18-01SMI01B-0613 / VE-UXO18-01SMI01C-0613) was identified for this SDG. There was no calculable Percent Relative Standard Deviation (%RSD). No action was required.

IX.) TCL Compound Identification:

All TCL Compound Identification criteria were met. No action was required.

X.) Compound Quantitation and Reported Limit of Quantitation / Detection (LOQ/LOD):

All LOQ/LOD criteria were met. No action was required.

XI.) System Performance:

All System Performance criteria were met. No action was required.

PERCHLORATE

SUMMARY

I.) General:

The analyses for Perchlorate were performed by HPLC according to SW-846 Method 6850.

II.) Overall Assessment of Data:

All laboratory data were acceptable with qualifications.

MAJOR ISSUES

There were no major problems observed for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was required.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met. No action was required.

Initial Calibration Verification:

All Initial Calibration Verification criteria were met. No action was required.

Continuing Calibration:

All Continuing Calibration criteria were met. No action was required.

IV.) Blanks:

Method Blanks:

There were no detections in the method blanks associated with this fraction of the SDG. No action was required.

Equipment Blank:

There were no detections in the equipment blank associated with this fraction of the SDG. No action was required.

V.) Laboratory Control Samples (LCS):

Two LCS samples were analyzed for this fraction of the SDG. All LCS criteria were met. No action was required.

Ground LCS:

The laboratory analyzed one Ground LCS for this site (VE-UXO18), with the analyses being performed in this SDG. The perchlorate LCS recovery of 68.3% was outside the QC limits of 80-120%. The lab did not reanalyze the LCS. Since the %R was greater than 40%, citing professional judgment, the validator determined that all associated sample results should be qualified as estimated (J) and (UJ). All perchlorate results for this SDG were non-detect and therefore qualified as estimated (UJ).

VI.) LC/MS Ratio:

All LC/MS Ratio criteria were met. No action was required.

VII.) Interference Check Sample:

All Interference Check Sample criteria were met. No action was required.

VIII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were performed on SDG sample VE-UXO18-01SMI02-0613, for the preparation batch containing the soil samples for this SDG. All MS / MSD criteria were met. No action was required.

MS / MSD analyses were performed on SDG sample VE-UXO18-EB01-061313, for the preparation batch containing the water sample for this SDG. All MS / MSD criteria were met. The sample chosen for the water samples was a field QC sample, and therefore not considered a relevant sample. The only associated sample in this SDG was a field QC; therefore, no action was required.

IX.) Field Triplicates:

One set of field triplicate samples (VE-UXO18-01SMI01-0613 / VE-UXO18-01SMI01T-0613 / VE-UXO18-01SMI01TT-0613) was identified for this SDG. There was no calculable Percent Relative Standard Deviation (%RSD). No action was required.

Laboratory Triplicates:

One set of laboratory triplicate samples (VE-UXO18-01SMI01-0613 / VE-UXO18-01SMI01B-0613 / VE-UXO18-01SMI01C-0613) was identified for this SDG. There was no calculable Percent Relative Standard Deviation (%RSD). No action was required.

X.) Internal Standards Performance (ISTD):

All ISTD criteria were met. No action was required.

XI.) TCL Compound Identification:

All TCL Compound Identification criteria were met. No action was required.

XII.) Compound Quantitation and Reported Limit of Quantitation / Detection (LOQ/LOD):

All LOQ/LOD criteria were met. No action was required.

XIII.) System Performance:

All System Performance criteria were met. No action was required.

PICRIC ACID

SUMMARY

I.) General:

The analyses for Picric Acid were performed by HPLC according to SW-846 Method 8321A.

II.) Overall Assessment of Data:

The four non-detect soil sample results for picric acid in the SDG were rejected due to low Ground LCS recovery (%R) of 2.2%. See Major Issues section below for details.

MAJOR ISSUES

I.) Laboratory Control Samples (LCS):

Ground LCS:

The laboratory analyzed one Ground LCS for this site (VE-UXO18), with the analyses being performed in this SDG. The picric acid LCS recovery of 2.2% was outside the QC limits of 30-130%. All picric acid soil results were non-detect and qualified as rejected (R).

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was required.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met. No action was required.

Initial Calibration Verification:

All Initial Calibration Verification criteria were met. No action was required.

Continuing Calibration:

All Continuing Calibration criteria were met. No action was required.

IV.) Blanks:

Method Blanks:

There were no detections in the method blanks associated with this fraction of the SDG. No action was required.

Equipment Blank:

There were no detections in the equipment blank associated with this fraction of the SDG. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Laboratory Control Samples (LCS):

Two LCS samples were analyzed for this fraction of the SDG. All LCS criteria were met. No action was required.

Ground LCS:

Please see Major Issues section for rejected soil results.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were performed on SDG sample VE-UXO18-01SMI02-0613, for the preparation batch containing the soil samples for this SDG. All MS / MSD criteria were met. No action was required.

MS / MSD analyses data were not submitted for the water matrix fraction of the SDG. The only associated SDG sample was a field QC. Data qualification based on the absence of MS / MSD data was not required, so no action was taken.

VIII.) Field Triplicates:

One set of field triplicate samples (VE-UXO18-01SMI01-0613 / VE-UXO18-01SMI01T-0613 / VE-UXO18-01SMI01TT-0613) was identified for this SDG. There was no calculable Percent Relative Standard Deviation (%RSD). No action was required.

Laboratory Triplicates:

One set of laboratory triplicate samples (VE-UXO18-01SMI01-0613 / VE-UXO18-01SMI01B-0613 / VE-UXO18-01SMI01C-0613) was identified for this SDG. There was no calculable Percent Relative Standard Deviation (%RSD). No action was required.

IX.) TCL Compound Identification:

All TCL Compound Identification criteria were met. No action was required.

X.) Compound Quantitation and Reported Limit of Quantitation / Detection (LOQ/LOD):

All LOQ/LOD criteria were met. No action was required.

XI.) System Performance:

All System Performance criteria were met. No action was required.

TOTAL METALS

SUMMARY

I.) General:

The analyses for Total Metals were performed using SW-846 Methods 6010C and 6020A.

II.) Overall Assessment of Data:

All laboratory data were acceptable with qualification.

MAJOR ISSUES

There were no major problems observed for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Tuning, Initial and Continuing Calibration criteria were met. No action was required.

III.) LOD Standards:

All LOD criteria were met. No action was required.

IV.) Blanks:

Preparation Blank Results:

All Preparation Blank criteria were met for the preparation batch containing the soil samples for this SDG. No action was required.

The following analytes were detected in the water preparation blank PBW:

Analyte	Concentration
sodium	146 ug/L
antimony	0.18 ug/L
chromium	0.24 ug/L
selenium	0.37 ug/L

The only associated sample was equipment blank VE-UXO18-EB02-061313; therefore, no action was required.

Equipment Blanks:

The following analytes were detected in equipment blank sample VE-UXO18-EB01-061313:

Analyte	Concentration
antimony	0.18 ug/L
arsenic	0.09 ug/L
chromium	0.37 ug/L
selenium	0.54 ug/L

The concentration of antimony in the equipment blank was less than the LOD but greater than the DL. All antimony results were non-detect; therefore, no action was required.

The concentration of arsenic in the equipment blank was less than the LOD. All arsenic results were positive and less than the LOD; therefore, were qualified as undetected (U) with the result raised to the LOD. The associated samples were VE-UXO18-01SMI01-0613, VE-UXO18-01SMI01T-0613, VE-UXO18-01SMI01TT-0613, and VE-UXO18-01SMI02-0613.

The concentration of chromium in the equipment blank was greater than the LOD. The chromium result for sample VE-UXO18-01SMI01-0613 was positive and less than the LOD; therefore, was qualified as undetected (U) with the result raised to the LOD. The chromium results for samples VE-UXO18-01SMI01T-0613, VE-UXO18-01SMI01TT-0613, and VE-UXO18-01SMI02-0613 were greater than the LOD and greater than 10X the blank concentration; therefore, no action was required.

The concentration of selenium in the equipment blank was greater than the LOD. The selenium results for samples VE-UXO18-01SMI01-0613, VE-UXO18-01SMI01T-0613, and VE-UXO18-01SMI01TT-0613 were positive and less than the LOD; therefore, were qualified as undetected (U) with the result raised to the LOD. The selenium result for VE-UXO18-01SMI02-0613 was greater than the LOD and greater than 10X the blank concentration; therefore, no action was required.

Calibration Blanks:

All Calibration Blank criteria were met. No action was required.

V.) ICP Interference Check Sample Results:

All Interference Percent Recovery criteria were met. No action was required.

VI.) ICP Serial Dilution Analysis:

Note: Per Region II guidance on homogeneity, non-SMI soil sample MS/MSD and serial dilution outlier qualifications were applied to the parent sample only. Water samples and SMI soil samples are considered to be homogeneous and any qualification based on MS/MSD or serial dilution outliers are applied to all associated preparation batch samples.

Serial Dilution Analysis was performed on SDG sample VE-UXO18-01SMI02-0613. All Serial Dilution criteria were met. No action was required.

Serial Dilution Analysis data was not submitted for the aqueous sample for this fraction of the SDG. The only aqueous sample in the SDG was a field blank; therefore, no action was taken for the water sample.

VII.) Laboratory Control Samples (LCS):

Two LCS samples were analyzed for this fraction of the SDG. All LCS criteria were met. No action was required.

VIII.) Matrix Spike / Matrix Spike Duplicate (MS/MSD):

Note: Per Region II guidance on homogeneity, non-SMI soil sample MS/MSD and serial dilution outlier qualifications were applied to the parent sample only. Water samples and SMI soil samples are considered to be homogeneous and any qualification based on MS/MSD or serial dilution outliers are applied to all associated preparation batch samples.

Matrix Spike / Matrix Spike Duplicate analyses were performed on SDG sample VE-UXO04-01SMI02-0213, for the preparation batch containing the soil samples for this SDG. The results for aluminum, calcium, iron, and manganese were not considered meaningful since the parent sample results were greater than 4X the spike concentrations. The following Percent Recoveries (Rs) were outside the 80-120% QC limits:

Analyte	MS, %R	MSD, %R
antimony	15%	22%
beryllium	65%	65%
copper	74.2%	
lead	57%	61%
magnesium		122%
nickel	61.4%	65.4%
potassium	149%	194%
selenium	68.7%	
thallium	78.8%	
vanadium	60.6%	74.6%
zinc	61%	68%

In addition to the %Rs, the calculable Relative Percent Differences (RPDs) exceeded the 20% QC limit for the following analyte: antimony (38%). Post digestion spikes were within QC limits. Since SMI samples are considered homogeneous, the positive results for magnesium and potassium would be qualified estimated (J) since the %Rs for these analytes exceeded the QC limits. All positive and non-detect SDG sample results for the remaining listed analytes were qualified as estimated (J) and (UJ) unless a higher priority flag was applied. The associated samples were VE-UXO18-01SMI01-0613, VE-UXO18-01SMI01T-0613, VE-UXO18-01SMI01TT-0613, and VE-UXO18-01SMI02-0613.

Matrix Spike / Matrix Spike Duplicate analyses were performed on client sample VE-UXO12-EB01-062013 from SDG 71042, for the preparation batch containing the water sample for this SDG. All MS / MSD Percent Recovery (%R) and Relative Percent Difference (RPD) criteria were met for the water samples. The sample chosen for the water samples was a field QC sample, and therefore not considered a relevant sample. The only associated sample in this SDG was a field QC; therefore, no action was required.

IX.) Field Triplicates:

One set of field triplicate samples (VE-UXO18-01SMI01-0613 / VE-UXO18-01SMI01T-0613 / VE-UXO18-01SMI01TT-0613) was identified for this SDG. Below are the Percent Relative Standard Deviations (RSDs) for the calculable results.

Analyte	% RSD
aluminum	125%
barium	14.3%
calcium	13.6%
magnesium	7.3%
manganese	12.9%
sodium	18.7%

Aluminum exceeded the < 30% RSD QC limit for the soil. The RSD QC limits for field triplicate analyses are advisory only; therefore, no action was required. All other calculable results were within the < 30% RSD QC limit for the soil.

Laboratory Triplicates:

One set of laboratory triplicate samples (VE-UXO18-01SMI01-0613/ VE-UXO18-01SMI01B-0613/ VE-UXO18-01SMI01C-0613) was identified for this SDG. Below are the Percent Relative Standard Deviations (RSDs) for the calculable results.

Analyte	% RSD
aluminum	127%
calcium	15.5%
magnesium	3.2%
manganese	16.5%
sodium	19.7%

Aluminum exceeded the 20% RSD QC limit for the soil. The aluminum results in the associated samples were qualified as estimated (J). All other calculable results were within the 20% RSD QC limit for the soil. The associated samples were: VE-UXO18-01SMI01-0613, VE-UXO18-01SMI01T-0613, VE-UXO18-01SMI01TT-0613, and VE-UXO18-01SMI02-0613.

X.) Internal Standards Recovery (ISTD):

All ISTD criteria were met. No action was required.

XI.) Sample Result, Calculation/Transcription Verification:

The initial analysis results for calcium in samples VE-UXO18-01SMI01-0613, VE-UXO18-01SMI01T-0613, VE-UXO18-01SMI01TT-0613, and VE-UXO18-01SMI02-0613 exceeded the linear calibration range. A 100X dilution analysis was performed for each sample with all calibration criteria met. The Form I for each sample is a composite of the overall best set of results, so no action was required.

XII.) Quarterly Verification of Instrumental Parameters:

All criteria were met. No action was taken.

TOTAL HEXAVALENT CHROMIUM

SUMMARY

I.) General:

The analyses for Total Hexavalent Chromium were performed using SW-846 Method 7196A.

II.) Overall Assessment of Data:

All laboratory data were acceptable with qualifications.

MAJOR ISSUES

There were no major problems observed for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

The 29 hours between sample collection and sample analysis for SDG aqueous sample VE-UXO18-EB01-061313 exceeded the 24 hour QC limit. The results for hexavalent chromium in the aqueous SDG sample, which was non-detect, was qualified as estimated (UJ) since the holding time is past the QC limit but is within 2X the limit.

II.) Calibration:

All Initial and Continuing Calibration criteria were met. No action was required.

III.) Blanks:

There were no results in the calibration or preparation blanks associated with this fraction of the SDG. No action was required.

There were no results in the equipment blank associated with this fraction of the SDG. No action was required.

IV.) Laboratory Control Samples (LCS):

Two LCS / LCSD sets were analyzed for this fraction of the SDG. All LCS criteria were met. No action was required.

V.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

Note: Per Region II guidance on homogeneity, non-SMI soil sample MS/MSD and serial dilution outlier qualifications were applied to the parent sample only. Water samples and SMI soil samples are considered to be homogeneous and any qualification based on MS/MSD or serial dilution outliers are applied to all associated preparation batch samples.

MS / MSD analyses were performed on SDG sample VE-UXO18-01SMI02-0613, for the preparation batch containing the soil samples for this SDG. All MS / MSD criteria were met. No action was required.

MS / MSD analyses data were not submitted for the water matrix fraction of the SDG. The only associated SDG sample was a field QC. No action was required.

VI.) Field Triplicates:

One set of field triplicate samples (VE-UXO18-01SMI01-0613 / VE-UXO18-01SMI01T-0613 / VE-UXO18-01SMI01TT-0613) was identified for this SDG. There was no calculable Percent Relative Standard Deviation (%RSD). No action was required.

Laboratory Triplicates:

One set of laboratory triplicate samples (VE-UXO18-01SMI01-0613 / VE-UXO18-01SMI01B-0613 / VE-UXO18-01SMI01C-0613) was identified for this SDG. There was no calculable Percent Relative Standard Deviation (%RSD). No action was required.

VII.) Sample Result, Calculation/Transcription Verification:

All criteria were met. No action was necessary.

Appendix A

Qualified Form Is

EPA 8330B EXPLOSIVES-SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI01-0613

APPL ID: AY81989

Sample Collection Date: 06/12/13

QCG: #833BS-130625A-179190

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.200 U R	0.50	0.200	0.079	mg/kg	06/25/13	07/04/13 CC
EPA 8330B	1,3-DINITROBENZENE	0.200 U	0.45	0.200	0.063	mg/kg	06/25/13	07/04/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/25/13	07/04/13
EPA 8330B	2,4-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/25/13	07/04/13
EPA 8330B	2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/25/13	07/04/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/25/13	07/04/13
EPA 8330B	2-NITROTOLUENE	0.200 U	0.50	0.200	0.066	mg/kg	06/25/13	07/04/13
EPA 8330B	3-NITROTOLUENE	0.200 U	0.50	0.200	0.071	mg/kg	06/25/13	07/04/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/25/13	07/04/13
EPA 8330B	4-NITROTOLUENE	0.200 U	0.50	0.200	0.080	mg/kg	06/25/13	07/04/13
EPA 8330B	HMX	0.200 U	0.50	0.200	0.080	mg/kg	06/25/13	07/04/13
EPA 8330B	NITROBENZENE	0.200 U	0.50	0.200	0.075	mg/kg	06/25/13	07/04/13
EPA 8330B	NITROGLYCERIN	0.200 U	0.50	0.200	0.085	mg/kg	06/25/13	07/04/13
EPA 8330B	PETN	1.000 U	2.50	1.000	0.579	mg/kg	06/25/13	07/04/13
EPA 8330B	RDX	0.200 U	0.50	0.200	0.080	mg/kg	06/25/13	07/04/13
EPA 8330B	TETRYL	0.200 U	0.50	0.200	0.091	mg/kg	06/25/13	07/04/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	92.5	70-130			%	06/25/13	07/04/13

Quant Method: W130702.M
Run #: 0703_0000041
Instrument: Waldorf
Sequence: 130702
Dilution Factor: 1
Initials: PY

Printed: 07/10/13 12:56:10 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-12-13

EPA 8330B EXPLOSIVES-SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI01T-0613

APPL ID: AY81992

Sample Collection Date: 06/12/13

QCG: #833BS-130625A-179190

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.200 U R	0.50	0.200	0.079	mg/kg	06/25/13	07/04/13
EPA 8330B	1,3-DINITROBENZENE	0.200 U	0.45	0.200	0.063	mg/kg	06/25/13	07/04/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/25/13	07/04/13
EPA 8330B	2,4-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/25/13	07/04/13
EPA 8330B	2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/25/13	07/04/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/25/13	07/04/13
EPA 8330B	2-NITROTOLUENE	0.200 U	0.50	0.200	0.066	mg/kg	06/25/13	07/04/13
EPA 8330B	3-NITROTOLUENE	0.200 U	0.50	0.200	0.071	mg/kg	06/25/13	07/04/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/25/13	07/04/13
EPA 8330B	4-NITROTOLUENE	0.200 U	0.50	0.200	0.080	mg/kg	06/25/13	07/04/13
EPA 8330B	HMX	0.200 U	0.50	0.200	0.080	mg/kg	06/25/13	07/04/13
EPA 8330B	NITROBENZENE	0.200 U	0.50	0.200	0.075	mg/kg	06/25/13	07/04/13
EPA 8330B	NITROGLYCERIN	0.200 U	0.50	0.200	0.085	mg/kg	06/25/13	07/04/13
EPA 8330B	PETN	1.000 U	2.50	1.000	0.579	mg/kg	06/25/13	07/04/13
EPA 8330B	RDX	0.200 U	0.50	0.200	0.080	mg/kg	06/25/13	07/04/13
EPA 8330B	TETRYL	0.200 U	0.50	0.200	0.091	mg/kg	06/25/13	07/04/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	92.8	70-130			%	06/25/13	07/04/13

Quant Method: W130702.M
Run #: 0703_0000044
Instrument: Waldorf
Sequence: 130702
Dilution Factor: 1
Initials: PY

Printed: 07/10/13 12:56:10 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-12-13

EPA 8330B EXPLOSIVES-SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI01TT-0613

APPL ID: AY81993

Sample Collection Date: 06/12/13

QCG: #833BS-130625A-179190

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.200 U R	0.50	0.200	0.079	mg/kg	06/25/13	07/04/13 cc
EPA 8330B	1,3-DINITROBENZENE	0.200 U	0.45	0.200	0.063	mg/kg	06/25/13	07/04/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/25/13	07/04/13
EPA 8330B	2,4-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/25/13	07/04/13
EPA 8330B	2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/25/13	07/04/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/25/13	07/04/13
EPA 8330B	2-NITROTOLUENE	0.200 U	0.50	0.200	0.066	mg/kg	06/25/13	07/04/13
EPA 8330B	3-NITROTOLUENE	0.200 U	0.50	0.200	0.071	mg/kg	06/25/13	07/04/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/25/13	07/04/13
EPA 8330B	4-NITROTOLUENE	0.200 U	0.50	0.200	0.080	mg/kg	06/25/13	07/04/13
EPA 8330B	HMX	0.200 U	0.50	0.200	0.080	mg/kg	06/25/13	07/04/13
EPA 8330B	NITROBENZENE	0.200 U	0.50	0.200	0.075	mg/kg	06/25/13	07/04/13
EPA 8330B	NITROGLYCERIN	0.200 U	0.50	0.200	0.085	mg/kg	06/25/13	07/04/13
EPA 8330B	PETN	1.000 U	2.50	1.000	0.579	mg/kg	06/25/13	07/04/13
EPA 8330B	RDX	0.200 U	0.50	0.200	0.080	mg/kg	06/25/13	07/04/13
EPA 8330B	TETRYL	0.200 U	0.50	0.200	0.091	mg/kg	06/25/13	07/04/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	94.8	70-130			%	06/25/13	07/04/13

Quant Method: W130702.M
Run #: 0703_0000045
Instrument: Waldorf
Sequence: 130702
Dilution Factor: 1
Initials: PY

Printed: 07/10/13 12:56:10 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-12-13

EPA 8330B EXPLOSIVES-SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI02-0613

APPL ID: AY81994

Sample Collection Date: 06/12/13

QCG: #833BS-130625A-179190

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.200 U	0.50	0.200	0.079	mg/kg	06/25/13	07/04/13
EPA 8330B	1,3-DINITROBENZENE	0.200 U	0.45	0.200	0.063	mg/kg	06/25/13	07/04/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/25/13	07/04/13
EPA 8330B	2,4-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/25/13	07/04/13
EPA 8330B	2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	06/25/13	07/04/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/25/13	07/04/13
EPA 8330B	2-NITROTOLUENE	0.200 U	0.50	0.200	0.066	mg/kg	06/25/13	07/04/13
EPA 8330B	3-NITROTOLUENE	0.200 U	0.50	0.200	0.071	mg/kg	06/25/13	07/04/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	06/25/13	07/04/13
EPA 8330B	4-NITROTOLUENE	0.200 U	0.50	0.200	0.080	mg/kg	06/25/13	07/04/13
EPA 8330B	HMX	0.200 U	0.50	0.200	0.080	mg/kg	06/25/13	07/04/13
EPA 8330B	NITROBENZENE	0.200 U	0.50	0.200	0.075	mg/kg	06/25/13	07/04/13
EPA 8330B	NITROGLYCERIN	0.200 U	0.50	0.200	0.085	mg/kg	06/25/13	07/04/13
EPA 8330B	PETN	1.000 U	2.50	1.000	0.579	mg/kg	06/25/13	07/04/13
EPA 8330B	RDX	0.200 U	0.50	0.200	0.080	mg/kg	06/25/13	07/04/13
EPA 8330B	TETRYL	0.200 U	0.50	0.200	0.091	mg/kg	06/25/13	07/04/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	95.5	70-130			%	06/25/13	07/04/13

Quant Method: W130702.M
Run #: 0703_0000046
Instrument: Waldorf
Sequence: 130702
Dilution Factor: 1
Initials: PY

Printed: 07/11/13 12:49:55 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-12-13

EPA 8330B EXPLOSIVES-WATER

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-EB01-061313

APPL ID: AY81995

Sample Collection Date: 06/13/13

QCG: #833BW-130617A-179143

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.300 U	0.50	0.300	0.130	ug/L	06/17/13	06/18/13
EPA 8330B	1,3-DINITROBENZENE	0.300 U	0.50	0.300	0.131	ug/L	06/17/13	06/18/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.300 U	0.50	0.300	0.133	ug/L	06/17/13	06/18/13
EPA 8330B	2,4-DINITROTOLUENE	0.300 U	0.50	0.300	0.125	ug/L	06/17/13	06/18/13
EPA 8330B	2,6-DINITROTOLUENE	0.300 U	0.50	0.300	0.125	ug/L	06/17/13	06/18/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.300 U	0.50	0.300	0.125	ug/L	06/17/13	06/18/13
EPA 8330B	2-NITROTOLUENE	0.300 U	0.50	0.300	0.126	ug/L	06/17/13	06/18/13
EPA 8330B	3-NITROTOLUENE	0.300 U	0.50	0.300	0.133	ug/L	06/17/13	06/18/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.300 U	0.50	0.300	0.100	ug/L	06/17/13	06/18/13
EPA 8330B	4-NITROTOLUENE	0.300 U	0.50	0.300	0.133	ug/L	06/17/13	06/18/13
EPA 8330B	HMX	0.300 U	0.50	0.300	0.115	ug/L	06/17/13	06/18/13
EPA 8330B	NITROBENZENE	0.300 U	0.50	0.300	0.126	ug/L	06/17/13	06/18/13
EPA 8330B	NITROGLYCERIN	0.300 U	0.50	0.300	0.130	ug/L	06/17/13	06/18/13
EPA 8330B	PETN	1.500 U	2.50	1.500	0.607	ug/L	06/17/13	06/18/13
EPA 8330B	RDX	0.300 U	0.50	0.300	0.123	ug/L	06/17/13	06/18/13
EPA 8330B	TETRYL	0.300 U	0.50	0.300	0.133	ug/L	06/17/13	06/18/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	81.2	70-130			%	06/17/13	06/18/13

Quant Method: W130403.M
Run #: 0618_0000009
Instrument: Waldorf
Sequence: 130403
Dilution Factor: 1
Initials: PY

Printed: 07/10/13 12:56:10 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-12-13

Perchlorate EPA 6850 - Soil

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI01-0613

APPL ID: AY81989

Sample Collection Date: 06/12/13

QCG: #6850MIS-130625A-179290

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 6850	PERCHLORATE	4.00 U J	6.0	4.00	2.00	ug/Kg	06/25/13	07/08/13 GBSL

Quant Method: QTLMFL2
Run #: T707_094.d
Instrument: AGIL_6460
Sequence: TQ070713
Dilution Factor: 1
Initials: RP

Printed: 07/12/13 3:52:54 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-20-13

Perchlorate EPA 6850 - Soil

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni
Project: 424191.FI.FK.04 Vieques CTO 005
Sample ID: VE-UXO18-01SMI01T-0613
Sample Collection Date: 06/12/13

ARF: 70988
APPL ID: AY81992
QCG: #6850MIS-130625A-179290

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 6850	PERCHLORATE	4.00 U J	6.0	4.00	2.00	ug/Kg	06/25/13	07/08/13 GDSL

Quant Method:	QTLMFL2
Run #:	T707_097.d
Instrument:	AGIL_6460
Sequence:	TQ070713
Dilution Factor:	1
Initials:	RP

Printed: 07/12/13 3:52:54 PM
APPL-F1-SC-NoMC-REG MDLs

TDG 9-20-13

Perchlorate EPA 6850 - Soil

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI01TT-0613

APPL ID: AY81993

Sample Collection Date: 06/12/13

QCG: #6850MIS-130625A-179290

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 6850	PERCHLORATE	4.00 U J	6.0	4.00	2.00	ug/Kg	06/25/13	07/08/13 GRSL

Quant Method: QTLMFL2
Run #: T707_102.d
Instrument: AGIL_6460
Sequence: TQ070713
Dilution Factor: 1
Initials: RP

Printed: 07/12/13 3:52:54 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-20-13

Perchlorate EPA 6850 - Soil

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI02-0613

APPL ID: AY81994

Sample Collection Date: 06/12/13

QCG: #6850MIS-130625A-179290

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 6850	PERCHLORATE	4.00 U J	6.0	4.00	2.00	ug/Kg	06/25/13	07/08/13 BSL

Quant Method: QTLMFL2
Run #: T707_103.d
Instrument: AGIL_6460
Sequence: TQ070713
Dilution Factor: 1
Initials: RP

Printed: 07/12/13 3:52:54 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-20-13

Perchlorate

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-EB01-061313

APPL ID: AY81995

Sample Collection Date: 06/13/13

QCG: #6850-130620A-179289

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 6850	PERCHLORATE	0.400 U	0.60	0.400	0.200	ug/L	06/20/13	07/08/13

Quant Method: QTLMFL2
Run #: T707_068.d
Instrument: AGIL_6460
Sequence: TQ070713
Dilution Factor: 1
Initials: RP

Printed: 07/12/13 3:52:54 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-20-13

EPA 8321A PICRIC ACID-IS SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni
Project: 424191.FI.FK.04 Vieques CTO 005
Sample ID: VE-UXO18-01SMI01-0613
Sample Collection Date: 06/12/13

ARF: 70988
APPL ID: AY81989
QCG: #PICSMI-130625A-179239

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	120.00 ~~U~~ R	200.0	120.00	60.00	ug/kg	06/25/13	07/10/13 GBSL
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	92.5	50-150			%	06/25/13	07/10/13

Quant Method: 83PIC709.M
Run #: L709_062.D
Instrument: AGIL_1100
Sequence: LQ070913
Dilution Factor: 1
Initials: MP

Printed: 07/12/13 12:31:44 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-20-13

EPA 8321A PICRIC ACID-IS SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI01T-0613

APPL ID: AY81992

Sample Collection Date: 06/12/13

QCG: #PICSMI-130625A-179239

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	120.00 U R	200.0	120.00	60.00	ug/kg	06/25/13	07/10/13 GBSL
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	92.8	50-150			%	06/25/13	07/10/13

Quant Method:	83PIC709.M
Run #:	L709_065.D
Instrument:	AGIL_1100
Sequence:	LQ070913
Dilution Factor:	1
Initials:	MP

Printed: 07/12/13 12:31:44 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-20-13

EPA 8321A PICRIC ACID-IS SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI01TT-0613

APPL ID: AY81993

Sample Collection Date: 06/12/13

QCG: #PICSMI-130625A-179239

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	120.00 ~~U~~ R	200.0	120.00	60.00	ug/kg	06/25/13	07/10/13 GBSL
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	94.8	50-150			%	06/25/13	07/10/13

Quant Method:	83PIC709.M
Run #:	L709_066.D
Instrument:	AGIL_1100
Sequence:	LQ070913
Dilution Factor:	1
Initials:	MP

Printed: 07/12/13 12:31:44 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-20-13

EPA 8321A PICRIC ACID-IS SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI02-0613

APPL ID: AY81994

Sample Collection Date: 06/12/13

QCG: #PICSMI-130625A-179239

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	120.00 UR	200.0	120.00	60.00	ug/kg	06/25/13	07/10/13 GBSL
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	95.5	50-150			%	06/25/13	07/10/13

Quant Method:	83PIC709.M
Run #:	L709_067.D
Instrument:	AGIL_1100
Sequence:	LQ070913
Dilution Factor:	1
Initials:	MP

Printed: 07/12/13 12:31:44 PM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-20-13

EPA 8321A Picric Acid-Water

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-EB01-061313

APPL ID: AY81995

Sample Collection Date: 06/13/13

QCG: #PICW-130618A-179225

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	0.12 U	0.2	0.12	0.06	ug/L	06/18/13	07/09/13
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	89.0	50-150			%	06/18/13	07/09/13

Quant Method: 83PIC709.M
Run #: L709_018.D
Instrument: AGIL_1100
Sequence: LQ070913
Dilution Factor: 1
Initials: MP

Printed: 07/12/13 11:23:40 AM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-20-13

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI01-0613

APPL ID: AY81989

Sample Collection Date: 06/12/13

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
6010C/3050B	ALUMINUM (AL)	18.4 J	10.0	4.00	1.98	mg/kg	1	07/03/13	07/09/13 LD
6020A/3050B	ANTIMONY (SB)	0.20U J	0.2	0.20	0.10	mg/Kg	1	07/03/13	07/09/13 MSL
6020A/3050B	ARSENIC (AS)	0.30 ~~0.095J~~ U	0.5	0.30	0.08	mg/Kg	1	07/03/13	07/09/13 EBL
6010C/3050B	BARIUM (BA)	2.4	0.50	0.400	0.075	mg/kg	1	07/03/13	07/09/13
6010C/3050B	BERYLLIUM (BE)	0.200U J	0.20	0.200	0.044	mg/kg	1	07/03/13	07/09/13 MSL
6020A/3050B	CADMIUM (CD)	0.08U	0.1	0.08	0.03	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	CALCIUM (CA)	38300	1000.0	800.00	500.00	mg/kg	100	07/03/13	07/08/13
6020A/3050B	CHROMIUM (CR)	0.20 ~~0.13J~~ U	0.5	0.20	0.04	mg/Kg	1	07/03/13	07/09/13 EBL
6020A/3050B	COBALT (CO)	0.057J	0.1	0.08	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	COPPER (CU)	0.400U J	0.50	0.400	0.094	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	IRON (FE)	4.0J	5.0	4.00	0.85	mg/kg	1	07/03/13	07/09/13
6010C/3050B	LEAD (PB)	0.400U J	0.50	0.400	0.160	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	MAGNESIUM (MG)	1240 J	5.0	4.00	1.29	mg/kg	1	07/03/13	07/09/13 MSH
6010C/3050B	MANGANESE (MN)	19.3	0.50	0.400	0.130	mg/kg	1	07/03/13	07/09/13
6010C/3050B	NICKEL (NI)	0.400U J	0.50	0.400	0.068	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	POTASSIUM (K)	62.0~~J~~ J	100	50.0	13.9	mg/kg	1	07/03/13	07/09/13 MSH
6020A/3050B	SELENIUM (SE)	0.10 ~~0.055J~~ U	0.2	0.10	0.04	mg/Kg	1	07/03/13	07/09/13 EBL
6020A/3050B	SILVER (AG)	0.05U	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	SODIUM (NA)	294	100	50.0	11.1	mg/kg	1	07/03/13	07/09/13
6020A/3050B	THALLIUM (TL)	0.05U J	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13 MSL
6010C/3050B	VANADIUM (V)	0.400U J	0.50	0.400	0.100	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	ZINC (ZN)	2.4~~J~~ J	5.0	4.00	1.15	mg/kg	1	07/03/13	07/09/13 MSL

J = Estimated value.

Printed: 07/15/13 11:55:53 AM

APPL-F1-SC-NoMC-REG MDLs

TBG 9-25-13

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI01T-0613

APPL ID: AY81992

Sample Collection Date: 06/12/13

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
6010C/3050B	ALUMINUM (AL)	42.5 J	10.0	4.00	1.98	mg/kg	1	07/03/13	07/09/13 LD
6020A/3050B	ANTIMONY (SB)	0.20U J	0.2	0.20	0.10	mg/Kg	1	07/03/13	07/09/13 MSL
6020A/3050B	ARSENIC (AS)	0.30 ~~0.098J~~ U	0.5	0.30	0.08	mg/Kg	1	07/03/13	07/09/13 EBL
6010C/3050B	BARIUM (BA)	2.1	0.50	0.400	0.075	mg/kg	1	07/03/13	07/09/13
6010C/3050B	BERYLLIUM (BE)	0.200U J	0.20	0.200	0.044	mg/kg	1	07/03/13	07/09/13 MSL
6020A/3050B	CADMIUM (CD)	0.08U	0.1	0.08	0.03	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	CALCIUM (CA)	41300	1000.0	800.00	500.00	mg/kg	100	07/03/13	07/08/13
6020A/3050B	CHROMIUM (CR)	0.21J	0.5	0.20	0.04	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	COBALT (CO)	0.061J	0.1	0.08	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	COPPER (CU)	0.400U J	0.50	0.400	0.094	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	IRON (FE)	13.0	5.0	4.00	0.85	mg/kg	1	07/03/13	07/09/13
6010C/3050B	LEAD (PB)	0.400U J	0.50	0.400	0.160	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	MAGNESIUM (MG)	1430 J	5.0	4.00	1.29	mg/kg	1	07/03/13	07/09/13 MSH
6010C/3050B	MANGANESE (MN)	17.1	0.50	0.400	0.130	mg/kg	1	07/03/13	07/09/13
6010C/3050B	NICKEL (NI)	0.400U J	0.50	0.400	0.068	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	POTASSIUM (K)	42.8 ~~J~~ J	100	50.0	13.9	mg/kg	1	07/03/13	07/09/13 MSH
6020A/3050B	SELENIUM (SE)	0.10 ~~0.053J~~ U	0.2	0.10	0.04	mg/Kg	1	07/03/13	07/09/13 EBL
6020A/3050B	SILVER (AG)	0.05U	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	SODIUM (NA)	271	100	50.0	11.1	mg/kg	1	07/03/13	07/09/13
6020A/3050B	THALLIUM (TL)	0.05U J	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13 MSL
6010C/3050B	VANADIUM (V)	0.400U J	0.50	0.400	0.100	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	ZINC (ZN)	2.7 ~~J~~ J	5.0	4.00	1.15	mg/kg	1	07/03/13	07/09/13 MSL

J = Estimated value.

Printed: 07/15/13 11:55:54 AM

APPL-F1-SC-NoMC-REG MDLs

TBG 9-25-13

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI01TT-0613

APPL ID: AY81993

Sample Collection Date: 06/12/13

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
6010C/3050B	ALUMINUM (AL)	262 J	10.0	4.00	1.98	mg/kg	1	07/03/13	07/09/13 LD
6020A/3050B	ANTIMONY (SB)	0.20U J	0.2	0.20	0.10	mg/Kg	1	07/03/13	07/09/13 MSL
6020A/3050B	ARSENIC (AS)	0.30 ~~0.47J~~ U	0.5	0.30	0.08	mg/Kg	1	07/03/13	07/09/13 EBL
6010C/3050B	BARIUM (BA)	1.8	0.50	0.400	0.075	mg/kg	1	07/03/13	07/09/13
6010C/3050B	BERYLLIUM (BE)	0.200U J	0.20	0.200	0.044	mg/kg	1	07/03/13	07/09/13 MSL
6020A/3050B	CADMIUM (CD)	0.08U	0.1	0.08	0.03	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	CALCIUM (CA)	31500	1000.0	800.00	500.00	mg/kg	100	07/03/13	07/08/13
6020A/3050B	CHROMIUM (CR)	0.69	0.5	0.20	0.04	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	COBALT (CO)	0.098J	0.1	0.08	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	COPPER (CU)	0.46~~J~~ J	0.50	0.400	0.094	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	IRON (FE)	185	5.0	4.00	0.85	mg/kg	1	07/03/13	07/09/13
6010C/3050B	LEAD (PB)	0.20~~J~~ J	0.50	0.400	0.160	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	MAGNESIUM (MG)	1300 J	5.0	4.00	1.29	mg/kg	1	07/03/13	07/09/13 MSH
6010C/3050B	MANGANESE (MN)	14.9	0.50	0.400	0.130	mg/kg	1	07/03/13	07/09/13
6010C/3050B	NICKEL (NI)	0.17~~J~~ J	0.50	0.400	0.068	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	POTASSIUM (K)	70.9~~J~~ J	100	50.0	13.9	mg/kg	1	07/03/13	07/09/13 MSH
6020A/3050B	SELENIUM (SE)	0.10 ~~0.079J~~ U	0.2	0.10	0.04	mg/Kg	1	07/03/13	07/09/13 EBL
6020A/3050B	SILVER (AG)	0.05U	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	SODIUM (NA)	202	100	50.0	11.1	mg/kg	1	07/03/13	07/09/13
6020A/3050B	THALLIUM (TL)	0.05U J	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13 MSL
6010C/3050B	VANADIUM (V)	0.50 J	0.50	0.400	0.100	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	ZINC (ZN)	3.6~~J~~ J	5.0	4.00	1.15	mg/kg	1	07/03/13	07/09/13 MSL

J = Estimated value.

Printed: 07/15/13 11:55:54 AM

APPL-F1-SC-NoMC-REG MDLs

TBG 9-25-13

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI02-0613

APPL ID: AY81994

Sample Collection Date: 06/12/13

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
6010C/3050B	ALUMINUM (AL)	598 J	10.0	4.00	1.98	mg/kg	1	07/03/13	07/09/13 LD
6020A/3050B	ANTIMONY (SB)	0.20U J	0.2	0.20	0.10	mg/Kg	1	07/03/13	07/09/13 MSL
6020A/3050B	ARSENIC (AS)	0.30 ~~0.15J~~ U	0.5	0.30	0.08	mg/Kg	1	07/03/13	07/09/13 EBL
6010C/3050B	BARIUM (BA)	4.5	0.50	0.400	0.075	mg/kg	1	07/03/13	07/09/13
6010C/3050B	BERYLLIUM (BE)	0.200U J	0.20	0.200	0.044	mg/kg	1	07/03/13	07/09/13 MSL
6020A/3050B	CADMIUM (CD)	0.08U	0.1	0.08	0.03	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	CALCIUM (CA)	27100	1000.0	800.00	500.00	mg/kg	100	07/03/13	07/08/13
6020A/3050B	CHROMIUM (CR)	0.85	0.5	0.20	0.04	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	COBALT (CO)	0.24	0.1	0.08	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	COPPER (CU)	0.68 J	0.50	0.400	0.094	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	IRON (FE)	316	25.0	20.00	4.30	mg/kg	5	07/03/13	07/08/13
6010C/3050B	LEAD (PB)	0.400U J	0.50	0.400	0.160	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	MAGNESIUM (MG)	620 J	5.0	4.00	1.29	mg/kg	1	07/03/13	07/09/13 MSH
6010C/3050B	MANGANESE (MN)	54.6	2.50	2.000	0.650	mg/kg	5	07/03/13	07/08/13
6010C/3050B	NICKEL (NI)	0.36 J J	0.50	0.400	0.068	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	POTASSIUM (K)	184 J	100	50.0	13.9	mg/kg	1	07/03/13	07/09/13 MSH
6020A/3050B	SELENIUM (SE)	0.12 J J	0.2	0.10	0.04	mg/Kg	1	07/03/13	07/09/13 MSL
6020A/3050B	SILVER (AG)	0.05U	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	SODIUM (NA)	61.7J	100	50.0	11.1	mg/kg	1	07/03/13	07/09/13
6020A/3050B	THALLIUM (TL)	0.05U J	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13 MSL
6010C/3050B	VANADIUM (V)	0.54 J	0.50	0.400	0.100	mg/kg	1	07/03/13	07/09/13 MSL
6010C/3050B	ZINC (ZN)	2.9 J J	5.0	4.00	1.15	mg/kg	1	07/03/13	07/09/13 MSL

J = Estimated value.

Printed: 07/15/13 11:55:54 AM

APPL-F1-SC-NoMC-REG MDLs

TBG 9-25-13

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni
Project: 424191.FI.FK.04 Vieques CTO 005
ARF: 70988
Sample ID: VE-UXO18-EB01-061313
APPL ID: AY81995
Sample Collection Date: 06/13/13

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
6010C/3010A	ALUMINUM (AL)	80.0U	100	80.0	27.4	ug/L	1	06/25/13	06/28/13
6020A/3015^	ANTIMONY (SB)	0.18J	1.0	0.50	0.14	ug/L	1	06/25/13	07/09/13
6020A/3015^	ARSENIC (AS)	0.090J	0.5	0.20	0.09	ug/L	1	06/25/13	07/09/13
6010C/3010A	BARIUM (BA)	4.00U	5.0	4.00	0.75	ug/L	1	06/25/13	06/28/13
6010C/3010A	BERYLLIUM (BE)	1.00U	2.0	1.00	0.24	ug/L	1	06/25/13	06/28/13
6020A/3015^	CADMIUM (CD)	0.10U	0.2	0.10	0.02	ug/L	1	06/25/13	07/09/13
6010C/3010A	CALCIUM (CA)	50.0U	100	50.0	27.5	ug/L	1	06/25/13	06/28/13
6020A/3015^	CHROMIUM (CR)	0.37J	0.5	0.20	0.07	ug/L	1	06/25/13	07/09/13
6020A/3015^	COBALT (CO)	0.40U	1.0	0.40	0.13	ug/L	1	06/25/13	07/09/13
6010C/3010A	COPPER (CU)	4.00U	5.0	4.00	1.71	ug/L	1	06/25/13	06/28/13
6010C/3010A	IRON (FE)	25.0U	50	25.0	9.0	ug/L	1	06/25/13	06/28/13
6010C/3010A	LEAD (PB)	4.00U	5.0	4.00	1.58	ug/L	1	06/25/13	06/28/13
6010C/3010A	MAGNESIUM (MG)	30.0U	50	30.0	12.9	ug/L	1	06/25/13	06/28/13
6010C/3010A	MANGANESE (MN)	4.00U	5.0	4.00	1.23	ug/L	1	06/25/13	06/28/13
6010C/3010A	NICKEL (NI)	3.00U	5.0	3.00	0.42	ug/L	1	06/25/13	06/28/13
6010C/3010A	POTASSIUM (K)	500.0U	1000	500.0	125.0	ug/L	1	06/25/13	06/28/13
6020A/3015^	SELENIUM (SE)	0.54J	1.0	0.40	0.10	ug/L	1	06/25/13	07/09/13
6020A/3015^	SILVER (AG)	0.10U	0.2	0.10	0.03	ug/L	1	06/25/13	07/09/13
6010C/3010A	SODIUM (NA)	500.0U	1000	500.0	111.1	ug/L	1	06/25/13	06/28/13
6020A/3015^	THALLIUM (TL)	0.20U	0.2	0.20	0.10	ug/L	1	06/25/13	07/09/13
6010C/3010A	VANADIUM (V)	4.00U	5.0	4.00	0.97	ug/L	1	06/25/13	06/28/13
6010C/3010A	ZINC (ZN)	20.0U	50	20.0	13.7	ug/L	1	06/25/13	06/28/13

J = Estimated value.

Printed: 07/15/13 11:55:54 AM
APPL-F1-SC-NoMC-REG MDLs

TBG 9-12-13

Wet Lab Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

Sample ID: VE-UXO18-01SMI01-0613
Sample Collection Date: 06/12/13

APPL ID: AY81989
ARF: 70988

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
EPA 7196A/30	HEXAVALENT CHROMIUM	4.00 U	10.0	4.00	2.30	mg/kg	10	07/01/13	07/08/13
EPA 9045D	PH	7.6@24.3C	NA			pH Units	1	07/02/13	07/02/13
WalkBlk	TOTAL ORGANIC CARBON	19900	200.0	150.00	100.00	mg/Kg	1	07/05/13	07/05/13

Printed: 07/15/13 3:51:40 PM

APPL-F1-SC-NoMC-REG MDLs

TBG 9-12-13

Wet Lab Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

Sample ID: VE-UXO18-01SMI01T-0613
Sample Collection Date: 06/12/13

APPL ID: AY81992
ARF: 70988

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
EPA 7196A/30	HEXAVALENT CHROMIUM	4.00 U	10.0	4.00	2.30	mg/kg	10	07/01/13	07/08/13

Printed: 07/15/13 3:51:40 PM

APPL-F1-SC-NoMC-REG MDLs

TGG 9-12-13

Wet Lab Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

Sample ID: VE-UXO18-01SMI01TT-0613
Sample Collection Date: 06/12/13

APPL ID: AY81993
ARF: 70988

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
EPA 7196A/30	HEXAVALENT CHROMIUM	4.00 U	10.0	4.00	2.30	mg/kg	10	07/01/13	07/08/13

Printed: 07/15/13 3:51:40 PM

APPL-F1-SC-NoMC-REG MDLs

TBG 9-12-13

Wet Lab Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

Sample ID: VE-UXO18-01SMI02-0613
Sample Collection Date: 06/12/13

APPL ID: AY81994
ARF: 70988

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
EPA 7196A/30	HEXAVALENT CHROMIUM	10.00 U	25.0	10.00	5.75	mg/kg	25	07/01/13	07/08/13
EPA 9045D	PH	7.5@24.4C	NA			pH Units	1	07/02/13	07/02/13
WalkBlk	TOTAL ORGANIC CARBON	86700	200.0	150.00	100.00	mg/Kg	1	07/09/13	07/09/13

Printed: 07/15/13 3:51:40 PM

APPL-F1-SC-NoMC-REG MDLs

TAG 9-12-13

Wet Lab Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

Sample ID: VE-UXO18-EB01-061313
Sample Collection Date: 06/13/13

APPL ID: AY81995
ARF: 70988

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
SW846 7196A	HEXAVALENT CHROMIUM	0.010 UJ	0.02	0.010	0.006	mg/L	1	06/14/13	06/14/13 HT

Printed: 07/15/13 3:51:40 PM

APPL-F1-SC-NoMC-REG MDLs

TB6 9-12-13

Appendix B

Support Documentation

3.0x
70988

APPL LABS

APPL, Inc.
908 N Temperance Ave
Clovis, CA 93611

ELECTRONIC CHAIN OF CUSTODY RECORD

Phone: (559) 275-2175
Fax: (559) 275-4422
C.O.C. 20130613-SMI-SS-APPL-01

Report to: PLEASE PRINT
Company Name: CH2MHILL Phone: 703.376.5301
Address: 15010 Conference Dr. ; 200
Chantilly, VA 20151 Fax: 703.376.5801
Attn: Mike Zamboni

Invoice to: PLEASE PRINT
Company Name: See Contact Phone:
Address: Fax:
Attn:

Project Name/Number: Terrestrial UXO Site Sampling/424191.FI.FK.04
Purchase Order Number: 951152
Sampler (Print): not required
Sampler (Signature): not required

Date Shipped: 6/13/13
Carrier: FedEx
Waybill No.: 799990756650
Comments:

Sample Identification	Location	Date Collected	Time Collected	Time Zone	No. of Containers	Matrix: Aq	Matrix: Sed.	Matrix: Soil		Analysis Requested/Method Number: Add. 2 WS 8270-D 8260 Presorting prior to analysis	SW-846 8330B Lab + NG + PETN no SA DWA	SW-846-8321	SW-846 8850	SW-846 8015C Add. 2 Worksheet # 16-3 Sp/A	SW-846 8270A Add. 2 Worksheet # 16-3 Sp/A	SW-846 3005A, 7196A	SW-846 6010D	Walkley Black	ASTM D1498	SW-846 8270D SIM 18 PAHs (see Add. 2 WS #15-1)			Comments
VE-UXO18-01SS03-0001		6/12/13	10:05	AST	1			✓			X	X	X	X	X	X	X	X	X				
VE-UXO18-01SS02-0001		6/12/13	10:35	AST	1			✓			X	X	X	X	X	X	X	X	X				
VE-UXO18-01SS02-0001-MS		6/12/13	10:35	AST	1			✓			X	X	X	X	X	X							matrix spike
VE-UXO18-01SS02-0001-SD		6/12/13	10:35	AST	1			✓			X	X	X	X	X	X							matrix spike duplicate
VE-UXO18-01SS01-0001		6/12/13	10:45	AST	1			✓			X	X	X	X	X	X	X	X	X				
VE-UXO18-01SS01P-0001		6/12/13	10:50	AST	1			✓			X	X	X	X	X	X							
VE-UXO18-01SMI01-0613	LAB TRIP B & C	6/12/13	12:05	AST	1			✓		X	X	X	X	X	X	X	X	X	X				
VE-UXO18-01SMI01T-0613		6/12/13	12:05	AST	1			✓		X	X	X	X	X	X	X							
VE-UXO18-01SMI01TT-0613		6/12/13	12:05	AST	1			✓		X	X	X	X	X	X	X							
VE-UXO18-01SMI02-0613		6/12/13	13:00	AST	1			✓		X	X	X	X	X	X	X	X	X	X				
VE-UXO18-01SMI02-0613-MS		6/12/13	13:00	AST	1			✓		X	X	X	X	X	X	X							matrix spike

Shuttle Temperature:
Turnaround Requested: Check one ☑ Stan 28 days ☐ One week ☐ 24/48 Hrs. ☐ Other
Sample Disposal: ☐ ~~Return to client~~ ☐ ~~Disposal by Lab (30 day retention)~~ not applicable

Relinquished by:	Date	Time	Received by:	Relinquished by:	Date	Time	Received by:
[signature]	6/13/13	1300					
Relinquished by:	Date	Time	Received by:	Relinquished by:	Date	Time	Received at lab by:
					6/14/13	11:35	[signature]

White: Return to client with report Yellow: Laboratory Copy Pink: Sampler

Note: The first sampled date of the ARF will be used as the COC number unless indicated otherwise.

APPL LABS

APPL, Inc.
908 N Temperance Ave
Clovis, CA 93611

ELECTRONIC CHAIN OF CUSTODY RECORD

Phone: (559) 275-2175
Fax: (559) 275-4422
C.O.C. 20130613-SMI-SS-APPL-02

Report to: PLEASE PRINT
Company Name: CH2MHILL
Address: 15010 Conference Dr. ; 200
Chantilly, VA 20151
Attn: Mike Zamboni
Phone: 703.376.5301
Fax: 703.376.5801

Invoice to: PLEASE PRINT
Company Name: See Contact
Address:
Attn:
Phone:
Fax:

Project Name/Number: Terrestrial UXO Site Sampling/424191.FLFK.04
Purchase Order Number: 951152
Sampler (Print): not required
Sampler (Signature): not required

Date Shipped: 6/13/13
Carrier: FedEx
Waybill No.: 799990756650
Comments:

Sample Identification	Location	Date Collected	Time Collected	Time Zone	No. of Containers	Aq.	Sed.	Soil		Analysis Requested/Method Number: Aqu. 2 VHS 8260 GM Pumping prior to sampling	SW-846 8330B LM + MS + PETN no 3,5 DNA	SW-846-8321	SW-846 8850	SW-846 8015C Aqu. 2 Volatiles # 16-3 Soils	SW-846 8015A Aqu. 2 Volatiles # 16-3 Soils	SW-846 3550A, 7199A	SW-846 9040D	Walkley Black	ASTM D1498	SW-846 8270D SIM 18 PAHs (see Aqu. 2 VHS #16-1)		
VE-UXO18-01SMI02-0613-SD		6/12/13	13:00	AST	1			✓			X	X	X	X	X	X						matrix spike duplicate
VE-UXO18-EB01-061313		6/13/13	12:00	AST	5	✓					X	X	X	X	X	X						equipment blank-SMI
VE-UXO18-EB02-061313		6/13/13	12:15	AST	5	✓					X	X	X	X	X	X						equipment blank-SS
									✓													
									✓													
									✓													
									✓													
									✓													

Shuttle Temperature:

Turnaround Requested: Check one
☑ Stan 28 days ☐ One week ☐ 24/48 Hrs. ☐ Other

Sample Disposal:
☐ ~~Return to client~~ ☐ ~~Disposal by Lab (30 day retention)~~ not applicable

Relinquished by sampler:	Date 6/13/13	Time 1300	Received by:	Relinquished by:	Date	Time	Received by:
Relinquished by:	Date	Time	Received by:	Relinquished by:	Date 6/14/13	Time 11:35	Received at lab by:

White: Return to client with report Yellow: Laboratory Copy Pink: Sampler

Note: The first sampled date of the ARF will be used as the COC number unless indicated otherwise.

COOLER RECEIPT FORM

1) Project: 424191. FI. FR. 04 Viegues CTO 005 Date Received: 6/14/13
2) **Coolers:** Number of Coolers: 1
3) YES NO Were coolers and samples screened for radioactivity?
4) YES NO Were custody seals on outside of cooler? How many? 2 Date on seal? 6/13/13
5) Name on seal? See Label
6) YES NO NA Were custody seals unbroken and intact at the time of arrival?
7) YES NO Did the cooler come with a shipping slip (air bill, etc.)? Carrier name: Fed Ex
8) Shipping slip numbers: 1) 7999 9075 6650 2) 3)
9) YES NO NA Was the shipping slip scanned into the database?
10) YES NO NA If cooler belongs to APPL, has it been logged into the ice chest database?
11) Describe type of packing in cooler (bubble wrap, popcorn, type of ice, etc.): bubble bag, Ziploc in wet ice
12) YES NO NA For hand delivered samples was sufficient ice present to start the cooling process?
13) YES NO Was a temperature blank included in the cooler?
14) Serial number of certified NIST thermometer used: A39267 Correction factor: 0
15) Cooler temp(s): 1) 3.0°C 2) 3) 4) 5) 6) 7) 8)

Chain of custody:

16) YES NO Was a chain of custody received?
17) YES NO Were the custody papers signed in the appropriate places?
18) YES NO Was the project identifiable from custody papers?
19) YES NO Did the chain of custody include date and time of sampling?
20) YES NO Is location where sample was taken listed on the chain of custody?

Sample Labels:

21) YES NO Were container labels in good condition?
22) YES NO Was the client ID on the label?
23) YES NO Was the date of sampling on the label?
24) YES NO Was the time of sampling on the label?
25) YES NO Did all container labels agree with custody papers?

Sample Containers:

26) YES NO Were all containers sealed in separate bags?
27) YES NO Did all containers arrive unbroken?
28) YES NO Was there any leakage from samples?
29) YES NO Were any of the lids cracked or broken?
30) YES NO Were correct containers used for the tests indicated?
31) YES NO Was a sufficient amount of sample sent for tests indicated?
32) YES NO NA Were bubbles present in volatile samples? If yes, the following were received with air bubble
Larger than a pea:
Smaller than a pea:

CUSTODY SEAL DATE SIGNATURE 6/13/13

Preservation & Hold time:

33) YES NO NA Was a sufficient amount of holding time remaining to analyze the samples?
34) YES NO NA Do the sample containers contain the same preservative as what is stated on the COC?
35) YES NO NA Was the pH taken of all non-VOA preserved samples and written on the sample container?
36) YES NO NA Was the pH of acid preserved non-VOA samples < 2?
37) YES NO NA Was the pH of sodium hydroxide preserved samples for Cyanide > 12 and Sulfide >9?
38) YES NO NA Unpreserved VOA Vials received?
39) YES NO NA Are unpreserved VOA vials noted in the ADD TEST FIELD on the ARF?

Lab notified if pH was not adequate:
Deficiencies: Received pH and Hex Chrom greater than 24 hours from collection time.

Signature of personnel receiving samples: Second reviewer:
Signature of project manager notified: Renée Date and Time of notification: 6-17-13 1419
Name of client notified: Date and Time of notification:
Information given to client:
by whom (Initials):

F:\Forms\Worksheet - CoolerReceipt.doc Revision 19, May 21, 2013

APPL - Receiving

From: Cynthia Clark [cclark@applinc.com]
Sent: Friday, June 14, 2013 11:46 AM
To: 'APPL - Receiving'; 'Chue Moua'; 'Renee Patterson'
Cc: 'extractions'; 'APPL - MIS'
Subject: FW: Vieques Soil Samples to be received 06/14/13
Attachments: 20130613_VQS_SMI_SS_COC_airbill_appl_01.pdf; CTF_samples rec at APPL 061413.doc

Importance: High

Here is the COC and change memo for samples to be received tomorrow.
Please log the SS and SMI samples on two different ARFs.
Please add comments for a PE sample to the SMI ARF. I think we will need a lab triplicate added to the SMI ARF as well.

Please add PAHs to the samples listed in the attached memo. The COC says they only sent 1 jar. If that is the case, please mark all those samples as limited volume. For the samples listed in the memo, please put "PAHs HCA only" in the add test field.

VE-UXO18-EB02-061313 goes with SS samples
VE-UXO18-EB01-061313 goes with SMI samples

Sincerely,

Cynthia Clark, Project Manager

APPL, Inc.
908 North Temperance Ave., Clovis, CA 93611
Phone: 559-275-2175
Fax: 559-275-4422
cclark@applinc.com
www.applinc.com

This is a PRIVATE and CONFIDENTIAL message. If you are not the intended recipient, please delete without copying and kindly advise us by e-mail of the mistake in delivery. NOTE: Regardless of content, this e-mail shall not operate to bind APPL, Inc. to any order or other contract unless pursuant to explicit written agreement or government initiative expressly permitting the use of e-mail for such purpose.

From: Juliana.Dean@ch2m.com [mailto:Juliana.Dean@ch2m.com]
Sent: Friday, June 14, 2013 9:57 AM
To: cclark@applinc.com
Subject: Vieques Soil Samples

Hi Cynthia,

Attached are the COCs for samples shipped yesterday. There is one major issue. Almost all of these samples should be marked for SVOCs (hexachloroethane) but they are not. Could you let me know if you receive extra samples marked for SVOCs? I've attached the CTF memo, in case you do have enough volume.

Thank you!

Juliana Dean

Chemist I

Sample receipt information

ARF: 70988

Project: 424191.F1.FK.04 Vieques CTO 005

Sample Receipt Information:

The samples were received on June 14, 2013, at 3.0°C. The samples were assigned Analytical Request Form (ARF) number 70988. The sample numbers and requested analyses were compared to the chains of custody and email communications. Lab duplicate and triplicate analysis was added to sample VE-UXO18-01SMI01-0613. No exception was encountered.

Sample Table

CLIENT ID	APPL ID	Matrix	Date Sampled	Date Received
VE-UXO18-01SMI01-0613	AY81989	SOIL	06/12/13	06/14/13
VE-UXO18-01SMI01B-0613	AY81990	SOIL	06/12/13	06/14/13
VE-UXO18-01SMI01C-0613	AY81991	SOIL	06/12/13	06/14/13
VE-UXO18-01SMI01T-0613	AY81992	SOIL	06/12/13	06/14/13
VE-UXO18-01SMI01TT-0613	AY81993	SOIL	06/12/13	06/14/13
VE-UXO18-01SMI02-0613	AY81994	SOIL	06/12/13	06/14/13
VE-UXO18-EB01-061313	AY81995	WATER	06/13/13	06/14/13

The samples and blanks were screened for J-value responses between the detection limit (DL) and limit of quantitation (LOQ).

APPL's laboratory control limits generated in house statistically do not meet the control limits listed in DoD QSM 4.2 for all analytes. Laboratory control spike recoveries for this project meet all control limits listed in the DoD QSM 4.2 except where noted. A copy of our in house generated control limits is available upon request. In addition, a copy of our LOQ control limits, established using 7 data points, are also available upon request.

Only the portion of the injection log relative to these samples is included. A full sequence log is available upon request.

Measurement uncertainty can be reported upon request.

EPA Method 8330B - Explosives

Sample Preparation:

The soil samples were designated for incremental sampling; they were dried, mechanically ground, and incrementally sampled according to EPA method 8330B, Appendix A, then extracted according to EPA method 8330B. The water sample was extracted according to EPA method 3535A. A commercially available PE sample was ground in the puck mill, sub sampled, and extracted using the same criteria as was used for the samples. All holding times were met.

Analysis:

The samples were analyzed according to EPA Method 8330B using an Agilent 1290 HPLC with DA detector. Manual integrations were performed in accordance with APPL's SOP. The following analytes were manually integrated in the calibration standards: HMX, Nitroglycerin, Tetryl and PETN. PETN was manually integrated in the PE LCS and the MS/MSD. Chromatograms of before and after manual integration are enclosed.

Quality Control/Assurance:

Spike Recovery

Laboratory Control Spikes (LCS) were used for quality assurance. For the water LCSD, HMX recovered slightly below the lower control limit of 80% at 79.9%. All other spike acceptance criteria were met.

Sample VE-UXO18-01SMI02-0613 was selected for MS/MSD analysis. All recoveries were within the acceptance limits.

A Performance Evaluation spike was also used for quality assurance. The control limits listed on the results page are in house control limits generated using ground PE samples. The PE sample recovered 2-Nitrotoluene at 116% and Nitrobenzene at 94.3%. All other recoveries were acceptable.

Method blanks:

No target analyte was detected above one-half the limit of quantitation (LOQ) in the method blanks.

Surrogates:

Surrogate recoveries are summarized on the form 2 & 8. All surrogates had acceptable recoveries.

Laboratory Duplicate and Triplicate:

Sample VE-UXO18-01SMI02-0613 was prepared and analyzed as laboratory duplicate/triplicate.

Calibration:

The initial and continuing calibrations and second source (ICV) were analyzed according to the method. All calibration criteria were met.

Summary:

No other analytical problem was encountered. The data generated are acceptable.

EPA Method 6850

Perchlorate LC/MS

Sample Preparation:

The soil samples were designated for incremental sampling; they dried, mechanically ground, and incrementally sampled according to EPA method 8330B, Appendix A, then prepared according to the method. The water sample was prepared according to the method. All holding times were met.

A soil PE sample was prepared in the laboratory by spiking 100g of blank soil with 0.06mL of 10ppm perchlorate standard. The 100g aliquot was then ground in the puck mill using the same criteria for grinding and sub sampling as was used for the sample.

Sample Analysis Information:

The samples were analyzed according to the EPA 6850 method and the DoD Perchlorate Handbook, Revision 1, Change 1, August 2007, using an Agilent 6460 LC Triple Quad MS. Manual integrations were performed in accordance with APPL's SOP. Perchlorate_85 was manually integrated on the 130625 ICS. Chromatograms of before and after manual integration are enclosed.

Quality Control/Assurance

Spikes and Duplicates:

Laboratory Control Spikes (LCS/LCSD) and an Interference Check Sample were used for quality assurance. All LCS and ICS recoveries met acceptance criteria.

A Performance Evaluation spike was also used for quality assurance. The PE sample recovered at 68.3%. No control limits have been established for ground perchlorate PE samples. The control limits listed on the results page are unground control limits. When sufficient PE samples have been ground, in house control limits will be established.

Samples VE-UXO18-01SMI02-0613 and VE-UXO18-EB01-061313 were selected for MS/MSD analysis. All spike recoveries were acceptable.

Blanks:

The blanks did not contain Perchlorate at or above one-half the limit of quantitation (LOQ).

Laboratory Duplicate and Triplicate:

Sample VE-UXO18-01SMI02-0613 was prepared and analyzed as laboratory duplicate/triplicate.

Calibrations:

Calibrations were performed according to the method.

Internal Standards:

The area counts of the sample Internal Standards were compared to the average area counts of the initial calibration. The internal standard recovered above the upper control limit in the MS/MSD. All other internal standards were within the 50%D acceptance criteria.

Summary:

No other problem was encountered. Data generated are acceptable.

EPA Method 8321A
Picric Acid

Sample Preparation:

The soil samples were designated for incremental sampling; they were dried, mechanically ground, and incrementally sampled according to EPA method 8330B, Appendix A, then extracted according to EPA method 8330B. The water sample was extracted according to EPA method 3535A. All holding times were met.

A soil PE sample was prepared in the laboratory by spiking 100g of blank soil with 0.4mL of 100ppm picric acid standard. The 100g aliquot was then ground in the puck mill using the same criteria for grinding and sub-sampling as was used for the samples.

Analysis:

The samples were analyzed according to EPA Method 8321A using an Agilent 1100 HPLC with Mass Spec detector and an Agilent 1290 HPLC with DA detector. Manual integrations were performed in accordance with APPL's SOP. The following analytes were manually integrated in the calibration standards: Picric Acid and 4-Nitrophenol. 4-Nitrophenol was manually integrated in sample VE-UXO18-EB01-061313, VE-UXO18-01SMI01C-0613, VD-UXO18-01SMI01TT-0613, VE-UXO18-01SMI02-0613, the blank for water and the LCS for soil. Picric Acid was manually integrated in the LCS/LCSD for water, LCS for soil, PE LCS and the MS/MSD. Chromatograms of before and after manual integration are enclosed.

Quality Control/Assurance:

Spike Recovery

Laboratory Control Spikes (LCS) were used for quality assurance. All spike acceptance criteria was met.

Sample VE-UXO18-01SMI02-0613 was selected for MS/MSD analysis. All recoveries were within the acceptance limits.

A Performance Evaluation spike was also used for quality assurance. The PE sample recovered at 2.2%. No control limits have been established for ground picric acid PE samples. The control limits listed on the results page are unground control limits. When sufficient PE samples have been ground, in house control limits will be established.

Method blanks:

No target analyte was detected above one-half the limit of quantitation (LOQ) in the method blanks.

Surrogates:

Surrogate recoveries are summarized on the Form 2 & 8. All surrogates had acceptable recoveries. The surrogates were analyzed on a separate run sequence, since the surrogates require different instrument parameters than picric acid.

Laboratory Duplicate and Triplicate:

Sample VE-UXO18-01SMI02-0613 was prepared and analyzed as laboratory duplicate/triplicate.

Calibration:

The initial and continuing calibrations and second source were analyzed according to the method. All calibration criteria were met.

Summary:

No other analytical problem was encountered.

EPA Methods 6010C and 6020A
Metals

Digestion Information:

The soil samples were designated for incremental sampling; they weres dried, manually ground, and incrementally sampled according to EPA method 8330B, Appendix A, then digested according to EPA method 3050B. The water sample was digested according to EPA method 3010A. All holding times were met.

Analysis Information:

Samples:

The samples were analyzed according to EPA method 6010C using a Perkin Elmer Optima 5300DV ICP and according to EPA method 6020A using an Agilent 7700cx ICP-MS. Based on the curve's lowest calibration point, the samples analyzed by EPA method 6020A were reported at a DF10, without affecting the limit of quantitation (LOQ).

Calibrations:

Calibrations were performed according to the methods for the initial calibration and the initial calibration verification. The initial calibration verification is prepared from a second source standard. All calibration acceptance criteria were met.

Blanks:

No target analyte was detected above one-half the limit of quantitation (LOQ) in the method blanks.

Spikes:

Laboratory Control Spikes (LCS), matrix spikes (MS/MSD), post-digestion spikes (PDS), and dilution tests (DT) were used for quality assurance. All acceptance criteria were met in the LCS.

Sample VE-UXO18-01SMI02-0613 was selected as the QC sample for the analytical batch. In the MS/MSD, 15 metals recover outside the 80% - 120% control limits, and three RPDs exceed 20%. The DT was applicable to six metals; three metals exceed the 10% deviation limit. The PDS was applicable to 19 metals; one recovers below the 75% limit. All other recoveries were within the acceptance limits.

Laboratory Duplicate and Triplicate:

Sample VE-UXO18-01SMI02-0613 was prepared and analyzed as laboratory duplicate/triplicate.

Internal Standards

All acceptance criteria were met in the internal standards.

Summary:

No other analytical exception is noted.

Inorganic Analyses

EPA Methods 7196A, 9045D, and Walkley-Black

Sample Preparation Information:

The water sample was prepared according to the EPA method 7196A. The soil samples were designated for incremental sampling; they were dried, sieved, and incrementally sampled according to EPA method 8330B, Appendix A, then digested according to EPA method 3060A.

Analysis Information:

Samples:

The samples were analyzed for hexavalent chromium according to EPA method 7196A using a Thermo Electron Genesys 10uv Spectrophotometer. The soil was also analyzed for total organic carbon by the Walkley-Black method and for pH by EPA method 9045D. The soil was received after the EPA recommended holding time for pH, and the water was received after the EPA recommended holding time for hexavalent chromium. All other holding times were met.

Calibrations:

Calibrations were performed according to the methods for the initial calibration and the initial calibration verification. The initial calibration verification is prepared from a second source standard.

Blanks:

No target compound was detected at or above one-half the LOQ in the method blanks.

Spikes:

Laboratory Control Spikes (LCS/LCSD) were used for quality assurance. All acceptance criteria were met.

Sample VE-UXO18-01SMI02-0613 was selected by the laboratory for MS/MSD analysis. Hexavalent chromium recovers below the 86% lower control limit at 85.5% in the MS. MSD recovery was acceptable.

Laboratory Duplicate and Triplicate:

Sample VE-UXO18-01SMI02-0613 was prepared and analyzed as laboratory duplicate/triplicate.

Summary:

No other analytical exception is noted. All data are acceptable.

Injection Log

Directory: H:\WALDORF\CHEM32\1\DATA\130702\130703

Line	Vial	FileName	Multiplier	SampleName	Misc Info	Injected
1	0	0703_0000022.D		8330_CCV 1.0 PPM 07/03/13		07/03/2013 20:34
2	0	0703_0000023.D	7.9602	130625ALCS-1 7.960 DF 06/25/13	Soil	07/03/2013 21:02
3	0	0703_0000025.D	7.9602	AY81994S01_MS-1 7.960 DF 06/25/13	Soil	07/03/2013 22:17
4	0	0703_0000026.D	7.92864	AY81994S01_MSD-1 7.929 DF 06/25/13	Soil	07/03/2013 22:54
5	0	0703_0000037.D	7.79727	130625ABLKS 7.797 DF 06/25/13	Soil	07/04/2013 05:47
6	0	0703_0000039.D	7.92079	130625A_PE-B 7.921 DF 06/25/13	Soil	07/04/2013 07:02
7	0	0703_0000040.D	7.9602	130625A_PE-C 7.960 DF 06/25/13	Soil	07/04/2013 07:39
8	0	0703_0000041.D	7.96813	AY81989S01 7.968 DF 06/25/13	Soil	07/04/2013 08:17
9	0	0703_0000042.D	7.82779	AY81990S01 7.828 DF 06/25/13	Soil	07/04/2013 08:54
10	0	0703_0000043.D	7.92079	AY81991S01 7.921 DF 06/25/13	Soil	07/04/2013 09:32
11	0	0703_0000044.D	7.94439	AY81992S01 7.944 DF 06/25/13	Soil	07/04/2013 10:09
12	0	0703_0000045.D	7.8125	AY81993S01 7.813 DF 06/25/13	Soil	07/04/2013 10:47
13	0	0703_0000046.D	7.99201	AY81994S01 7.992 DF 06/25/13	Soil	07/04/2013 11:24
14	0	0703_0000051.D		8330_CCV 1.0 PPM 07/03/13		07/04/2013 14:32

17 hours

58 min.

SPG 70988

8330 B Exp.

Laboratory Control Spike Recovery

EPA 8330B PE LCS

APPL ID: **130625S-81992 LCS - 179199**
Batch ID: #833PE-130625A

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Compound Name	Spike Level mg/kg	SPK Result mg/kg	SPK % Recovery	Recovery Limits
1,3,5-TRINITROBENZENE	0.600	0.503	83.8	69-111
1,3-DINITROBENZENE	0.596	0.585	98.2	68-107
2,4,6-TRINITROTOLUENE	0.600	0.528	88.0	71-114
2,4-DINITROTOLUENE	0.609	0.590	96.9	70-116
2,6-DINITROTOLUENE	0.605	0.622	103	65-117
2-AMINO-4,6-DINITROTOLUENE	0.600	0.538	89.7	59-111
2-NITROTOLUENE	0.599	0.697	116 #	46-103
3-NITROTOLUENE	0.597	0.587	98.3	48-102
4-AMINO-2,6-DINITROTOLUENE	0.600	0.548	91.3	51-111
4-NITROTOLUENE	0.597	0.567	95.0	53-102
HMX	0.600	0.589	98.2	66-114
NITROBENZENE	0.592	0.558	94.3 #	36-89
NITROGLYCERIN	0.600	0.591	98.5	68-108
PETN	0.600	0.549	91.5	56-121
RDX	0.600	0.434	72.3	52-113
TETRYL	1.0	0.205	20.5	10-150
SURROGATE: 1,2-DINITROBENZENE (S)	0.600	0.575	95.8	70-130

= Recovery is outside QC limits.

Comments:

Primary	SPK
Quant Method :	W130702.M
Extraction Date :	06/25/13
Analysis Date :	07/04/13
Instrument :	Waldorf
Run :	0703_000040
Initials :	PY

Printed: 07/10/13 2:10:18 PM
APPL Standard LCS

Laboratory Control Spike Recovery

PERCHLORATE EPA 6850 - PE

APPL ID: **130625S-81992 LCS - 179305**
Batch ID: #6850MISP-130625

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Compound Name	Spike Level ug/Kg	SPK Result ug/Kg	SPK % Recovery	Recovery Limits
PERCHLORATE	6.00	4.10	68.3 #	80-120

= Recovery is outside QC limits.

Comments:

Primary	SPK
Quant Method :	QTLMFL2
Extraction Date :	06/25/13
Analysis Date :	07/08/13
Instrument :	AGIL_6460
Run :	T707_090
Initials :	PY

Printed: 07/12/13 3:52:11 PM
APPL Standard LCS

Laboratory Control Spike Recovery

EPA 8321A PICRIC ACID-PE

APPL ID: **130625S-81992 LCS - 179282**
Batch ID: #PICSMIPE-130625

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Compound Name	Spike Level ug/kg	SPK Result ug/kg	SPK % Recovery	Recovery Limits
PICRIC ACID/AMMONIUM PICRATE	400	8.96	2.2 #	30-130
SURROGATE: 1,2-DINITROBENZENE (S)	591	572	96.8	50-150

= Recovery is outside QC limits.

Comments: _____

Primary	SPK
Quant Method :	83PIC709.M
Extraction Date :	06/25/13
Analysis Date :	07/10/13
Instrument :	AGIL_1100
Run :	L709_061.D
Initials :	PY

Printed: 07/12/13 12:30:22 PM
APPL Standard LCS

METALS BLANK

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Method	Analyte	Result	LOQ	LOD	DL	Units	Prep Date	Analysis Date	QC Group
6010C	ALUMINUM (AL)	4.00 U	10.0	4.00	1.98	mg/kg	07/03/13	07/08/13	#6010C-130703A-AY81994
6010C	BARIUM (BA)	0.400 U	0.50	0.400	0.075	mg/kg	07/03/13	07/08/13	#6010C-130703A-AY81994
6010C	BERYLLIUM (BE)	0.200 U	0.20	0.200	0.044	mg/kg	07/03/13	07/08/13	#6010C-130703A-AY81994
6010C	CALCIUM (CA)	8.00 U	10.0	8.00	5.00	mg/kg	07/03/13	07/08/13	#6010C-130703A-AY81994
6010C	COPPER (CU)	0.400 U	0.50	0.400	0.094	mg/kg	07/03/13	07/08/13	#6010C-130703A-AY81994
6010C	IRON (FE)	4.00 U	5.0	4.00	0.85	mg/kg	07/03/13	07/08/13	#6010C-130703A-AY81994
6010C	LEAD (PB)	0.400 U	0.50	0.400	0.160	mg/kg	07/03/13	07/08/13	#6010C-130703A-AY81994
6010C	MAGNESIUM (MG)	4.00 U	5.0	4.00	1.29	mg/kg	07/03/13	07/08/13	#6010C-130703A-AY81994
6010C	MANGANESE (MN)	0.400 U	0.50	0.400	0.130	mg/kg	07/03/13	07/08/13	#6010C-130703A-AY81994
6010C	NICKEL (NI)	0.400 U	0.50	0.400	0.068	mg/kg	07/03/13	07/08/13	#6010C-130703A-AY81994
6010C	POTASSIUM (K)	50.0 U	100	50.0	13.9	mg/kg	07/03/13	07/08/13	#6010C-130703A-AY81994
6010C	SODIUM (NA)	50.0 U	100	50.0	11.1	mg/kg	07/03/13	07/08/13	#6010C-130703A-AY81994
6010C	VANADIUM (V)	0.400 U	0.50	0.400	0.100	mg/kg	07/03/13	07/08/13	#6010C-130703A-AY81994
6010C	ZINC (ZN)	4.00 U	5.0	4.00	1.15	mg/kg	07/03/13	07/08/13	#6010C-130703A-AY81994
6020A	ANTIMONY (SB)	0.20 U	0.2	0.20	0.10	mg/Kg	07/03/13	07/09/13	#6020A-130703A-AY81994
6020A	ARSENIC (AS)	0.30 U	0.5	0.30	0.08	mg/Kg	07/03/13	07/09/13	#6020A-130703A-AY81994
6020A	CADMIUM (CD)	0.08 U	0.1	0.08	0.03	mg/Kg	07/03/13	07/09/13	#6020A-130703A-AY81994
6020A	CHROMIUM (CR)	0.20 U	0.5	0.20	0.04	mg/Kg	07/03/13	07/09/13	#6020A-130703A-AY81994
6020A	COBALT (CO)	0.08 U	0.1	0.08	0.02	mg/Kg	07/03/13	07/09/13	#6020A-130703A-AY81994
6020A	SELENIUM (SE)	0.10 U	0.2	0.10	0.04	mg/Kg	07/03/13	07/09/13	#6020A-130703A-AY81994
6020A	SILVER (AG)	0.05 U	0.1	0.05	0.02	mg/Kg	07/03/13	07/09/13	#6020A-130703A-AY81994
6020A	THALLIUM (TL)	0.05 U	0.1	0.05	0.02	mg/Kg	07/03/13	07/09/13	#6020A-130703A-AY81994
6010C	ALUMINUM (AL)	80.0 U	100	80.0	27.4	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	BARIUM (BA)	4.00 U	5.0	4.00	0.75	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	BERYLLIUM (BE)	1.00 U	2.0	1.00	0.24	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	CALCIUM (CA)	50.0 U	100	50.0	27.5	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	COPPER (CU)	4.00 U	5.0	4.00	1.71	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	IRON (FE)	25.0 U	50	25.0	9.0	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	LEAD (PB)	4.00 U	5.0	4.00	1.58	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	MAGNESIUM (MG)	30.0 U	50	30.0	12.9	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	MANGANESE (MN)	4.00 U	5.0	4.00	1.23	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238

J = Estimated value.

Metals SC-Blank-REG MDLs
Printed: 07/15/13 1:10:25 PM

METALS BLANK

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Method	Analyte	Result	LOQ	LOD	DL	Units	Prep Date	Analysis Date	QC Group
6010C	NICKEL (NI)	3.00 U	5.0	3.00	0.42	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	POTASSIUM (K)	500.0 U	1000	500.0	125.0	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	SODIUM (NA)	146 J	1000	500.0	111.1	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	VANADIUM (V)	4.00 U	5.0	4.00	0.97	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6010C	ZINC (ZN)	20.0 U	50	20.0	13.7	ug/L	06/25/13	06/28/13	#6010C-130625A2-AY82238
6020A	ANTIMONY (SB)	0.18 J	1.0	0.50	0.14	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238
6020A	ARSENIC (AS)	0.20 U	0.5	0.20	0.09	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238
6020A	CADMIUM (CD)	0.10 U	0.2	0.10	0.02	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238
6020A	CHROMIUM (CR)	0.24 J	0.5	0.20	0.07	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238
6020A	COBALT (CO)	0.40 U	1.0	0.40	0.13	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238
6020A	SELENIUM (SE)	0.37 J	1.0	0.40	0.10	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238
6020A	SILVER (AG)	0.10 U	0.2	0.10	0.03	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238
6020A	THALLIUM (TL)	0.20 U	0.2	0.20	0.10	ug/L	06/25/13	07/09/13	#6020A-130625A1-AY82238

J = Estimated value.

Metals SC-Blank-REG MDLs
Printed: 07/15/13 1:10:25 PM

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-EB01-061313

APPL ID: AY81995

Sample Collection Date: 06/13/13

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
6010C/3010A	ALUMINUM (AL)	80.0U	100	80.0	27.4	ug/L	1	06/25/13	06/28/13
6020A/3015^	ANTIMONY (SB)	0.18J	1.0	0.50	0.14	ug/L	1	06/25/13	07/09/13
6020A/3015^	ARSENIC (AS)	0.090J	0.5	0.20	0.09	ug/L	1	06/25/13	07/09/13
6010C/3010A	BARIUM (BA)	4.00U	5.0	4.00	0.75	ug/L	1	06/25/13	06/28/13
6010C/3010A	BERYLLIUM (BE)	1.00U	2.0	1.00	0.24	ug/L	1	06/25/13	06/28/13
6020A/3015^	CADMIUM (CD)	0.10U	0.2	0.10	0.02	ug/L	1	06/25/13	07/09/13
6010C/3010A	CALCIUM (CA)	50.0U	100	50.0	27.5	ug/L	1	06/25/13	06/28/13
6020A/3015^	CHROMIUM (CR)	0.37J	0.5	0.20	0.07	ug/L	1	06/25/13	07/09/13
6020A/3015^	COBALT (CO)	0.40U	1.0	0.40	0.13	ug/L	1	06/25/13	07/09/13
6010C/3010A	COPPER (CU)	4.00U	5.0	4.00	1.71	ug/L	1	06/25/13	06/28/13
6010C/3010A	IRON (FE)	25.0U	50	25.0	9.0	ug/L	1	06/25/13	06/28/13
6010C/3010A	LEAD (PB)	4.00U	5.0	4.00	1.58	ug/L	1	06/25/13	06/28/13
6010C/3010A	MAGNESIUM (MG)	30.0U	50	30.0	12.9	ug/L	1	06/25/13	06/28/13
6010C/3010A	MANGANESE (MN)	4.00U	5.0	4.00	1.23	ug/L	1	06/25/13	06/28/13
6010C/3010A	NICKEL (NI)	3.00U	5.0	3.00	0.42	ug/L	1	06/25/13	06/28/13
6010C/3010A	POTASSIUM (K)	500.0U	1000	500.0	125.0	ug/L	1	06/25/13	06/28/13
6020A/3015^	SELENIUM (SE)	0.54J	1.0	0.40	0.10	ug/L	1	06/25/13	07/09/13
6020A/3015^	SILVER (AG)	0.10U	0.2	0.10	0.03	ug/L	1	06/25/13	07/09/13
6010C/3010A	SODIUM (NA)	500.0U	1000	500.0	111.1	ug/L	1	06/25/13	06/28/13
6020A/3015^	THALLIUM (TL)	0.20U	0.2	0.20	0.10	ug/L	1	06/25/13	07/09/13
6010C/3010A	VANADIUM (V)	4.00U	5.0	4.00	0.97	ug/L	1	06/25/13	06/28/13
6010C/3010A	ZINC (ZN)	20.0U	50	20.0	13.7	ug/L	1	06/25/13	06/28/13

J = Estimated value.

Printed: 07/15/13 11:55:38 AM

APPL-F1-SC-NoMC-REG MDLs

Matrix Spike Recoveries

METALS

APPL ID: **130711S-81994 MS - 179211**

Sample ID: AY81994

Client ID: VE-UXO18-01SMI02-0613

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Method	Compound Name	Spike Lvl mg/kg	Matrix Res mg/kg	SPK Res mg/kg	DUP Res mg/kg	SPK % Recovery	DUP % Recovery	RPD	RPD Max	Recovery Limits	Extract Date-Spk	Analysis Date-Spk	Extract Date-Dup	Analysis Date-Dup	QC Group	QC Sample
EPA 6010C	ALUMINUM (AL)	80.02	598	1070	1360	590 #	952 #	23.9 #	20	80-120	07/11/13	07/12/13	07/11/13	07/12/13	179211	AY81994
EPA 6010C	BARIUM (BA)	10.0	4.5	14.2	14.7	97.0	102	3.5	20	80-120	07/11/13	07/12/13	07/11/13	07/12/13	179211	AY81994
EPA 6010C	BERYLLIUM (BE)	2.00	ND	1.3	1.3	65.0 #	65.0 #	0.0	20	80-120	07/11/13	07/12/13	07/11/13	07/12/13	179211	AY81994
EPA 6010C	CALCIUM (CA)	1000	27100	41300	40900	1420 #	1380 #	1.0	20	80-120	07/11/13	07/12/13	07/11/13	07/12/13	179211	AY81994
EPA 6010C	COPPER (CU)	10.0	0.68	8.1	9.4	74.2 #	87.2	14.9	20	80-120	07/11/13	07/12/13	07/11/13	07/12/13	179211	AY81994
EPA 6010C	IRON (FE)	40.01	316	410	766	235 #	1125 #	60.5 #	20	80-120	07/11/13	07/12/13	07/11/13	07/12/13	179211	AY81994
EPA 6010C	LEAD (PB)	10.0	ND	5.7	6.1	57.0 #	61.0 #	6.8	20	80-120	07/11/13	07/12/13	07/11/13	07/12/13	179211	AY81994
EPA 6010C	MAGNESIUM (MG)	1000	620	1740	1840	112	122 #	5.6	20	80-120	07/11/13	07/12/13	07/11/13	07/12/13	179211	AY81994
EPA 6010C	MANGANESE (MN)	10.0	54.6	90.0	92.5	354 #	379 #	2.7	20	80-120	07/11/13	07/12/13	07/11/13	07/12/13	179211	AY81994
EPA 6010C	NICKEL (NI)	10.0	0.36	6.5	6.9	61.4 #	65.4 #	6.0	20	80-120	07/11/13	07/12/13	07/11/13	07/12/13	179211	AY81994
EPA 6010C	POTASSIUM (K)	200.0	184	481	571	149 #	194 #	17.1	20	80-120	07/11/13	07/12/13	07/11/13	07/12/13	179211	AY81994
EPA 6010C	SODIUM (NA)	1000	61.7	891	921	82.9	85.9	3.3	20	80-120	07/11/13	07/12/13	07/11/13	07/12/13	179211	AY81994
EPA 6010C	VANADIUM (V)	10.0	0.54	6.6	8.0	60.6 #	74.6 #	19.2	20	80-120	07/11/13	07/12/13	07/11/13	07/12/13	179211	AY81994
EPA 6010C	ZINC (ZN)	20.00	2.9	15.1	16.5	61.0 #	68.0 #	8.9	20	80-120	07/11/13	07/12/13	07/11/13	07/12/13	179211	AY81994
EPA 6020A	ANTIMONY (SB)	10.02	ND	1.5	2.2	15.0 #	22.0 #	37.8 #	20	80-120	07/11/13	07/11/13	07/11/13	07/11/13	179268	AY81994
EPA 6020A	ARSENIC (AS)	10.02	0.15	8.2	9.3	80.3	91.3	12.6	20	80-120	07/11/13	07/11/13	07/11/13	07/11/13	179268	AY81994
EPA 6020A	CADMIUM (CD)	2.004	ND	1.7	1.9	84.8	94.8	11.1	20	80-120	07/11/13	07/11/13	07/11/13	07/11/13	179268	AY81994
EPA 6020A	CHROMIUM (CR)	10.02	0.85	10.1	11.4	92.3	105	12.1	20	80-120	07/11/13	07/11/13	07/11/13	07/11/13	179268	AY81994

= Recovery is outside QC limits.

Comments:

Printed: 07/15/13 11:55:36 AM
APPL MSD SCII

Matrix Spike Recoveries

METALS

APPL ID: **130711S-81994 MS - 179268**

Sample ID: AY81994

Client ID: VE-UXO18-01SMI02-0613

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Method	Compound Name	Spike Lvl mg/Kg	Matrix Res mg/Kg	SPK Res mg/Kg	DUP Res mg/Kg	SPK % Recovery	DUP % Recovery	RPD	RPD Max	Recovery Limits	Extract Date-Spk	Analysis Date-Spk	Extract Date-Dup	Analysis Date-Dup	QC Group	QC Sample
EPA 6020A	COBALT (CO)	10.02	0.24	8.4	9.1	81.4	88.4	8.0	20	80-120	07/11/13	07/11/13	07/11/13	07/11/13	179268	AY81994
EPA 6020A	SELENIUM (SE)	10.02	0.12	7.0	8.2	68.7 #	80.6	15.8	20	80-120	07/11/13	07/11/13	07/11/13	07/11/13	179268	AY81994
EPA 6020A	SILVER (AG)	4.008	ND	3.4	3.7	84.8	92.3	8.5	20	80-120	07/11/13	07/11/13	07/11/13	07/11/13	179268	AY81994
EPA 6020A	THALLIUM (TL)	10.02	ND	7.9	8.5	78.8 #	84.8	7.3	20	80-120	07/11/13	07/11/13	07/11/13	07/11/13	179268	AY81994

= Recovery is outside QC limits.

Comments:

Parent for Field Dup and Lab Dup

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni
Project: 424191.FI.FK.04 Vieques CTO 005
Sample ID: VE-UXO18-01SMI01-0613
Sample Collection Date: 06/12/13

ARF: 70988
APPL ID: AY81989

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
6010C/3050B	ALUMINUM (AL)	18.4	10.0	4.00	1.98	mg/kg	1	07/03/13	07/09/13
6020A/3050B	ANTIMONY (SB)	0.20U	0.2	0.20	0.10	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	ARSENIC (AS)	0.095J	0.5	0.30	0.08	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	BARIUM (BA)	2.4	0.50	0.400	0.075	mg/kg	1	07/03/13	07/09/13
6010C/3050B	BERYLLIUM (BE)	0.200U	0.20	0.200	0.044	mg/kg	1	07/03/13	07/09/13
6020A/3050B	CADMIUM (CD)	0.08U	0.1	0.08	0.03	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	CALCIUM (CA)	38300	1000.0	800.00	500.00	mg/kg	100	07/03/13	07/08/13
6020A/3050B	CHROMIUM (CR)	0.13J	0.5	0.20	0.04	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	COBALT (CO)	0.057J	0.1	0.08	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	COPPER (CU)	0.400U	0.50	0.400	0.094	mg/kg	1	07/03/13	07/09/13
6010C/3050B	IRON (FE)	4.0J	5.0	4.00	0.85	mg/kg	1	07/03/13	07/09/13
6010C/3050B	LEAD (PB)	0.400U	0.50	0.400	0.160	mg/kg	1	07/03/13	07/09/13
6010C/3050B	MAGNESIUM (MG)	1240	5.0	4.00	1.29	mg/kg	1	07/03/13	07/09/13
6010C/3050B	MANGANESE (MN)	19.3	0.50	0.400	0.130	mg/kg	1	07/03/13	07/09/13
6010C/3050B	NICKEL (NI)	0.400U	0.50	0.400	0.068	mg/kg	1	07/03/13	07/09/13
6010C/3050B	POTASSIUM (K)	62.0J	100	50.0	13.9	mg/kg	1	07/03/13	07/09/13
6020A/3050B	SELENIUM (SE)	0.055J	0.2	0.10	0.04	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	SILVER (AG)	0.05U	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	SODIUM (NA)	294	100	50.0	11.1	mg/kg	1	07/03/13	07/09/13
6020A/3050B	THALLIUM (TL)	0.05U	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	VANADIUM (V)	0.400U	0.50	0.400	0.100	mg/kg	1	07/03/13	07/09/13
6010C/3050B	ZINC (ZN)	2.4J	5.0	4.00	1.15	mg/kg	1	07/03/13	07/09/13

J = Estimated value.

Printed: 07/15/13 11:55:53 AM
APPL-F1-SC-NoMC-REG MDLs

Lab Dup 1

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI01B-0613

APPL ID: AY81990

Sample Collection Date: 06/12/13

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
6010C/3050B	ALUMINUM (AL)	44.8	10.0	4.00	1.98	mg/kg	1	07/03/13	07/09/13
6020A/3050B	ANTIMONY (SB)	0.20U	0.2	0.20	0.10	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	ARSENIC (AS)	0.088J	0.5	0.30	0.08	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	BARIUM (BA)	1.7	0.50	0.400	0.075	mg/kg	1	07/03/13	07/09/13
6010C/3050B	BERYLLIUM (BE)	0.200U	0.20	0.200	0.044	mg/kg	1	07/03/13	07/09/13
6020A/3050B	CADMIUM (CD)	0.08U	0.1	0.08	0.03	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	CALCIUM (CA)	33400	1000.0	800.00	500.00	mg/kg	100	07/03/13	07/08/13
6020A/3050B	CHROMIUM (CR)	0.17J	0.5	0.20	0.04	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	COBALT (CO)	0.060J	0.1	0.08	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	COPPER (CU)	0.400U	0.50	0.400	0.094	mg/kg	1	07/03/13	07/09/13
6010C/3050B	IRON (FE)	20.2	5.0	4.00	0.85	mg/kg	1	07/03/13	07/09/13
6010C/3050B	LEAD (PB)	0.400U	0.50	0.400	0.160	mg/kg	1	07/03/13	07/09/13
6010C/3050B	MAGNESIUM (MG)	1280	5.0	4.00	1.29	mg/kg	1	07/03/13	07/09/13
6010C/3050B	MANGANESE (MN)	15.3	0.50	0.400	0.130	mg/kg	1	07/03/13	07/09/13
6010C/3050B	NICKEL (NI)	0.073J	0.50	0.400	0.068	mg/kg	1	07/03/13	07/09/13
6010C/3050B	POTASSIUM (K)	39.6J	100	50.0	13.9	mg/kg	1	07/03/13	07/09/13
6020A/3050B	SELENIUM (SE)	0.049J	0.2	0.10	0.04	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	SILVER (AG)	0.05U	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	SODIUM (NA)	236	100	50.0	11.1	mg/kg	1	07/03/13	07/09/13
6020A/3050B	THALLIUM (TL)	0.05U	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	VANADIUM (V)	0.400U	0.50	0.400	0.100	mg/kg	1	07/03/13	07/09/13
6010C/3050B	ZINC (ZN)	3.0J	5.0	4.00	1.15	mg/kg	1	07/03/13	07/09/13

J = Estimated value.

Printed: 07/15/13 11:55:54 AM

APPL-F1-SC-NoMC-REG MDLs

Lab Dup 2

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni
Project: 424191.FI.FK.04 Vieques CTO 005
Sample ID: VE-UXO18-01SMI01C-0613
Sample Collection Date: 06/12/13

ARF: 70988
APPL ID: AY81991

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
6010C/3050B	ALUMINUM (AL)	288	10.0	4.00	1.98	mg/kg	1	07/03/13	07/09/13
6020A/3050B	ANTIMONY (SB)	0.20U	0.2	0.20	0.10	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	ARSENIC (AS)	0.19J	0.5	0.30	0.08	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	BARIUM (BA)	1.6	0.50	0.400	0.075	mg/kg	1	07/03/13	07/09/13
6010C/3050B	BERYLLIUM (BE)	0.200U	0.20	0.200	0.044	mg/kg	1	07/03/13	07/09/13
6020A/3050B	CADMIUM (CD)	0.08U	0.1	0.08	0.03	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	CALCIUM (CA)	28000	1000.0	800.00	500.00	mg/kg	100	07/03/13	07/08/13
6020A/3050B	CHROMIUM (CR)	0.69	0.5	0.20	0.04	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	COBALT (CO)	0.099J	0.1	0.08	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	COPPER (CU)	0.40J	0.50	0.400	0.094	mg/kg	1	07/03/13	07/09/13
6010C/3050B	IRON (FE)	214	5.0	4.00	0.85	mg/kg	1	07/03/13	07/09/13
6010C/3050B	LEAD (PB)	0.400U	0.50	0.400	0.160	mg/kg	1	07/03/13	07/09/13
6010C/3050B	MAGNESIUM (MG)	1200	5.0	4.00	1.29	mg/kg	1	07/03/13	07/09/13
6010C/3050B	MANGANESE (MN)	14.2	0.50	0.400	0.130	mg/kg	1	07/03/13	07/09/13
6010C/3050B	NICKEL (NI)	0.18J	0.50	0.400	0.068	mg/kg	1	07/03/13	07/09/13
6010C/3050B	POTASSIUM (K)	79.3J	100	50.0	13.9	mg/kg	1	07/03/13	07/09/13
6020A/3050B	SELENIUM (SE)	0.079J	0.2	0.10	0.04	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	SILVER (AG)	0.05U	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	SODIUM (NA)	199	100	50.0	11.1	mg/kg	1	07/03/13	07/09/13
6020A/3050B	THALLIUM (TL)	0.05U	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	VANADIUM (V)	0.55	0.50	0.400	0.100	mg/kg	1	07/03/13	07/09/13
6010C/3050B	ZINC (ZN)	2.8J	5.0	4.00	1.15	mg/kg	1	07/03/13	07/09/13

J = Estimated value.

Printed: 07/15/13 11:55:54 AM

APPL-F1-SC-NoMC-REG MDLs

FD 1

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 70988

Sample ID: VE-UXO18-01SMI01T-0613

APPL ID: AY81992

Sample Collection Date: 06/12/13

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
6010C/3050B	ALUMINUM (AL)	42.5	10.0	4.00	1.98	mg/kg	1	07/03/13	07/09/13
6020A/3050B	ANTIMONY (SB)	0.20U	0.2	0.20	0.10	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	ARSENIC (AS)	0.096J	0.5	0.30	0.08	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	BARIUM (BA)	2.1	0.50	0.400	0.075	mg/kg	1	07/03/13	07/09/13
6010C/3050B	BERYLLIUM (BE)	0.200U	0.20	0.200	0.044	mg/kg	1	07/03/13	07/09/13
6020A/3050B	CADMIUM (CD)	0.08U	0.1	0.08	0.03	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	CALCIUM (CA)	41300	1000.0	800.00	500.00	mg/kg	100	07/03/13	07/08/13
6020A/3050B	CHROMIUM (CR)	0.21J	0.5	0.20	0.04	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	COBALT (CO)	0.061J	0.1	0.08	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	COPPER (CU)	0.400U	0.50	0.400	0.094	mg/kg	1	07/03/13	07/09/13
6010C/3050B	IRON (FE)	13.0	5.0	4.00	0.85	mg/kg	1	07/03/13	07/09/13
6010C/3050B	LEAD (PB)	0.400U	0.50	0.400	0.160	mg/kg	1	07/03/13	07/09/13
6010C/3050B	MAGNESIUM (MG)	1430	5.0	4.00	1.29	mg/kg	1	07/03/13	07/09/13
6010C/3050B	MANGANESE (MN)	17.1	0.50	0.400	0.130	mg/kg	1	07/03/13	07/09/13
6010C/3050B	NICKEL (NI)	0.400U	0.50	0.400	0.068	mg/kg	1	07/03/13	07/09/13
6010C/3050B	POTASSIUM (K)	42.8J	100	50.0	13.9	mg/kg	1	07/03/13	07/09/13
6020A/3050B	SELENIUM (SE)	0.053J	0.2	0.10	0.04	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	SILVER (AG)	0.05U	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	SODIUM (NA)	271	100	50.0	11.1	mg/kg	1	07/03/13	07/09/13
6020A/3050B	THALLIUM (TL)	0.05U	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	VANADIUM (V)	0.400U	0.50	0.400	0.100	mg/kg	1	07/03/13	07/09/13
6010C/3050B	ZINC (ZN)	2.7J	5.0	4.00	1.15	mg/kg	1	07/03/13	07/09/13

J = Estimated value.

Printed: 07/15/13 11:55:54 AM

APPL-F1-SC-NoMC-REG MDLs

FD2

Metals Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni
Project: 424191.FI.FK.04 Vieques CTO 005
Sample ID: VE-UXO18-01SMI01TT-0613
Sample Collection Date: 06/12/13

ARF: 70988
APPL ID: AY81993

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
6010C/3050B	ALUMINUM (AL)	262	10.0	4.00	1.98	mg/kg	1	07/03/13	07/09/13
6020A/3050B	ANTIMONY (SB)	0.20U	0.2	0.20	0.10	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	ARSENIC (AS)	0.17J	0.5	0.30	0.08	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	BARIUM (BA)	1.8	0.50	0.400	0.075	mg/kg	1	07/03/13	07/09/13
6010C/3050B	BERYLLIUM (BE)	0.200U	0.20	0.200	0.044	mg/kg	1	07/03/13	07/09/13
6020A/3050B	CADMIUM (CD)	0.08U	0.1	0.08	0.03	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	CALCIUM (CA)	31500	1000.0	800.00	500.00	mg/kg	100	07/03/13	07/08/13
6020A/3050B	CHROMIUM (CR)	0.69	0.5	0.20	0.04	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	COBALT (CO)	0.098J	0.1	0.08	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	COPPER (CU)	0.46J	0.50	0.400	0.094	mg/kg	1	07/03/13	07/09/13
6010C/3050B	IRON (FE)	185	5.0	4.00	0.85	mg/kg	1	07/03/13	07/09/13
6010C/3050B	LEAD (PB)	0.20J	0.50	0.400	0.160	mg/kg	1	07/03/13	07/09/13
6010C/3050B	MAGNESIUM (MG)	1300	5.0	4.00	1.29	mg/kg	1	07/03/13	07/09/13
6010C/3050B	MANGANESE (MN)	14.9	0.50	0.400	0.130	mg/kg	1	07/03/13	07/09/13
6010C/3050B	NICKEL (NI)	0.17J	0.50	0.400	0.068	mg/kg	1	07/03/13	07/09/13
6010C/3050B	POTASSIUM (K)	70.9J	100	50.0	13.9	mg/kg	1	07/03/13	07/09/13
6020A/3050B	SELENIUM (SE)	0.079J	0.2	0.10	0.04	mg/Kg	1	07/03/13	07/09/13
6020A/3050B	SILVER (AG)	0.05U	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	SODIUM (NA)	202	100	50.0	11.1	mg/kg	1	07/03/13	07/09/13
6020A/3050B	THALLIUM (TL)	0.05U	0.1	0.05	0.02	mg/Kg	1	07/03/13	07/09/13
6010C/3050B	VANADIUM (V)	0.50	0.50	0.400	0.100	mg/kg	1	07/03/13	07/09/13
6010C/3050B	ZINC (ZN)	3.6J	5.0	4.00	1.15	mg/kg	1	07/03/13	07/09/13

J = Estimated value.

Printed: 07/15/13 11:55:54 AM
APPL-F1-SC-NoMC-REG MDLs

Wet Lab Analysis

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

Sample ID: VE-UXO18-EB01-061313

Sample Collection Date: 06/13/13 1200

APPL ID: AY81995

ARF: 70988

Method	Analyte	Result	LOQ	LOD	DL	Units	DF	Prep Date	Analysis Date
SW846 7196A	HEXAVALENT CHROMIUM	0.010 U	0.02	0.010	0.006	mg/L	1	06/14/13	06/14/13 1707

Printed: 07/11/13 11:42:14 AM

APPL-F1-SC-NoMC-REG MDLs

Appendix C

Data Validation Checklists

YES NO N/A

PACKAGE COMPLETENESS AND DELIVERABLES

CASE NUMBER:_____ SDG# 70988

LAB: APPL, Inc. SITE: E.Vieques UXO Sites

METHODS VALIDATED: SW-846 8330B, 6850, 8321A

1.0 Introduction

1.1 The attached Standard Operating Procedure (SOP) is applicable to nitro substituted aromatic and nitro substituted amines by High Performance Liquid Chromatography (HPLC)data. Its scope is not only to facilitate the data validation process of the data reported by the contracting laboratory, but also to ensure the data is being reviewed in a uniform manner.

1.2 This SOP is based upon the quality control assurance requirements specified in analytical SW 846 Method 8330A Revision 1, January 1998, and the National Function Guidlines, January 2005.

2.0 Responsibilities

2.1 The reviewer must be knowledgeable of the analytical method and its criteria.

2.2 The reviewer must complete and/or file the following:

Data Assessment Checklist - The data reviewer evaluates Each criterion carefully and checks if data is in compliance, non-compliace or not applicable.

Data Assessment Narrative - The data reviewer must present professional judgement, address areas of concern and comment on the validity of the overall data package. The reviewer must explain the reasons for rejecting and or qualifying the data.

Telephone Record Log - All phone conservations must be transcribed by the reviewer. Upon completion of the data review, the original telephone log is attached to the data assessment narrative.

YES NO N/A

3.0 Data Completeness and Deliverables

3.1 Has all the data been submitted in CLP deliverable format? [✓] ___ ___

3.2 Have any missing deliverables been received and added to the data package? [ ] ___ ✓

ACTION: Call lab for explanation/resubmittal of any missing deliverables. If lab cannot provide them, note the effect on review of the data in the reviewer narrative.

4.0 Cover Letter, SDG Narrative

4.1 Is a laboratory narrative or cover letter present? [✓] ___ ___

4.2 Are the case number and/or SDG number contained in the narrative or cover letter? [✓] ___ ___

5.0 Data Validation Checklist

5.1 Does this data package contain:

Water data? [✓] ___ ___

Waste data? [ ] ___ ✓

Soil/solid data? [✓] ___ ___

6.0 Traffic Reports and Laboratory Narrative

6.1 Are traffic report and chain-of-custody forms present for all samples? [✓] ___ ___

ACTION: If no, contact lab for replacement of missing or illegible copies.

6.2 Do the traffic reports, chain-of-custody forms or SDG narrative indicate any problems with sample receipt, condition of the samples, analytical problems or

YES NO N/A

special circumstances affecting the quality of the data? ___ [✓] ___

ACTION: If any sample analyzed as a soil, contains 50%-90% water, all data should be qualified as estimated, "J." If a soil sample contains more than 90% water, non detects shall be qualified as unusable, "R."

ACTION: If samples were not iced or if the ice was melted upon arrival at the laboratory and the temperature of the cooler was elevated (> 10° C), flag all positive results "J" and all non-detects "UJ".

7.0 Special QC *-VCS1

7.1 Prior to preparation of stock solutions; acetonitrile, methanol, and water should be analyzed to determine possible interferences with analyte peaks. A different batch of solvent should be used if contamination is present.

7.2 Chromatograms are to be submitted showing that there are no interferences with analyte peaks.

Are these chromatograms present in package? [ ] ___ [✓]

Are the chromatograms free of interferences? [ ] ___ ___

Action: Ask lab for resubmittals. If deliverables are unavailable, judge the effect of the validity of the data. If questionable, contact SMO and note in data assessment.

8.0 Holding Times

8.1 Have any nitroaromatics and nitroamines technical holding times, determined from date of collection to date of extraction, been exceeded? ___ [✓] ___

Water and waste samples must be properly perseved (cooled to 4° +/- 2°), and nitro substituted aromatics and amines analysis must be extracted within 7 days of the date of collection. Extracts must be analyzed within 40 days of

YES NO N/A

the date of extraction. Soils and solid samples must be extracted within 14 days of collection and analyzed within 40 days of extraction.

ACTION: If technical holding times are exceeded, flag all positive results as estimated, "J," and sample quantitation limits "UJ" and document in the narrative that holding times were exceeded. If analyses were done more than 14 days beyond holding time, either on the first analysis or upon re-analysis, the reviewer must use professional judgement to determine the reliability of the data and the effects of additional storage on the sample results. At a minimum, all the data should at least be qualified "J", but the reviewer may determine that non-detects are unusable,"R." (Table 1)

Table 1. Holding Time Criteria

Matrix	Preserved	Criteria	Action	
			Detected compounds	Non-detected compounds
Aqueous	No	≤ 7 days(extraction) ≤ 40 days(analysis)	Use professional judgement	
	No	> 7 days(extraction) > 14 days(analysis)	Use professional judgement	
	Yes	≤ 7 days(extraction) ≤ 40 days(analysis)	No qualification	
	Yes	> 7 days(extraction) > 40 days(analysis)	J	UJ
	Yes/No	Grossly exceeded	J	UJ or R
Non-aqueous	No	≤ 14days(extraction) ≤ 40 days (analysis)	Use professional judgement	
	No	> 14days(extraction) >40 days(analysis)	Use professional judgement	
	Yes	≤ 14days(extraction) ≤ 40 days(analysis)	No qualification	
	Yes	> 14days(extraction) > 40 days(analysis)	J	UJ
	Yes/No	Grossly Exceeded	J	UJ or R

YES NO N/A

9.0 Surrogate Recovery (Form II)

9.1 The analyst most monitor the performance of the extraction and analytical system as well as the effectiveness of the method in dealing with each sample matrix by spiking each sample, standard and reagent water blank with one or two surrogates (e.g., analytes not expected to be present in the sample).

9.2 Were the recoveries of the surrogate spikes presented on CLP Surrogate Recovery Summary forms (Form II), or equivalent, for each of the following matrices?

		YES	NO	N/A
a.	Water/Waste	[✓]	___	___
b.	Soil/Solid	[✓]	___	___

ACTION: Call lab for explanation/resubmittals. If missing deliverables or information are unavailable, document the effect in the data assessment.

9.3 Are all the pesticide samples listed on the appropriate surrogate recovery form for each of the following matrices?

		YES	NO	N/A
a.	Water	[✓]	___	___
b.	Waste	[ ]	___	✓
c.	Soil/Solid	[✓]	___	___

9.4 The laboratory must evaluate the surrogate data from individual samples versus the surrogate control limits developed by the laboratory. Method 8000C, Sec 9.0 details evaluating surrogate data and updating surrogate limits. If laboratory established recovery limits are not established, use surrogate recovery between 70 - 130% for all samples, including MS, MSDs, LCSs, and all blanks. Are surrogate recovery limits met? [✓] ___ ___

ACTION: Circle all outliers in red. Follow surrogate action Table 2.

YES NO N/A

9.5 Were surrogate retention times (RT) within the windows established during the initial 5-point analysis? [✓] ___ ___

ACTION: Follow surrogate action, Table 2 below.

Table 2. Surrogate Recovery Criteria

Criteria	Action	
	Detected Target Compounds	**Non-detected Target Compounds**
%R > 200%	J	Use professional judgement
130% < %R ≤ 200%	J	No qualification
70% ≤ %R ≤ 130%	No qualification	
10% ≤ %R < 70%	J	UJ
%R < 10% (sample dilution not a factor)	J	R
%R < 10% (sample dilution is a factor)	Use professional judgement	
RT out of RT window	Use professional judgement	
RT within RT window	No qualification	

9.6 Are there any transcription/calculation errors between raw data and Form II? [ ] [✓] ___

ACTION: If large errors exist, call lab for explanation/resubmittal. Make any necessary corrections and document the effect in data assessments.

10.0 Laboratory Control Sample

10.1 Is the LCS prepared, extracted, analyzed, and reported once for every 20 field samples of a similar matrix, per SDG. [✓] ___ ___

YES NO N/A

ACTION: If any Laboratory Control Sample data are missing, call the lab for explanation/ resubmittals. Make note in the data assessment.

10.2 Are raw data and percent recoveries present for all Laboratory Control samples as required by Method 8000C (section 9.5). [✓] ___ ___

Verify that QC check samples were extracted and analyzed by the same procedures used for the actual samples.

ACTION: If any Laboratory Control Sample data are missing, call the lab for explanation/ resubmittals. Make note in the data assessment.

Note: When the results for matrix spike analysis indicates a problem due to sample matrix effects, the LCS results are used to verify the laboratory can perform the analysis in a clean sample.

10.3 Were the Laboratory Control Samples analyzed for all the nitroaromatics and nitroamines analytes that the samples are analyzed for.
[✓] ___ ___

10.4 Were Laboratory Control Samples analyzed at the required concentration as specified in Method 8000C(sec 9.5)(near the middle of the calibration range) for all target analytes.
[ ] ___ ___

ACTION: If Laboratory Control Samples were not analyzed at the required concentration or the required frequency, make note in the data assessment and use professional judgement to determined the affect on the data.

10.5 Did laboratory calculate in-house performance criteria for LCS recoveries according to Method 8000C section 9.7, and were recoveries met?
2 analytes for explosives were outside the QC limits
[ ] [✓] ___

10.6 If in house LCS recoveries performance criteria were not generated, the laboratory should use 70 - 130% criteria, and was this criteria met? [ ] [✓] ___
80-120% was used for Perchlorate and Picric Acid Ground LCS

10.7 If LCS recovery criteria were not met, were Laboratory Control Samples re-analyzed?
[ ] [✓] ___

YES NO N/A

ACTION: If QC check samples were not re-analyzed, or a general system problem is indicated by repeated failure to meet the QC acceptance criteria specified in the method, make note in the data assessment and use Table 3 recovery actions criteria.

Table 3. LCS Recovery Actions

Criteria	Action	
	Detected Associated Compounds	Non-Detected Compounds
%R > Upper Acceptance Limit	J	No qualification
%R < Lower Acceptance Limit	J	R
Lower Acceptance Limit ≤ %R ≤ Upper Acceptance Limit	No qualifications	

11.0 Matrix Spikes (Form III)

11.1 Are all data for one matrix spike and matrix duplicate (unspiked) pair (MS/Dup) or matrix spike/matric spike duplicate (MS/MSD)present and complete for each matrix. [ ] ✓ ___

NOTE: For soil and waste samples showing detectable amounts of organics, the lab may substitute replicate samples in place of the matrix spike spike.

11.2 Have MS/Dup or MS/MSD results been summarized on modified CLP Form III? [✓] ___ ___

ACTION: If any data are missing take action as specified in section 3.2 above.

11.3 Were matrix spikes analyzed at the required frequency for each of the following matrices? (One MS/Dup, MS/MSD must be performed for every 20 samples of similar matrix or concentration level.

a. Water [ ] ✓ ___
b. Waste [ ] ___ ✓
c. Soil/Solid [✓] ___ ___

ACTION: If any MS/Dup or MS/MSD data are missing,take the action specified in 3.2 above.

11.4 Were the Matrix Spike Samples spiked and analyzed for all the nitroaromatics and nitroamines analytes that the samples are analyzed for (Same analytes as LCS). [✓] ___ ___

YES NO N/A

ACTION: If no, did the lab use the optional QC acceptance criteria discussed in Method 8000C(section 9.7)?

List the criteria used and make note in data assessment.

Criteria used SAP Limits

11.5 Were Laboratory Control Samples analyzed at the required concentration as specified in Method 8000C(sec (9.5)(Same concentration as LCS) for all target analytes. [✓] ___ ___

11.6 Did laboratory calculate in-house performance criteria for matrix spike recoveries according to Method 8000C section 9.7, and were recoveries met? [ ] ___ ✓

11.7 If in house LCS recoveries performance criteria were not generated, the laboratory should use 70 - 130% criteria, and was this criteria met? [ ] ___ ✓

11.8 How many matrix spike recoveries are outside the in-house performance criteria or QC limits of 70 - 130%?

Water	Soil
0 out of 2	0 out of 36

11.9 How many RPDs for the Matrix Spike and Matrix Spike Duplicate (if applicable)recoveries are greater than the QC limit of 20%?

Water	Soil
0 out of 1	0 out of 18

11.8 Were the matrix spike and matrix spike duplicate recovery and RPD limits met as specified in Table 4. Note: No qualification of the data is necessary on MS and MSD data alone. Use professional judgement to use the MS and MSD results in conjunction with other QC criteria to determine the need for some qualification of the data. If any MS and MSD, percent recovery, or RPD results in the nitroaromatics and nitroamines fraction is out of specification (Table 4), use professional judgement to qualify data to include the consideration of the existence interference in the raw data. In some instances it may be determined that only the replicate or spiked samples are affected. Alternatively, the data may suggest that the laboratory is having a systematic problem with one or more analytes, thereby affecting all associated samples. Use professional judgement to determine the need for qualification of detects of non-spiked compounds.

YES NO N/A

Table 4. MS/MSD Actions for Analysis

Criteria	Action	
	Detected Associated Compounds	Non-Detected Compounds
%R or RPD > Upper Acceptance Limit	J	No qualification
20% ≤ %R < Lower Acceptance Limit	J	UJ
%R < 20%	J	Use professional judgement
Lower Acceptance Limit ≤ %R ≤ Upper Acceptance Limit	No qualifications	

12.0 Blanks (Form IV) *-VCS2

12.1 Was reagent blank data reported on CLP equivalent Method Blank Summary form(s) (Form IV)? [✓] ___ ___

12.2 Frequency of Analysis: Has a reagent blank been analyzed for every 20 (or less) samples of similar matrix or concentration or each extraction batch? [✓] ___ ___

ACTION: If any blank data are missing, take action as specified above (section 3.2). If blank data is not available, reject (R) all associated positive data. However, using professional judgement, the data reviewer may substitute field blank data for missing method blank data.

12.3 Chromatography: review the blank raw data - chromatograms, quant reports or data system printouts.

Is the chromatographic performance (baseline stability) for each instrument acceptable for nitroaromatics and nitramines? [✓] ___ ___

13.0 Contamination

YES NO N/A

NOTE: "Water blanks", "distilled water blanks" and "drilling water blanks" are validated like any other sample and are not used to qualify the data. Do not confuse them with the other QC blanks discussed below.

13.1 Do any method/instrument/reagent/cleanup blanks have positive results for nitroaromatics or nitramines?When applied as described below, the contaminant concentration in these blanks are multiplied by the sample Dilution Factor and corrected for % moisture when necessary.

___ [✓] ___

13.2Do any field/rinse blanks have positive nitroaromatics or nitramines results?

___ [✓] ___

ACTION: Prepare a list of the samples associated with each of the contaminated blanks. (Attach a separate sheet.)

NOTE: All field blank results associated to a particular group of samples (may exceed one per case or one per day) may be used to qualify data. Blanks may not be qualified because of contamination in another blank. Field blanks must be qualified for surrogate, or calibration QC problems.

ACTION: Follow the directions in Table 5 below to qualify sample results due to contamination. Use the largest value from all the associated blanks.

Table 5. Blank Contamination Criteria

YES NO N/A

Blank Type	Blank Result	Sample Result	Action for Samples
Method, Clean up, Instrument, Field	Detects	Not detected	No qualification
	< CRQL	< CRQL	Report CRQL value with a U
		≥ CRQL	Use professional judgement
	> CRQL	< CRQL	Report CRQL value with a U
		≥ CRQL and < blank contamination	Report the concentration for the sample with a U, or quanity the data as unusable R
		≥ CRQL and ≥ blank contamination	Use professional judgement
	= CRQL	< CRQL	Report CRQL value with a U
		≥ CRQL	Use professional judgement
	Gross contamination	Detects	Qualify results as unusable R

NOTE: If gross blank contamination exists(e.g., saturated peaks, "hump-o-grams," "junk" peaks), all affected positive compounds in the associated samples should be qualified as unusable "R", due to interference. Non-detected pesticide target compounds do not require qualification unless the contamination is so high that it interferes with the analyses of non-detected compounds.

13.3Are there field/rinse/equipment blanks associated with every sample? [✓] ___ ___

ACTION: For low level samples, note in data assessment that there is no associated field/rinse/ equipment blank. Exception: samples taken from a drinking water tap do not have associated field blanks.

14.0 HPLC Apparatus and Materials

YES NO N/A

14 .1 Was the proper HPLC chromatographic column used for the analysis of nitroaromatics or nitramines?

Action: Check raw data, instrument logs, or contact the lab to determine what type of columns were used. (Method 8330A, section 4.1) [✓] ___ ___

14.2 Indicate the specific type of HPLC column.

column 1: Agilent Zorbax

column 2: Acclaim

ACTION: Note any changes to the suggested materials in section 14.1 above in the data assessment. Also note the impact (positive or negative) such changes have on the analytical results.

15.0 Calibration and HPLC Performance *-VCS-3,4,5

15.1 Are the following liquid chromatograms and data systems printouts for both columns present for all samples, blanks, MS, replicates?

a. Samples [✓] ___ ___
b. All blanks [✓] ___ ___

c. Matrix spike samples [✓] ___ ___
d. 5 pt. initial calibration standards [✓] ___ ___

e. Calibration verification standards [✓] ___ ___

f. Laboratory Control samples (LCS) [✓] ___ ___

ACTION: If no, take action specified in 3.2 above.

15.2 Are data summary forms (containing calibration factors or response factors) for the initial 5 pt. calibration and daily calibration verification standards present and complete for each column and each analytical sequence? [✓] ___ ___

NOTE: External standard calibration procedures are used (Method 8000C (section 11.4.2), therefore calibration factors must be used.

ACTION: If any data are missing or it cannot be determined how the laboratory calculated calibration factors, contact the lab for explanation/resubmittals. Make necessary corrections and note any problems in the data assessment.

YES NO N/A

15.3 Are there any transcription/calculation errors between raw data and data summary forms?

___ [✓] ___

ACTION: If large errors exist, call lab for explanation/resubmittal, make necessary corrections and document the effect in data assessments.

15.4 Are standard retention time (RT) windows for each nitroaromatics and nitramines peak of interest presented on modified CLP summary forms? [✓] ___ ___

ACTION: If any data are missing, or it cannot be determined how RT windows were calculated, call the lab for explanation/resubmittals. Note any problems in the data assessment.

NOTE: Retention time windows for all nitroaromatics and nitramines are established using retention times from three calibration standards analyzed during the entire analytical sequence (Method 8000C section 11.6).

Best results are obtained using retention times which span the entire sequence; i.e., using the calibration verification/continuing calibration standards analyzed every 12 hours.

15.5 Were RT windows on the confirmation column established using three standards as described above? [✓] ___ ___

NOTE: RT windows for the confirmation column should be established using a 3 pt. calibration, preferably spanning the entire analytical sequence as described in 15.4 above. If RT windows on one column are tighter than the other, this may result in false negatives when attempting to identify compounds in the samples.

ACTION: Note potential problems, if any, in the data assessment.

15.6 Do all standard retention times in each level of the initial 5 pt. calibrations for nitroaromatics and nitramines fall within the windows established during the initial calibration sequence? [✓] ___ ___

ACTION i: If no, all samples in the entire analytical sequence are potentially affected. Check to see if three standards spanning the entire sequence were used to obtained RT windows. If the lab used three standards from the 5 pt., RT windows may be too tight. If so, RT windows should be recalculated as per Method 80000C(section 11.6).

ii. Alternatively, check to see if the chromatograms contain peaks within an expanded window surrounding the expected retention times.

YES NO N/A

If no peaks are found and the surrogates are visible, non-detects are valid. If peaks are present but cannot be discerned through pattern recognition or by using revised RT windows, qualify all positive results and non-detects as unusable, "R".

15.7 Has the linearity criteria for the initial calibration standards been satisfied for both columns? (% RSD for the calibration factors (CFs)must be < 20.0% for all analytes). [✓] ___ ___

ACTION: If no, follow Table 6 criteria.

Table 6. Initial Calibration CF Action for Nitroaromatic and Nitramine Analysis

Criteria	Action	
	Detected Associated Compounds	Non-Detected Associatedd Compounds
% RSD > 20%	J	UJ
% RSD within allowable limits	No qualifications	

15.8 Does the calibration verification/continuing calibration standard contain the nitroaromatics or nitramines peaks of interest, analyzed on each working day, prior to sample analyses? [✓] ___ ___

15.9 Has a calibration verification/continuing calibration standard been analyzed after every 10 samples and at the end of each analytical sequence [✓] ___ ___

ACTION: If no, take action as specified in section 3.2 above.

15.10 Has the percent difference (%D) between the Calibration Factor (CF) of the peaks used to identify the nitroaromatics and nitramines in the CCV and the CF from these peaks in the initial calibration exceeded ± 15%. ___ [✓] ___

15.11 Has a new 5 pt. initial calibration curve been generated for those nitroaromatics and nitramines analytes which failed in the calibration verification/continuing calibration

YES NO N/A

standard (8000C, section 11.7.3), and all samples which followed the out-of-control calibration verification/standard continuing calibration standard? [✓] ___ ___

ACTION: If the %D for any analyte exceeded the ± 15% criterion and the instrument was not recalibrated for those analytes, qualify positive results for all associated samples (those which followed the out-of-control standard) "J" and sample quantitation limits "UJ". (Table 7)

15.12 Have retention time (RT) windows been properly calculated for each analyte of interest (Method 8000C, section 11.6), using RTs from the associated calibration verification/continuing standard? [✓] ___ ___

ACTION: If no, take action specified in section 3.2 above

15.13 Do all standard retention times for each calibration verification/continuing calibration standard fall within the windows established during the initial calibration sequence? [✓] ___ ___

15.14 Do all standard retention times for each mid-concentration standard (analyzed after every 10 samples) fall within the daily RT windows. [✓] ___ ___

ACTION: If the answer to either 15.12 or 15.13 above is no, check the chromatograms of all samples which followed the last in-control standard. All samples analyzed after the last in-control standard must be re-injected, if initial analysis indicated the presence of the specific analyte that exceeded the retention time criteria). If samples were not re-analyzed, document under Contract Non-compliance in the Data Assessment.

Reviewer has two options to determine how to qualify questionable sample data. First option is to determine if possible peaks are present within daily retention time window. If no possible peaks are found, non-detects are valid. If possible peaks are found (or interference), qualify positive hits as presumptively present "NJ" and non-detects are rejected "R". Second option is to use the ratio of the retention time of the analyte over the retention time of either surrogate. The passing criteria is ± 0.06 RRT units of the RRT of the standard component. Reject "R" all questionable analytes exceeding criteria, and "NJ" all other positive hits.

15.15 Has no more than 14 hours elapsed from the injection of the opening CCV and the end of the analytical sequence (closing CCV). (Table 7) [✓] ✓ ___

Explosives 17 hours 58 min

Table 7. CCV Criteria

Criteria	Action	
	Detected Associated	Non-Detected Associated

YES NO N/A

	Compounds	Compounds
RT out of RT window	Use professional judgement (Sec 15.14)	
%D not within +/- 15%	J	UJ
Time elapsed greater than section 15.15 criteria.	R	
%D, time elapsed, RT are all within acceptable limits.	No qualifications	

15.16 Are there any transcription/calculation errors between raw data and data summary forms? ___ [✓] ___

ACTION: If large errors exists call lab for explanation/resubmittal, make any necessary corrections and document the effect in data assessments under "Conclusions".

16.0 Analytical Sequence Check (Form VIII-nitroaromatics and nitramines)

16.1 Have all samples been listed on CLP Form VIII or equivalent, and are separate forms present for each column? [✓] ___ ___

ACTION: If no, take action specified in 3.2 above.

16.2 Was the proper analytical sequence followed for each initial calibration and subsequent analyses? [✓] ___ ___

Note: Sequence is as follows: 5 point initial calibration, method blank, LCS, CCS, 10 sample extracts, CCV, 10 sample extract, and so on. The sequence must always end with a CCV. As long as the first CCV is within QC, the initial calibration does not have to be rerun.

ACTION: If no, use professional judgement to determine the severity of the effect on the data and qualify it accordingly. Generally, the effect is negligible unless the sequence was grossly altered or the calibration was also out of limits.

16.3 Were the surrogate RTs for the samples within the mean surrogate RT from the initial calibration? [✓] ___ ___

Action: If no, see "Action" in section 15.14 above

17.0 Extraction Techniques for Sample Preparation

YES NO N/A

Method 8330A permits a variety of extraction techniques to be used for sample preparation. Which extraction procedure was used?

17.1 Aqueous samples:

1. Low Level (salting-out extraction)) [ ] ___ ___
2. High-level (Sample filtration) [ ] ___ ___
3. Solid phase extraction (Method 3535) [✓] ___ ___
4. Other [ ] ___ ___

17.2 Soil and sediment samples:

1. Sonication [✓] ___ ___
2. Other [ ] ___ ___

18.0 Nitroaromatics and Nitramines Identification*-VCS6

18.1 Has CLP Form X or equivalent, showing retention time data for positive results on the two HPLC columns, been completed for every sample in which a nitroaromatics or nitramines was detected? [✓] ___ ___

ACTION: If no, take action specified in 3.2 above, or compile a list comparing the retention times for all sample hits on the two columns.

18.2 Are there any transcription/calculation errors between raw data and data summary forms (initial calibration summaries, calibration verification summaries, analytical sequence summaries. ___ [✓] ___

ACTION: If large errors exist, call lab for explanation/resubmittal, make necessary corrections and note error in the data assessment.

18.3 Are retention times (RT) of sample compounds within the established RT windows for both columns/analyses? [✓] ___ ___

ACTION: Qualify as unusable (R) all positive results which were not confirmed by second HPLC column analysis. Also qualify "R", unusable, all positive results not within RT windows unless associated standard compounds are similarly biased. The reviewer should use professional judgement to assign an appropriate quantitation limit.

YES NO N/A

18.4 Check chromatograms for false negatives, especially if RT windows on each column were established differently. Were there any false negatives? ___ [✓] ___

ACTION: Use professional judgement to decide if the compound should be reported. If there is reason to believe that peaks outside retention RT windows should be reported, make corrections to data summary forms (Form I) and note in data assessment.

18.5 Is the percent difference (%D) calculated for the positive sample results on the two HPLC columns<25.0%? [✓] ___ ___

NOTE: The method requires quantitation from one column. The second column is to confirm the presence of an analyte. It is the reviewer's responsibility to verify from the project plan what the lab was required to report. If the lab was required to report concentrations from both columns, continue with validation for % Difference. If required, but not reported, either contact the lab for results or calculate the concentrations from the calibration. If not required, skip this section. Document actions in Data Assessment.

ACTION: If the reviewer finds neither column shows interference for the positive hits, the data should be qualified as follows:

% Difference	Qualifier
0-25%	none
26-70%	"J"
71-100%	"NJ"
101-200% (No Interference)	"R"
101-200% (Interference detected)**	"NJ"
>50% (Analyte value is <CRQL)	"U"
>200%	"R"

Note: The lower of the two values is reported on Form I. If using professional judgement, the reviewer determines that he higher result was more acceptable, the reviewer should replace the value and indicate the reason for the change in the data assessment.

19.0 Compound Quantitation and Reported Detection Limits

19.1 Are there any transcription/calculation errors in Form I results? Check at least two positive values. Were any errors found? ___ [✓] ___

YES NO N/A

NOTE: Nitroaromatics and Nitramines peak results can be checked for rough agreement between quantitative results obtained on the two HPLC columns. The reviewer should use professional judgement to decide whether a much larger concentration obtained on one column versus the other indicates the presence of an interfering compound. If an interference is suspected, the lower of the two values should be reported and qualified according to section 18.5 above. This necessitates a determination of an estimated concentration on the confirmation column. The narrative should indicate that the presence of interferences has led to the quantitation of the second column confirmation results.

19.2 Are the EDLs (Estimated Detection Limits) adjusted to reflect sample dilutions and, for soils,% moisture? [✓] ___ ___

ACTION: If errors are large, call lab for explanation/resubmittal, make any necessary corrections and document effect in data assessments.

ACTION: When a sample is analyzed at more than one dilution, the lowest EDLs are used (unless a QC exceedance dictates the use of the higher EDL data from the diluted sample analysis). Replace concentrations that exceed the calibration range in the original analysis by crossing out the value on the original Form I and substituting it with data from the analysis of diluted sample. Specify which Form I is to be used, then draw a red "X" across the entire page of all Form I's that should not be used, including any in the summary package.

ACTION: EDLs affected by large, off-scale peaks should be qualified as unusable, "R". If the interference is on-scale, the reviewer can provide a modified EDL flagged "UJ" for each affected compound.

14.0 Chromatogram Quality

14.1 Were baselines stable? [✓] ___ ___

14.2 Were any electropositive displacement (negative peaks) or unusual peaks seen? ___ [✓] ___

ACTION: Note all system performance problems in the data assessment.

15.0 Field Duplicates *VCS-7

15.1 Were any field duplicates submitted for Nitroaromatics and Nitramines. [✓] ___ ___

YES NO N/A

ACTION: Compare the reported results for field duplicates and calculate the relative percent difference.

ACTION: Any gross variation between field duplicate results must be addressed in the reviewer narrative. However, if large differences exist, the identity of the field duplicates is questionable. An attempt should be made to determine the proper identification of field duplicates.

Validata Chemical Services Addendum to Explosives Checklist
Clarification of Policies Where Region II and SAP Requirements Differ
(See Numbered References in Checklist)

Analysis	Checklist Required Element	Validator Criteria and Action
Explosives (8330)		
1.	Acetonitrile, methanol and water should be analyzed prior possible interferences	Our Professional Judgment is no qualification because there is no SAP Limit.
2.	Blanks	Validata will qualify data in accordance with Region II approach.
3.	Initial Calibration (%RSD <20%)	If using ISTD calibration, %RSD <15% If using External calibration, %RSD <20%
4.	Second Source (ICV)	SAP limit %D<20%. List outliers in narrative.
	Since this element is not addressed by Region II there will be no qualification.	
5.	Continuing Calibration (%D <15%)	SAP limit %D <20% Use SAP Limit, but qualify per Region II.
6.	Column %D (<25%)	SAP limit <40% Validata will flag only J if >40%.
7.	Field Duplicates (compare and calculate RPD)	SAP For SB, SD and SMI <30% Validata will not qualify outliers.

STANDARD OPERATING PROCEDURE

Title: Evaluation of Inorganic Analyses
Data Assessment – CH2M HILL Vieques
Total Review – Metals

SOP: EPA Region II / SAP
SOP_HW-2a_ICP-AES /
SOP_HW-2b_ICP-MS

Project SDG: 70988
Metals Methods: 6010C, 6020A, 7196A
Reviewer: Tom Granat

General Validation

	YES	NO	N/A	ACTION (if no)
Chain-of-Custody				
present or on file	✓			contact Validata Project manager
legible	✓			
Cover Page				
present	✓			contact Validata P.M.
Form I's				
present and complete	✓			contact Validata P.M.
correct units (ug/L or mg/kg)	✓			contact Validata P.M.
results corrected for percent solids	✓			contact Validata P.M.
sample IDs match C-of-C and cover page	✓			contact Validata P.M.
were "less than"values coded with "U"?	✓			contact Validata P.M.
was a brief sample description in the comment section?		✓		contact Validata P.M.
were samples diluted within requirements?	✓			
If no,were dilutions on Form I's	✓			note under Overall Assessment in Data Validation Narrative

Holding Times – from date of sample collection to date of sample analysis. Applies to aqueous samples only (apply to soil matrix at reviewer's discretion)

	YES	NO	N/A	ACTION (if no)
pH < 2 upon sample receipt	✓			positive results are estimated low (J-). Non-detects are unusable (R).
ICP Metals – waters - within 180 day Soils – within 30 days	✓			positive results are estimated low (J-). Non-detects are unusable (R)
Hex. Cr – water – 24 hours		✓		positive and non-detect results are estimated low (J-) and (UJ). If >2X limit, then positive results are estimated low (J-) and non-detect results are unusable (R)
Hex. Cr - soils – 30 days from collection to extraction, 7 days from extraction to analysis.	✓			positive results are estimated low (J-). Non-detects are unusable (R)

	YES	NO	N/A	ACTION (if no)
Raw Data – measurement readout present for:				
ICP	✓			contact Validata P.M.
Are all raw data to support all sample analyses and QC operations present for:	✓			contact Validata P.M.
Dated digestion logs present for:				
ICP	✓			contact Validata P.M.
Percent solids (soils)	✓			contact Validata P.M.

Tune Analysis – ICP-MS only – prior to calibration, the ICP-MS tuning solution must be analyzed at least five times consecutively. The solution must contain all required isotopes of Be, Mg, Co, In, and Pb.

Tuning present	✓			all results are unusable (R).
Tuning solution analyzed 5X consecutively with all required isotopes	✓			use professional judgment to qualify data. Contact Validata PM if additional information is required.
Mass calibration within 0.1 amu for all isotopes	✓			positive and non-detect results are estimated (J) and (UJ), respectively.
%RSD <5% for all analytes	✓			positive and non-detect results are estimated (J) and (UJ), respectively.

Calibration – must be present for each analysis run, instrument set-up, or every 24 hours, whichever is more frequent.

ICP – calibration present	✓			All data associated with the analysis run are unusable (R).
ICP – 5 point calibration (minimum) at least 1 at or below the CRQL	✓			All data associated with the analysis run whose results are >DL and < 2X LOD are estimated (J) .
correlation coefficient >0.995 or %RSD <30%	✓			All data associated with the analysis run are estimated (J) and (UJ).

Form II – Initial and Continuing Calibration Verification

For initial calibration verifications (ICVs) that do not meet technical criteria, the action is applied to all samples reported from that analytical run.

For continuing calibration verifications (CCVs) and CRIs that do not meet the technical criteria, the action is applied to all samples analyzed between a previous technically acceptable analysis of the QC sample and a subsequent technically acceptable analysis of the QC sample in the analytical run.

ICVs analyzed immediately after calibration	✓			use professional judgment to qualify data
Are ICP CCVS analyzed every 2 hours	✓			

	YES	NO	N/A	ACTION (if no)
Are all ICVs and CCVs within control limits: ICP - 90-110%	✓			See below if no
If recovery was: <75%				ACTION: use professional judgment to Qualify all results as unusable (R).
75-89%				positive results are estimated low (J-). Non-detects are estimated (UJ).
111-125%				positive results are estimated (J+).
>125, but <160%				use professional judgment to qualify all positive results as estimated (J+).
>160%				positive results are unusable (R).

Form III – Initial and Continuing Calibration Blanks and Preparation Blanks

For initial calibration blanks (ICBs) that do not meet technical criteria, the action is applied to all samples reported from that analytical run.
For continuing calibration blanks (CCBs) that do not meet the technical criteria, the action is applied to all samples analyzed between a previous technically acceptable analysis of a CCB and a subsequent technically acceptable analysis of a CCB in the analytical run.
For preparation blanks (PB) that do not meet the technical criteria, the action is applied to all samples prepared in the same preparation batch.

ICBs analyzed immediately after ICVs Are CCBs analyzed after every CCV	✓ ✓			use professional judgment to qualify data
ICB/CCB < DL	✓			See below if no
If ICB / CCB: >/=DL, but </=LOD				ACTION: positive results </= LOD are reported as undetected (U) with the results raised to the LOD.
> LOD				positive results </= LOD are reported as undetected (U) with the results raised to the LOD.
				Results > LOD, but < Blank Value are reported as

	YES	NO	N/A	ACTION (if no)
				undetected (U) with results raised to the blank level or results are qualified as unusable (R). Use professional judgment for results > Blank Value.
</= -DL, but >/= -LOD				using professional judgment, all results between the absolute –DL and –LOD were flagged as estimated potentially biased low (J-) and all non-detects were flagged as estimated (UJ).
< -LOD				Results >/= LOD, but <10X LOD are estimated low (J-). Non-detects are estimated (UJ).
Were prep blanks analyzed for each matrix	✓			use professional judgment to qualify all results
If PB:				ACTION:
> LOD				positive results </= LOD are reported as undetected (U) with the results raised to the LOD.
				results >LOD, but <10X the Blank Value are estimated high (J+) or are unusable (R).
>/= DL, but </= LOD				positive results <LOD are reported as undetected (U) with results raised to the LOD. Using professional judgment, positive results > but less than 10X the blank were flagged as estimated biased high (J+).
< -LOD				results >/= LOD, but <10X LOD are estimated low (J-) and non-detects are estimated (UJ).

Form IV – ICP interference Check Samples – consists of two solutions to be analyzed consecutively. The ICS must not be run before the ICV/ ICB and must be immediately followed by a CCV/ CCB.

ICP-AES: the ICS must be run at the beginning and the end for each analyte and interferent reported for ICP-AES. Any required action is applied to all samples analyzed between a previously technically

	YES	NO	N/A	ACTION (if no)
acceptable ICS analysis and a subsequent technically acceptable ICS analysis in the analytical run.				
Were ICSs analyzed appropriately	✓			use professional judgment to qualify data
ICS recovery 80-120% (or +/- 2X CRQL)	✓			See below if no
If ICS (ICSAB) %R: <50%				ACTION: qualify all non-detects as unusable (R). positive results are estimated low (J-).
50-79% (or <True Value – 2X CRQL)				positive results are estimated low (J-) and non-detects are estimated (UJ).
>120% (or >True Value + 2X CRQL)				positive results are estimated high (J+).
If potential false positives exist in field samples with interferents				positive results are estimated high (J+).
If potential false negatives exist in field samples with interferents				positive results <10X /negative value/ are estimated low (J-). Non-detects are estimated (UJ).

ICP-MS: the ICS must be run at the beginning of the run for all masses used for each analyte and interferent reported for ICP-MS. Any required action is applied to all samples reported from the analytical run.

Were ICSs analyzed appropriately	✓			use professional judgment to qualify data
ICS recovery 80-120% (or +/- 3X CRQL)	✓			See below if no
If ICS %R: <50%				ACTION: qualify all data as unusable (R).
50-79% (or <True Value – 2X CRQL)				positive results are estimated low (J-) and non-detects are estimated (UJ).
>120% (or <True Value – 2X CRQL)				positive results are estimated high (J+).
If potential false positives exist in field samples with interferents				positive results are estimated high (J+).
If potential false negatives exist in field samples with interferents				positive results <10X /negative value/ are estimated low (J-). Non-detects are estimated (UJ).

	YES	NO	N/A	ACTION (if no)

Form VIII – Serial Dilution – (ICP only) a 5X dilution must be performed on a sample from each sample delivery group for each matrix. Field blanks and performance evaluation samples cannot be used. If a serial dilution does not meet criteria, action is applied to all samples of the same matrix in the sample delivery group.

Serial dilution performed per matrix for ICP not performed on H_2O sample (EB)		✓		use professional judgment to qualify data.*
%D < 10% for aqueous samples if original sample concentration is > 50X DL			✓	positive results are estimated (J).*
%D < 100% for aqueous samples			✓	positive results are unusable (R)*
%D <15% for soil/ sediment samples if original sample concentration is >50X DL	✓			positive results are estimated (J)*
%D < 120% for soil/ sediment samples			✓	positive results are unusable (R)*

apply the action only to the field sample used to prepare the QC sample. If it is clearly stated in the data validation materials that the samples were taken through incremental sampling or some other method guaranteeing the homogeneity of the sample group, then the entire sample group may be qualified (For Vieques project – apply to all samples in water or SMI soil Prep. Batch. SMI samples contain the "SMI" in the client sample name.)

Form V – Matrix Spike Sample Analysis – at least one pre-digestion spiked sample must be prepared and analyzed from each sample delivery group and for each matrix. Any required action is applied to all samples in the delivery group of the same matrix. When an ICP or CN matrix spike is outside the control limits, a post digestion spike (PS) is required (exception : Ag). A field blank or performance evaluation sample may not be used for spike sample analysis.

Matrix Spike (MS) sample analysis frequency criteria were met for:

ICP	✓			if no, use professional judgment to qualify all results.*
Is MS recovery between 80-120% (Ag between 75-120%) for soils Water – 80-120%		✓		See below if no
ICP - If recovery is: <30% and PS <75%)				ACTION: positive results are estimated low (J-).*
(or if no PS performed)				Non-detects are unusable (R).*
<30% and PS >/= 75%				positive and non-detect results are estimated (J) and (UJ), respectively.*

	YES	NO	N/A	ACTION (if no)
30-79% and PS < 75% (or if no PS performed)				positive results are estimated low (J-). Non-detects are estimated (UJ).*
30-79% and PS >/= 75%				positive and non-detect results are estimated (J) and (UJ), respectively.*
>120% and PS >125% (or if no PS performed)				positive results are estimated high (J+).*
>120% and PS </= 125%				positive results are estimated (J).*

Matrix Spike (MS) sample analysis frequency criteria were met for:

Hexavalent Cr		✓		if no, use professional judgment to qualify all results.*
Is MS recovery between 85-115% (soil) 80-120% (water)	✓	✗ TBG		See below if no
If recovery is: <30%				ACTION: positive and non-detect results are estimated (J) and (UJ), respectively.*
30-84% (soil) 30-79% (water)				positive and non-detect results are estimated (J) and (UJ), respectively.*
>115% (soil) >120% (water)				positive results are estimated (J).*
If a post digestion spike was analyzed Are recoveries between 85-115%	✓			No action required based on absence or outliers
Was an insoluble spike performed (soils only Are recoveries between 85-115%			✓	No action required based on absence or outliers

apply the action only to the field sample used to prepare the QC sample. If it is clearly stated in the data validation materials that the samples were taken through incremental sampling or some other method guaranteeing the homogeneity of the sample group then the entire sample group may be qualified (For Vieques project – apply to all samples in water or SMI soil Prep. Batch. SMI samples contain the "SMI" in the client name.)

Form VI – Duplicate Sample Analysis – at least one duplicate sample analysis must be prepared and analyzed from each sample delivery group and for each matrix. Any required action is applied to all samples in the delivery group. A field blank or performance evaluation sample may not be used for duplicate sample analysis.

Duplicate sample analysis frequency criteria was met for:

	YES	NO	N/A	ACTION (if no)
ICP	✓			if no, use professional judgment to qualify all results*
Aqueous Samples				
RPD < 20% when sample and duplicate are > 5X LOD Hexavalent Cr RPD <30%	✓			positive results > LOD are estimated (J).*
RPD < 100% when sample and duplicate are > 5X LOD			✓	positive results > LOD are unusable (R).*
Absolute difference between sample and duplicate results is < CRQL when the sample and/or duplicate results (including non-detects) are <= 5X LOD.	✓			positive and non-detect results are estimated (J) and (UJ), respectively.*
Soil Samples				
RPD < 35% when sample and duplicate are > 5X LOD Hexavalent Cr RPD<30%		✓		positive results > LOD are estimated (J).*
RPD < 120% when sample and duplicate are > 5X LOD	✓			positive results > LOD are unusable (R)*
Absolute difference between sample and duplicate results is < 2X LOD when the sample and/or duplicate results (including non-detects) are <= 5X LOD.	✓			positive and non-detect results are estimated (J) and (UJ), respectively.*

apply the action only to the field sample used to prepare the QC sample. If it is clearly stated in the data validation materials that the samples were taken through incremental sampling or some other method guaranteeing the homogeneity of the sample group, then the entire sample group may be qualified (For Vieques project – apply to all samples in water or SMI soil Prep. Batch. SMI samples contain the "SMI" in the client sample name.)

Field Duplicates – field duplicate samples are collected in the field with sample collection. Report RPD when both samples are > 5X CRQL. Action applies only to the field sample and its duplicate.

Aqueous Samples				
RPD < 20% when sample and duplicate are > 5X LOD			✓	positive results > LOD are estimated (J).
Absolute difference between sample and duplicate results is < LOD when the sample and/or duplicate results (including non-detects) are <= 5X LOD.			✓	positive and non-detect results are estimated (J) and (UJ), respectively.

	YES	NO	N/A	ACTION (if no)
ICP	__	__	✓	if no, use professional judgment to qualify all results*
Aqueous Samples				
RPD < 20% when sample and duplicate are > 5X LOD Hexavalent Cr RPD <30%	__	__	✓	positive results > LOD are estimated (J).*
RPD < 100% when sample and duplicate are > 5X LOD	__	__	✓	positive results > LOD are unusable (R).*
Absolute difference between sample and duplicate results is < CRQL when the sample and/or duplicate results (including non-detects) are </= 5X LOD.	__	__	✓	positive and non-detect results are estimated (J) and (UJ), respectively.*
Soil Samples				
RPD < 35% when sample and duplicate are > 5X LOD Hexavalent Cr RPD<30%	__	__	✓	positive results > LOD are estimated (J).*
RPD < 120% when sample and duplicate are > 5X LOD	__	__	✓	positive results > LOD are unusable (R)*
Absolute difference between sample and duplicate results is < 2X LOD when the sample and/or duplicate results (including non-detects) are </= 5X LOD.	__	__	✓	positive and non-detect results are estimated (J) and (UJ), respectively.*

apply the action only to the field sample used to prepare the QC sample. If it is clearly stated in the data validation materials that the samples were taken through incremental sampling or some other method guaranteeing the homogeneity of the sample group, then the entire sample group may be qualified (For Vieques project – apply to all samples in water or SMI soil Prep. Batch. SMI samples contain the "SMI" in the client sample name.)

Field Duplicates / Triplicates – field duplicate samples are collected in the field with sample collection. Report RPD or %RSD when all samples are > 5X CRQL. Action applies only to the field sample and its duplicate / triplicate

Aqueous Samples				
RPD < 20% when sample and duplicate are > 5X LOD	__	__	✓	positive results > LOD are estimated (J).
Absolute difference between sample and duplicate results is < LOD when the sample and/or duplicate results (including non-detects) are </= 5X LOD.	__	__	✓	positive and non-detect results are estimated (J) and (UJ), respectively.

	YES	NO	N/A	ACTION (if no)
Soil Samples **(SB and SD)**				
RPD < 30% when sample and duplicate are > 5X LOD			✓	positive results > LOD are estimated (J).
Absolute difference between sample and duplicate results is < 2X LOD when the sample and/or duplicate results (including non-detects) are </= 5X LOD.			✓	positive and non-detect results are estimated (J) and (UJ), respectively.
Soil Samples **(SMI only)** – field triplicate				
RPD <50% when sample and triplicates are > 5X LOD		✓		positive results > LOD are estimated (J).
Absolute difference between sample and triplicate results is < 2X LOD when the sample and/or duplicate results (including non-detects) are </= 5X LOD.	✓			positive and non-detect results are estimated (J) and (UJ), respectively.

Form VII – Laboratory Control Sample (LCS) - must be prepared and analyzed with the every sample delivery group for each matrix. For an LCS that does not meet the technical criteria, the action is applied to all samples in the same preparation batch. LCS is not addressed for Hg or Cn.

	YES	NO	N/A	
Was an LCS analyzed by ICP-AES for each analyte and for each matrix	✓			use professional judgment to qualify all results
Was an aqueous LCS analyzed by ICP-MS for each analyte	✓			use professional judgment to qualify all results
Was a soil LCS analyzed for Hg and CN			✓	use professional judgment to qualify all results
Aqueous LCS %R 80-120% Soil LCS %R 80-120% (Ag 75-120%) Hexavalent Cr 85-115%	✓			See below if no

If recovery is:	ACTION:
<40% (<20% for Ag & Sb)	positive results are estimated low (J-). Non-detects are unusable (R).
40-79%	positive and non-detect results are estimated low (J-) and (UJ), respectively.
120-150% (150-170% for Ag & Sb)	positive results are estimated high (J+).

	YES	NO	N/A	ACTION (if no)
>150% (>170% for Ag & Sb)				all results are unusable (R).
Wipe/Filter LCS %R 70-130%			✓	See below if no
If recovery is: <40% (<20% for Ag & Sb)				ACTION: positive results are estimated low (J-). Non-detects are unusable (R).
40-69%				positive and non-detect results are estimated low (J-) and (UJ), respectively.
>130%				positive results are estimated high (J+).

Form XV - Internal Standards – ICP-MS only – All samples (including QC samples) analyzed during a run, with the exception of the ICP-MS tune, must contain at least 5 of the following internal standards: Li, Sc, Y, Rh, In, Tb, Ho, Lu, and Bi. Any required action is applied to all samples (including QC samples) analyzed during run, beginning with the calibration.

Were internal standards (ISTD) used	✓			qualify all results as unusable (R).
Were at least 5 required ISTDs used	✓			qualify all analytes not bracketed by ISTD masses as unusable (R).
All analyte masses are bracketed by ISTD masses	✓			qualify all analytes not bracketed by ISTD masses as unusable (R).
Is sample % Relative Intensity (%RI) within 60-125%	✓			See below if no
If sample %RI <60% or >125% when: sample reanalyzed at a 2-fold dilution				ACTION: positive and non-detect results in the dilution analysis are estimated (J) and (UJ), respectively.
Sample not reanalyzed at a 2-fold dilution				use professional judgment to qualify sample results as estimated (J) or unusable (R).

Overall Assessment – examine raw data and verify sample results by performing a 10% spot check of all types of computations and transcriptions for all SDG forms.

	YES	NO	N/A	ACTION (if no)
Transcriptions and computations are correct	✓			check all calculations for errors.
Data were free of any anomalies (ex: baseline shifts, negative absorbances, omissions, illegibility, etc)	✓			use professional judgment to qualify data. Contact Validata Project Manager if resubmissions are required.
methods and amounts used in digestions were correct	✓			use professional judgment to qualify data. Contact Validata PM if resubmissions are required.
Did results fall within the ICP linear range either before or after being reanalyzed at a dilution.	✓			use professional judgment to qualify data. Contact Validata PM if resubmissions are required.

Assess the overall quality of the data and make professional judgments and express concerns, as well as comment on the validity of the overall data. Consider the additive nature when several QC criteria are outside of the specification parameters. Comment briefly on the data quality and make recommendations for further data qualification when appropriate.

VALIDATA
Chemical Services, Inc.
2634 Nutwood Trace, Duluth, GA 30097
(770) 232-0130
(770) 232-5082 (Fax)
www.datavalidator.com

DATA VALIDATION SUMMARY REPORT

COMPANY:	CH2M HILL, Inc.
SITE NAME:	East Vieques Terrestrial UXO Sites, Vieques Island, PR
CTO / PROJECT No.:	CTO-0005 / 424191
CONTRACTED LAB:	APPL, Inc.
QA/QC LEVEL:	EPA Level IV
EPA SOW/METHODS:	SW-846
VALIDATION GUIDELINES:	*Master Sampling and Analysis Plan for East Vieques Terrestrial UXO Sites, Vieques Puerto Rico, Master SAP Addendum 2, USEPA Region II Modifications*
SAMPLE MATRICES:	Soil and Water
TYPES OF ANALYSES:	Explosives, Picric Acid

SDG NUMBER: 72181

SAMPLES:

Client Sample #	Lab Sample #	Matrix	Explosives	Picric Acid
VE-UXO18-01SMI01-1113	AY89017	Soil	X	
VE-UXO18-01SMI01-1113A	AY89018	Soil		X
VE-UXO18-01SMI01T1113	AY89019	Soil	X	
VE-UXO18-01SMI01T-1113A	AY89020	Soil		X
VE-UXO18-01SMI01TT-1113	AY89021	Soil	X	
VE-UXO18-01SMI01TT-1113A	AY89022	Soil		X
VE-UXO18-01SMI02-1113	AY89023	Soil	X	
VE-UXO18-01SMI02-1113A	AY89024	Soil		X
VE-UXO18-EB01-111513	AY89025	Water	X	X
VE-UXO18-01SMI01B-1113	AY89041	Soil	X	
VE-UXO18-01SMI01C-1113	AY89042	Soil	X	
VE-UXO18-01SMI01B-1113A	AY89043	Soil		X
VE-UXO18-01SMI01C-1113A	AY89044	Soil		X
VE-UXO18-01SMI02-1113MS	AY89023MS	Soil	X	
VE-UXO18-01SMI02-1113MSD	AY89023MSD	Soil	X	

Client Sample #	Lab Sample #	Matrix	Explosives	Picric Acid
VE-UXO18-01SMI02-1113AMS	AY89024MS	Soil		X
VE-UXO18-01SMI02-1113AMSD	AY89024MS	Soil		X

SUFFIX CODES: DL = DILUTION, MD = MATRIX DUPLICATE, MS = MATRIX SPIKE, MSD = MATRIX SPIKE DUPLICATE

DATA REVIEWER(S): Amy L. Hogan, Theresa Tipe

SECONDARY REVIEWER(S): Kevin C. Harmon, Ann Poon

Data Qualifier Definitions

J	-	The associated numerical value is an estimated quantity.
J+	-	The associated numerical value is an estimated quantity, potentially biased high.
J-	-	The associated numerical value is an estimated quantity, potentially biased low.
R	-	The data are unusable (the compound/analyte may or may not be present). Resampling and reanalysis are necessary for verification.
U	-	The compound/analyte was analyzed for, but not detected. The associated numerical value is the sample quantitation limit.
UJ	-	The compound/analyte was analyzed for, but not detected. The sample quantitation limit is an estimated quantity.

DATA QUALIFICATION SUMMARY

APPL, Inc. – 72181 - Organics

EXPLOSIVES

SUMMARY

I.) General:

The analyses for Explosives were performed by HPLC according to SW-846 Method 8330B.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualifications.

MAJOR ISSUES

There were no major problems observed for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was required.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met. No action was required.

Initial Calibration Verification:

All Initial Calibration Verification criteria were met. No action was required.

Continuing Calibration:

All Continuing Calibration criteria were met. No action was required.

IV.) Blanks:

Method Blanks:

There were no detections in the method blanks associated with this fraction of the SDG. No action was required.

Equipment Blank:

There were no detections in the equipment blank associated with this fraction of the SDG. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Laboratory Control Samples (LCS):

Two LCS were analyzed by the laboratory for this SDG. All LCS Percent Recovery criteria were met. No action was required.

Ground LCS:

The laboratory analyzed one Ground LCS for site UXO18, as part of SDG 70988. The Percent Recoveries (%Rs) of 2-nitrotoluene at 116% and nitrobenzene at 94.3% exceeded their respective 46-103% and 36-89% QC limits. Since there were no positive results for these compounds in the site UXO18 SMI samples for this SDG, no action was required.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were performed on client sample VE-UXO18-01SMI01-1113. The Percent Recoveries exceeded their respective QC limits for the following compounds:

Compound	MS, %R	MSD, %R	QC Limits
2,4-dinitrotoluene	185%	176%	80-125%
2,6-dinitrotoluene	201%	198%	80-120%
3-nitrotoluene	123%	122%	75-120%
PETN	2165%	2050%	69-132%

Data qualification based on MS / MSD criteria alone was not required. No action was taken.

MS / MSD analyses data were not submitted for the water matrix fraction of the SDG. The only associated SDG sample was a field QC. Data qualification based on the absence of MS / MSD data was not required, so no action was taken.

VIII.) Field Duplicates / Triplicates:

One set of field triplicates (VE-UXO18-01SMI01-1113 / VE-UXO18-01SMI01T-1113 / VE-UXO18-01SMI01TT-1113) was submitted for this SDG. There were no calculable Percent Relative Standard Deviations (%RSDs). No action was required.

IX.) Laboratory Duplicates / Triplicates:

One set of laboratory triplicates (VE-UXO18-01SMI01-1113 / VE-UXO18-01SMI01B-1113 and VE-UXO18-01SMI01C-1113) was associated with this SDG, with the data being a part of SDG 70052. There were no calculable Percent Relative Standard Deviations (%RSDs), so no data qualification based on laboratory duplicate / triplicate data was required.

X.) TCL Compound Identification:

All Compound Identification criteria were met. No action was required.

XI.) Compound Quantitation and Reported Limit of Quantitation/Detection (LOQ/LOD):

All LOQ/LOD criteria were met. No action was required.

XII.) System Performance:

All System Performance criteria were met. No action was required.

PICRIC ACID

SUMMARY

I.) General:

The analyses for Picric Acid were performed by HPLC according to SW-846 Method 8321A.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualifications.

MAJOR ISSUES

There were no major problems observed for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was required.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met. No action was required.

Initial Calibration Verification:

All Initial Calibration Verification criteria were met. No action was required.

Continuing Calibration:

All Continuing Calibration criteria were met. No action was required.

IV.) Blanks:

Method Blanks:

There were no detections in the method blanks associated with this fraction of the SDG. No action was required.

Equipment Blank:

There were no detections in the equipment blank associated with this fraction of the SDG. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Laboratory Control Samples (LCS):

Two LCS samples were analyzed by the laboratory for this SDG. All LCS Percent Recovery criteria were met. No action was required.

Ground LCS:

The laboratory analyzed one Ground LCS for site UXO18, as part of this SDG. The Percent Recovery (%R) was 81.8%, which was within the 30-130% QC limits. No action was required.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were performed on client sample VE-UXO18-01SMI01-1113A. All MS / MSD criteria were met. No action was required.

MS / MSD analyses data were not submitted for the water matrix fraction of the SDG. The only associated SDG sample was a field QC. Data qualification based on the absence of MS / MSD data was not required, so no action was taken.

VIII.) Field Duplicates / Triplicates:

One set of field triplicates (VE-UXO18-01SMI01-1113A / VE-UXO18-01SMI01T-1113A / VE-UXO18-01SMI01TT-1113A) was submitted for this SDG. There were no calculable Percent Relative Standard Deviations (%RSDs). No action was required.

IX.) Laboratory Duplicates / Triplicates:

One set of laboratory triplicates (VE-UXO18-01SMI01-1113A / VE-UXO18-01SMI01B-1113A and VE-UXO18-01SMI01C-1113A) was associated with this SDG, with the data being a part of SDG 70052. There were no calculable Percent Relative Standard Deviations (%RSDs), so no data qualification based on laboratory duplicate / triplicate data was required.

X.) TCL Compound Identification:

All TCL Compound Identification criteria were met. No action was required.

XI.) Compound Quantitation and Reported Limit of Quantitation/Detection (LOQ/LOD):

All LOQ/LOD criteria were met. No action was required.

XII.) System Performance:

All System Performance criteria were met. No action was required.

Appendix A

Qualified Form Is

EPA 8330B EXPLOSIVES-SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 72181

Sample ID: VE-UXO18-01SMI01-1113

APPL ID: AY89017

Sample Collection Date: 11/15/13

QCG: #833BS-131121A-183460

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.200 U	0.50	0.200	0.079	mg/kg	11/21/13	11/22/13
EPA 8330B	1,3-DINITROBENZENE	0.200 U	0.45	0.200	0.063	mg/kg	11/21/13	11/22/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	11/21/13	11/22/13
EPA 8330B	2,4-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	11/21/13	11/22/13
EPA 8330B	2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	11/21/13	11/22/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	11/21/13	11/22/13
EPA 8330B	2-NITROTOLUENE	0.200 U	0.50	0.200	0.066	mg/kg	11/21/13	11/22/13
EPA 8330B	3-NITROTOLUENE	0.200 U	0.50	0.200	0.071	mg/kg	11/21/13	11/22/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	11/21/13	11/22/13
EPA 8330B	4-NITROTOLUENE	0.200 U	0.50	0.200	0.080	mg/kg	11/21/13	11/22/13
EPA 8330B	HMX	0.200 U	0.50	0.200	0.080	mg/kg	11/21/13	11/22/13
EPA 8330B	NITROBENZENE	0.200 U	0.50	0.200	0.075	mg/kg	11/21/13	11/22/13
EPA 8330B	NITROGLYCERIN	0.200 U	0.50	0.200	0.085	mg/kg	11/21/13	11/22/13
EPA 8330B	PETN	1.000 U	2.50	1.000	0.579	mg/kg	11/21/13	11/22/13
EPA 8330B	RDX	0.200 U	0.50	0.200	0.080	mg/kg	11/21/13	11/22/13
EPA 8330B	TETRYL	0.200 U	0.50	0.200	0.091	mg/kg	11/21/13	11/22/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	103	70-130			%	11/21/13	11/22/13

Quant Method: W130907.M
Run #: 1120_000093
Instrument: Waldorf
Sequence: 130907
Dilution Factor: 1
Initials: PY

Printed: 12/12/13 12:57:56 PM
APPL-F1-SC-NoMC-REG MDLs

1/4/14

EPA 8330B EXPLOSIVES-SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 72181

Sample ID: VE-UXO18-01SMI01T-1113

APPL ID: AY89019

Sample Collection Date: 11/15/13

QCG: #833BS-131121A-183460

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.200 U	0.50	0.200	0.079	mg/kg	11/21/13	11/22/13
EPA 8330B	1,3-DINITROBENZENE	0.200 U	0.45	0.200	0.063	mg/kg	11/21/13	11/22/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	11/21/13	11/22/13
EPA 8330B	2,4-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	11/21/13	11/22/13
EPA 8330B	2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	11/21/13	11/22/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	11/21/13	11/22/13
EPA 8330B	2-NITROTOLUENE	0.200 U	0.50	0.200	0.066	mg/kg	11/21/13	11/22/13
EPA 8330B	3-NITROTOLUENE	0.200 U	0.50	0.200	0.071	mg/kg	11/21/13	11/22/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	11/21/13	11/22/13
EPA 8330B	4-NITROTOLUENE	0.200 U	0.50	0.200	0.080	mg/kg	11/21/13	11/22/13
EPA 8330B	HMX	0.200 U	0.50	0.200	0.080	mg/kg	11/21/13	11/22/13
EPA 8330B	NITROBENZENE	0.200 U	0.50	0.200	0.075	mg/kg	11/21/13	11/22/13
EPA 8330B	NITROGLYCERIN	0.200 U	0.50	0.200	0.085	mg/kg	11/21/13	11/22/13
EPA 8330B	PETN	1.000 U	2.50	1.000	0.579	mg/kg	11/21/13	11/22/13
EPA 8330B	RDX	0.200 U	0.50	0.200	0.080	mg/kg	11/21/13	11/22/13
EPA 8330B	TETRYL	0.200 U	0.50	0.200	0.091	mg/kg	11/21/13	11/22/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	104	70-130			%	11/21/13	11/22/13

Quant Method: W130907.M
Run #: 1120_000094
Instrument: Waldorf
Sequence: 130907
Dilution Factor: 1
Initials: PY

Printed: 12/12/13 12:57:56 PM
APPL-F1-SC-NoMC-REG MDLs

Accept
1/4/14

EPA 8330B EXPLOSIVES-SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 72181

Sample ID: VE-UXO18-01SMI01TT-1113

APPL ID: AY89021

Sample Collection Date: 11/15/13

QCG: #833BS-131121A-183460

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.200 U	0.50	0.200	0.079	mg/kg	11/21/13	11/22/13
EPA 8330B	1,3-DINITROBENZENE	0.200 U	0.45	0.200	0.063	mg/kg	11/21/13	11/22/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	11/21/13	11/22/13
EPA 8330B	2,4-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	11/21/13	11/22/13
EPA 8330B	2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	11/21/13	11/22/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	11/21/13	11/22/13
EPA 8330B	2-NITROTOLUENE	0.200 U	0.50	0.200	0.066	mg/kg	11/21/13	11/22/13
EPA 8330B	3-NITROTOLUENE	0.200 U	0.50	0.200	0.071	mg/kg	11/21/13	11/22/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	11/21/13	11/22/13
EPA 8330B	4-NITROTOLUENE	0.200 U	0.50	0.200	0.080	mg/kg	11/21/13	11/22/13
EPA 8330B	HMX	0.200 U	0.50	0.200	0.080	mg/kg	11/21/13	11/22/13
EPA 8330B	NITROBENZENE	0.200 U	0.50	0.200	0.075	mg/kg	11/21/13	11/22/13
EPA 8330B	NITROGLYCERIN	0.200 U	0.50	0.200	0.085	mg/kg	11/21/13	11/22/13
EPA 8330B	PETN	1.000 U	2.50	1.000	0.579	mg/kg	11/21/13	11/22/13
EPA 8330B	RDX	0.200 U	0.50	0.200	0.080	mg/kg	11/21/13	11/22/13
EPA 8330B	TETRYL	0.200 U	0.50	0.200	0.091	mg/kg	11/21/13	11/22/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	104	70-130			%	11/21/13	11/22/13

Quant Method: W130907.M
Run #: 1120_000095
Instrument: Waldorf
Sequence: 130907
Dilution Factor: 1
Initials: PY

Printed: 12/12/13 12:57:56 PM
APPL-F1-SC-NoMC-REG MDLs

1/4/14

EPA 8330B EXPLOSIVES-SOIL

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 72181

Sample ID: VE-UXO18-01SMI02-1113

APPL ID: AY89023

Sample Collection Date: 11/15/13

QCG: #833BS-131121A-183460

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.200 U	0.50	0.200	0.079	mg/kg	11/21/13	11/22/13
EPA 8330B	1,3-DINITROBENZENE	0.200 U	0.45	0.200	0.063	mg/kg	11/21/13	11/22/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	11/21/13	11/22/13
EPA 8330B	2,4-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	11/21/13	11/22/13
EPA 8330B	2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.083	mg/kg	11/21/13	11/22/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	11/21/13	11/22/13
EPA 8330B	2-NITROTOLUENE	0.200 U	0.50	0.200	0.066	mg/kg	11/21/13	11/22/13
EPA 8330B	3-NITROTOLUENE	0.200 U	0.50	0.200	0.071	mg/kg	11/21/13	11/22/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.200 U	0.50	0.200	0.075	mg/kg	11/21/13	11/22/13
EPA 8330B	4-NITROTOLUENE	0.200 U	0.50	0.200	0.080	mg/kg	11/21/13	11/22/13
EPA 8330B	HMX	0.200 U	0.50	0.200	0.080	mg/kg	11/21/13	11/22/13
EPA 8330B	NITROBENZENE	0.200 U	0.50	0.200	0.075	mg/kg	11/21/13	11/22/13
EPA 8330B	NITROGLYCERIN	0.200 U	0.50	0.200	0.085	mg/kg	11/21/13	11/22/13
EPA 8330B	PETN	1.000 U	2.50	1.000	0.579	mg/kg	11/21/13	11/22/13
EPA 8330B	RDX	0.200 U	0.50	0.200	0.080	mg/kg	11/21/13	11/22/13
EPA 8330B	TETRYL	0.200 U	0.50	0.200	0.091	mg/kg	11/21/13	11/22/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	102	70-130			%	11/21/13	11/22/13

Quant Method: W130907.M
Run #: 1120_000096
Instrument: Waldorf
Sequence: 130907
Dilution Factor: 1
Initials: PY

Printed: 12/12/13 12:57:56 PM
APPL-F1-SC-NoMC-REG MDLs

fcept
1/4/14

EPA 8330B EXPLOSIVES-WATER

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 72181

Sample ID: VE-UXO18-EB01-111513

APPL ID: AY89025

Sample Collection Date: 11/15/13

QCG: #833BW-131121A-183472

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8330B	1,3,5-TRINITROBENZENE	0.300 U	0.50	0.300	0.130	ug/L	11/21/13	11/22/13
EPA 8330B	1,3-DINITROBENZENE	0.300 U	0.50	0.300	0.131	ug/L	11/21/13	11/22/13
EPA 8330B	2,4,6-TRINITROTOLUENE	0.300 U	0.50	0.300	0.133	ug/L	11/21/13	11/22/13
EPA 8330B	2,4-DINITROTOLUENE	0.300 U	0.50	0.300	0.125	ug/L	11/21/13	11/22/13
EPA 8330B	2,6-DINITROTOLUENE	0.300 U	0.50	0.300	0.125	ug/L	11/21/13	11/22/13
EPA 8330B	2-AMINO-4,6-DINITROTOLUENE	0.300 U	0.50	0.300	0.125	ug/L	11/21/13	11/22/13
EPA 8330B	2-NITROTOLUENE	0.300 U	0.50	0.300	0.126	ug/L	11/21/13	11/22/13
EPA 8330B	3-NITROTOLUENE	0.300 U	0.50	0.300	0.133	ug/L	11/21/13	11/22/13
EPA 8330B	4-AMINO-2,6-DINITROTOLUENE	0.300 U	0.50	0.300	0.100	ug/L	11/21/13	11/22/13
EPA 8330B	4-NITROTOLUENE	0.300 U	0.50	0.300	0.133	ug/L	11/21/13	11/22/13
EPA 8330B	HMX	0.300 U	0.50	0.300	0.115	ug/L	11/21/13	11/22/13
EPA 8330B	NITROBENZENE	0.300 U	0.50	0.300	0.126	ug/L	11/21/13	11/22/13
EPA 8330B	NITROGLYCERIN	0.300 U	0.50	0.300	0.130	ug/L	11/21/13	11/22/13
EPA 8330B	PETN	1.500 U	2.50	1.500	0.607	ug/L	11/21/13	11/22/13
EPA 8330B	RDX	0.300 U	0.50	0.300	0.123	ug/L	11/21/13	11/22/13
EPA 8330B	TETRYL	0.300 U	0.50	0.300	0.133	ug/L	11/21/13	11/22/13
EPA 8330B	SURROGATE: 1,2-DINITROBENZENE (	104	70-130			%	11/21/13	11/22/13

Quant Method: W130907.M
Run #: 1120_000085
Instrument: Waldorf
Sequence: 131120
Dilution Factor: 1
Initials: PY

Printed: 12/12/13 12:57:57 PM
APPL-F1-SC-NoMC-REG MDLs

1/4/14

EPA 8321A PICRIC ACID-IS SOIL UN

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 72181

Sample ID: VE-UXO18-01SMI01-1113A

APPL ID: AY89018

Sample Collection Date: 11/15/13

QCG: #PICSMIUG-131121-183244

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	120.00 U	200.0	120.00	60.00	ug/kg	11/21/13	11/28/13
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	106	50-150			%	11/21/13	11/28/13

Quant Method: 83PICY27.M
Run #: LY27_071.D
Instrument: AGIL_1100
Sequence: LQ112713
Dilution Factor: 1
Initials: MP

Printed: 12/04/13 3:00:23 PM
APPL-F1-SC-NoMC-REG MDLs

1/4/14

EPA 8321A PICRIC ACID-IS SOIL UN

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 72181

Sample ID: VE-UXO18-01SMI01T-1113A

APPL ID: AY89020

Sample Collection Date: 11/15/13

QCG: #PICSMIUG-131121-183244

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	120.00 U	200.0	120.00	60.00	ug/kg	11/21/13	11/28/13
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	104	50-150			%	11/21/13	11/28/13

Quant Method: 83PICY27.M
Run #: LY27_072.D
Instrument: AGIL_1100
Sequence: LQ112713
Dilution Factor: 1
Initials: MP

Printed: 12/04/13 3:00:23 PM
APPL-F1-SC-NoMC-REG MDLs

12/4/14

EPA 8321A PICRIC ACID-IS SOIL UN

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 72181

Sample ID: VE-UXO18-01SMI01TT-1113A

APPL ID: AY89022

Sample Collection Date: 11/15/13

QCG: #PICSMIUG-131121-183244

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	120.00 U	200.0	120.00	60.00	ug/kg	11/21/13	11/28/13
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	103	50-150			%	11/21/13	11/28/13

Quant Method:	83PICY27.M
Run #:	LY27_073.D
Instrument:	AGIL_1100
Sequence:	LQ112713
Dilution Factor:	1
Initials:	MP

Printed: 12/04/13 3:00:24 PM
APPL-F1-SC-NoMC-REG MDLs

1/4/14

EPA 8321A PICRIC ACID-IS SOIL UN

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 72181

Sample ID: VE-UXO18-01SMI02-1113A

APPL ID: AY89024

Sample Collection Date: 11/15/13

QCG: #PICSMIUG-131121-183244

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	120.00 U	200.0	120.00	60.00	ug/kg	11/21/13	11/29/13
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	102	50-150			%	11/21/13	11/29/13

Quant Method: 83PICY27.M
Run #: LY27_074.D
Instrument: AGIL_1100
Sequence: LQ112713
Dilution Factor: 1
Initials: MP

Printed: 12/04/13 3:00:24 PM
APPL-F1-SC-NoMC-REG MDLs

1/4/14

EPA 8321A Picric Acid-Water

CH2M Hill
15010 Conference Center Drive;
Chantilly, VA 20151

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Attn: Michael Zamboni

Project: 424191.FI.FK.04 Vieques CTO 005

ARF: 72181

Sample ID: VE-UXO18-EB01-111513

APPL ID: AY89025

Sample Collection Date: 11/15/13

QCG: #PICW-131121B-183243

Method	Analyte	Result	LOQ	LOD	DL	Units	Extraction Date	Analysis Date
EPA 8321A	PICRIC ACID/AMMONIUM PICRATE	0.12 U	0.2	0.12	0.06	ug/L	11/21/13	11/28/13
EPA 8321A	SURROGATE: 1,2-DINITROBENZENE (	96.8	50-150			%	11/21/13	11/28/13

Quant Method: 83PICY27.M
Run #: LY27_063.D
Instrument: AGIL_1100
Sequence: LQ112713
Dilution Factor: 1
Initials: MP

Printed: 12/04/13 3:00:24 PM
APPL-F1-SC-NoMC-REG MDLs

fegett
1/4/14

Appendix B

Support Documentation

152

ELECTRONIC CHAIN OF CUSTODY RECORD

APPL, Inc.
908 N Temperance Ave
Clovis, CA 93611

Phone: (559) 275-2175
Fax: (559) 275-4422
C.O.C. 2013111513-APPL-1

Report to: PLEASE PRINT
Company Name: CH2M HILL Phone: 703-376-5301
Address: 15010 Conference Center Drive, Suite 200
Chantilly, VA 20151 Fax: 703-376-5801
Attn: Michael Zamboni

Invoice to: PLEASE PRINT
Company Name: See Contact Phone:
Address:
Fax:
Attn:

Project Name/Number: CTO-005 VE
Purchase Order Number: 951152
Sampler (Print): Troy Horn
Sampler (Signature):

Date Shipped: 11/15/13
Carrier: FedEx
Waybill No.:
Comments: resampled due to QC failure

Sample Identification	Location	Date Collected	Time Collected	Time Zone	No. of Containers	Matrix: Aq	Matrix: Sed.	Matrix: Soil		SW-846 8330 Est pub MS pur HCTH no 35-0/4	SMI Processing MOD #1	SW-846 8321 Picric Acid										Comments
VE-UXO18-01SMI01-1113		11/15/13	0900	AST	1			✓		X	X	X										
VE-UXO18-01SMI01T-1113		11/15/13	0900	AST	1			✓		X	X	X										
VE-UXO18-01SMI01TT-1113		11/15/13	0900	AST	1			✓		X	X	X										
VE-UXO18-01SMI02-1113		11/15/13	1000	AST	1			✓		X	X	X										MS/MSD
VE-UXO18-EB01-111513		11/15/13	1130	AST	5	✓				X	X	X										
									✓													Associated w/ SMI
									✓													
									✓													
									✓													
									✓													

Shuttle Temperature:

Turnaround Requested: Check one ☐ Standard 2-3 wk ☐ One week ☐ 24/48 Hrs. ☑ Other 28Day TAT

Sample Disposal: ☐ Return to client ☐ Disposal by Lab (30-day retention)

Relinquished by:	Date	Time	Received by:	Relinquished by:	Date	Time	Received by:
	11/15/13	1330					
Relinquished by:	Date	Time	Received by:	Relinquished by:	Date	Time	Received at lab by:
					11/16/13	11:28	

White: Return to client with report Yellow: Laboratory Copy Pink: Sampler

Note: The first sampled date of the ARF will be used as the COC number unless indicated otherwise.

COOLER RECEIPT FORM

1) Job: 424191.F1.FK.04 Vieques CTO 005 Date Received: 11/16/13

2) Coolers: Number of Coolers: 1

3) YES NO NA Were custody seals present and intact? TW 11/18/13

How many? 3 Name/Date on seal? See Below

4) YES NO NA Was there a shipping slip? Carrier name: Fed Ex

5) Circle type of packing in cooler:

bubble wrap popcorn foam plastic bags wet ice dry ice no ice gel ice unwrapped other

6) YES NO NA Were cooler temperatures acceptable? YL 11/18/13

7) Serial number of certified NIST thermometer used: ~~A39267~~ J5297

8) Cooler temp(s):

1) 1.5°C	2) °C	3) °C	4) °C	5) °C	
6) °C	7) °C	8) °C	9) °C	10) °C	

Chain of custody:

9) YES NO NA Was a chain of custody received?

10) YES NO NA Were the custody papers complete/signed in the appropriate places?

Sample Labels:

11) YES NO NA Were all sample labels complete (sample ID, date/time of sampling, etc.)?

12) YES NO NA Did all container labels agree with custody papers?

Sample Containers:

13) YES NO NA Were all containers sealed in separate bags?

14) YES NO NA Did all containers arrive in good condition:(unbroken, no leakage, no cracked/broken lids)?

15) YES NO NA Were correct containers and preservatives used for the tests indicated?

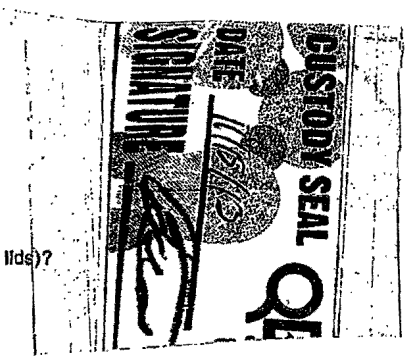
16) YES NO NA Was a sufficient amount of sample sent for tests indicated?

17) YES NO NA Were bubbles present in volatile samples?

If yes, the following were received with air bubbles:

Larger than a pea:

Smaller than a pea:



Preservation & Hold time:

18) YES NO NA Was a sufficient amount of holding time remaining to analyze the samples?

19) YES NO NA Was the pH taken of all non-VOA preserved samples and written on the sample container?

20) YES NO NA Was the pH of acid preserved non-VOA samples < 2?

21) YES NO NA Was the pH of sodium hydroxide preserved samples for Cyanide > 12 and Sulfide >9?

22) YES NO NA Were unpreserved VOA Vials received?

23) YES NO NA Are unpreserved VOA vials noted in the ADD TEST FIELD on the ARF?

pH strip lot number AC270245

Lab notified if pH was not adequate:

Notes/Deficiencies: Sample A4 89025 We Received 2 Ambe liter, 2 125mL Plastic, and 1 500mL HNO3. On The C.O.C Only List Analyses Codes For The amber liters.

Personnel receiving samples: [signature] Second reviewer: [signature]

Personnel labeling samples:

Project manager notified: Renée Date/Time of notification: 11-18-13

Name of client notified: Date/Time of notification:

Revision: 22, November 5, 2013

Sample receipt information

ARF: 72181

Project: 424191.F1.FK.04 Vieques CTO 005

Sample Receipt Information:

The samples were received on November 16, 2013, at 1.5°C. The samples were assigned Analytical Request Form (ARF) number 72181. The sample numbers and requested analyses were compared to the chain of custody and email communications. Hand-ground picric acid samples and laboratory duplicates and triplicates were added. Extra containers were received for the EB sample, and on the COC, SMI analysis was checked; the client was notified. No other exception was encountered.

Sample Table

CLIENT ID	APPL ID	Matrix	Date Sampled	Date Received
VE-UXO18-01SMI01-1113	AY89017	SOIL	11/15/13	11/16/13
VE-UXO18-01SMI01-1113A	AY89018	SOIL	11/15/13	11/16/13
VE-UXO18-01SMI01T-1113	AY89019	SOIL	11/15/13	11/16/13
VE-UXO18-01SMI01T-1113A	AY89020	SOIL	11/15/13	11/16/13
VE-UXO18-01SMI01TT-1113	AY89021	SOIL	11/15/13	11/16/13
VE-UXO18-01SMI01TT-1113A	AY89022	SOIL	11/15/13	11/16/13
VE-UXO18-01SMI02-1113	AY89023	SOIL	11/15/13	11/16/13
VE-UXO18-01SMI02-1113A	AY89024	SOIL	11/15/13	11/16/13
VE-UXO18-EB01-111513	AY89025	WATER	11/15/13	11/16/13
VE-UXO18-01SMI01B-1113	AY89041	SOIL	11/15/13	11/16/13
VE-UXO18-01SMI01C-1113	AY89042	SOIL	11/15/13	11/16/13
VE-UXO18-01SMI01B-1113A	AY89043	SOIL	11/15/13	11/16/13
VE-UXO18-01SMI01C-1113A	AY89044	SOIL	11/15/13	11/16/13

The samples and blanks were screened for J-value responses between the detection limit (DL) and limit of quantitation (LOQ).

APPL's laboratory control limits generated in house statistically do not meet the control limits listed in DoD QSM 4.2 for all analytes. Laboratory control spike recoveries for this project meet all control limits listed in the DoD QSM 4.2 except where noted. A copy of our in house generated control limits is available upon request. In addition, a copy of our LOQ control limits, established using 7 data points, are also available upon request.

Only the portion of the injection log relative to these samples is included. A full sequence log is available upon request.

Measurement uncertainty can be reported upon request.

EPA Method 8330B
Explosives

Sample Preparation:

The soil samples were designated for incremental sampling; they were dried, mechanically ground, and incrementally sampled according to EPA method 8330B, Appendix A, then extracted according to EPA method 8330B. The water sample was extracted according to EPA method 3535A. All holding times were met.

Analysis:

The samples were analyzed according to EPA Method 8330B using an Agilent 1290 HPLC with DA detector. Manual integrations were performed in accordance with APPL's SOP. The following analytes were manually integrated in the calibration standards: HMX, Nitroglycerin, RDX and PETN. PETN was manually integrated in sample VE-UXO18-EB01-111513. Nitroglycerin was manually integrated in the MS/MSD. Chromatograms of before and after manual integration are enclosed.

Quality Control/Assurance:

Spike Recovery

Laboratory Control Spikes (LCS) were used for quality assurance. All spike acceptance criteria were met.

Sample VE-UXO18-01SMI02-1113 was designated by the client for MS/MSD analysis. Due to the matrix, four analytes recovered above the upper control limit. All other spike recoveries were acceptable.

Method blanks:

No target analyte was detected above one-half the limit of quantitation (LOQ) in the method blanks.

Surrogates:

Surrogate recoveries are summarized on the form 2 & 8. All surrogates had acceptable recoveries.

Laboratory Duplicate and Triplicate:

Sample VE-UXO18-01SMI01-1113 was prepared and analyzed as laboratory duplicate/triplicate.

Calibration:

The initial and continuing calibrations and second source (ICV) were analyzed according to the method. All calibration criteria were met.

Summary:

No other analytical problem was encountered. The data generated are acceptable.

EPA Method 8321A
Picric Acid

Sample Preparation:

The water sample was extracted according to EPA method 3535A. The soil samples were designated for incremental sampling; they were dried, hand-ground and incrementally sampled according to EPA method 8330B, Appendix A, then extracted according to EPA method 8330B. All holding times were met.

A soil PE sample was prepared in the laboratory by spiking 100g of blank soil with 0.4mL of 100ppm picric acid standard. The 100g aliquot was then hand-ground using the same criteria for grinding and sub-sampling as was used for the samples.

Analysis:

The samples were analyzed according to EPA Method 8321A using an Agilent 1100 HPLC with Mass Spec detector and an Agilent 1290 HPLC with DA detector. Manual integrations were performed in accordance with APPL's SOP. Picric Acid and 4-Nitrophenol were manually integrated in the calibration standards samples, the LCS, and the MS/MSDs. Chromatograms of before and after manual integration are enclosed.

Quality Control/Assurance:

Spike Recovery

Laboratory Control Spikes (LCS) were used for quality assurance. All spike acceptance criteria was met.

Sample VE-UXO18-01SMI02-1113A was used for the MS/MSD analysis. All spike acceptance criteria were met.

A Performance Evaluation spike was also used for quality assurance. The PE sample had acceptable recoveries.

Method blanks:

No target analyte was detected above one-half the limit of quantitation (LOQ) in the method blanks.

Surrogates:

Surrogate recoveries are summarized on the Form 2 & 8. All surrogates had acceptable recoveries. The surrogates were analyzed on a separate run sequence, since the surrogates require different instrument parameters than picric acid.

Laboratory Duplicate and Triplicate:

Sample VE-UXO18-01SMI01-1113A was prepared and analyzed as the mechanically ground laboratory duplicate/triplicate.

Calibration:

The initial and continuing calibrations and second source were analyzed according to the method. All calibration criteria were met.

Summary:

No other analytical problem was encountered.

Renee Patterson 72181

From: Cynthia Clark [cclark@applinc.com]
Sent: Friday, November 15, 2013 9:01 AM
To: 'Renée Patterson'; 'Paula Young'; 'MIS'
Subject: FW: Vieques SMI Samples to be received Saturday
Attachments: 20131115_VQS_UXO18_resamples_COC.pdf; CH2M Hill CTO005 special instructions rev 11-8-13.doc

here is the COC for the SMI samples to be received tomorrow.
These need to be logged in with two AY#s each - one with an "A" at the end.
The first sample will be logged in for explosives only, the "A" sample will be logged in for Picric acid - unground

I have re-attached the revised special IS instructions, which describes the "MOD-1" MIS procedures.

Renee, will you please add a PE sample to the comments of one of the "A" samples? And, since these will be a new batch, lets add a triplicate as well (one for explosives and one for PA)

Paula - we will receive more of these resamples next week, let's try to keep them all batched together.

Thanks!!

Sincerely,

Cynthia Clark, Project Manager

APPL Inc. will be closed for the holidays November 28-29, December 24, 25, 31 and January 1st.

APPL, Inc.
908 North Temperance Ave., Clovis, CA 93611
Phone: 559-275-2175
Fax: 559-275-4422
cclark@applinc.com
www.applinc.com

This is a PRIVATE and CONFIDENTIAL message. If you are not the intended recipient, please delete without copying and kindly advise us by e-mail of the mistake in delivery. NOTE: Regardless of content, this e-mail shall not operate to bind APPL, Inc. to any order or other contract unless pursuant to explicit written agreement or government initiative expressly permitting the use of e-mail for such purpose.

From: Juliana.Dean@ch2m.com [mailto:Juliana.Dean@ch2m.com]
Sent: Friday, November 15, 2013 8:34 AM
To: cclark@applinc.com
Cc: Michael.Zamboni@ch2m.com
Subject: Vieques SMI Samples

Hi Cynthia,

Attached is the COC for Vieques UXO samples to be received tomorrow. A few notes on these:

- These are the UXO 18 samples that were rejected for 8330 due to the 12 hour CCV exceedance so they only need to reanalyzed for 8330 and picric acid. The picric acid should follow MOD #1 as the COC states.
- As discussed, we need another ground LCS analyzed following MOD #1 for picric acid. There should be more resamples collected next week so if you want to hold these to batch them, that will work fine.
- Obviously, the EB does not need SMI processing ☺.

CH2M Hill CTO-005 MIS procedure

Note: **Lab Triplicates** will be performed for all Incrementally Sampled analyses. Please batch carefully and include one triplicate per batch of 20 samples – Lab designated

1. The sample is dried.
2. The sample is #10 sieved. If necessary, a mortar and pestle is used to break up soil.
3. Calculate how much soil does **not** require mechanical grinding (depending on the requested analyses):
    a. 10g for 6010/6020 metals.
    b. 10g for HexCr.
    c. 30g for SVOCs.
    d. 5g for TOC
    e. 50g for pH
    f. 10g for ORP (subcontracted to ALS-Kelso)

   Multiply by 2 and Subsample (30 or more increments) to get this **total** amount (take out twice that needed for analytical preparation).
4. **Hand-grind (Mortar/Pestle: equipment suitable for metals) the soil from step 3, above.**
5. Subsample (30 or more increments) from the soil which has been hand-ground for each of the requested analyses. Place remaining hand ground soil in a clearly labeled jar or bag for use if re-extraction is required.
6. The remainder of the soil is mechanically-ground with the puck mill grinder (one 90s session per SOP). **Grinder Blanks** to be run between each sample and composited as Method Blank
7. Subsample (30 or more increments) the soil which has been mechanically-ground via puck mill as described in 8330B.
    a. 10g for Explosives.
    b. 0g for Picric acid (same extraction as for explosives).
    c. 10g for perchlorate.

CRM /spiked LCSs

Each site will require 1 pre-grind CRM or spiked LCS for the mechanically ground analyses (This includes explosives, Tetryl, Picric Acid and Perchlorate).

- Explosives and Tetryl: Use 100g for each CRM

Picric Acid and Perchlorate: the lab will spike 100g of clean sand to be ground, incrementally sampled and analyzed as a Lab Control Spike, in addition to the routine post-grind LCS

MODIFICATION TO MIS PROCEDURE BEGINNING NOVEMBER 2013:

- Picric Acid for **new** Incremental samples will be analyzed in two ways.
    1. Once as listed above
    2. Once from a handground portion similar to metals.

  Samples to be analyzed using the handground portion will use $PICSMI**UG** and _MSE018MIS**UG** and will be assigned a separate sample ID ending with an "A". There will be TWO AY#s assigned to each sample.
- Additionally, CH2M Hill will be resampling some samples which previously had a failing ground PE sample. These should arrive close enough together that we they can be batched together. This batch will need to conatin a triplicate and a lab spiked LCS that is spiked PRIOR TO THE HAND GRINDING PROCEDURE
- Please see the attached email and contact Cynthia with any questions

Special extraction/Digestions
Perchlorate: Use a 10g extraction amount for ALL soil samples (MIS and grab)
Walkley Black – use 5g extraction for MIS samples
Hex Chrom: use 10g extraction for MIS samples: new extraction code _3060A10G

Financial penalties after 28 days

Metals lists

Matrix:	SB, SS, SD, SMI and associated EBs	Matrix:	SW (surface water and SW EBs)
Wksht 15-3 metals		Wksht 15-7 metals	
6010	Al,Ba,Be,Ca,Cu,Fe,Pb,Mg,Mn,Ni,K, Na,V,Zn	6010	Al,Ba,Ca,Fe,Pb,Mg,Mn,Ni,K,Na, V,Zn
6020	Sb,As,Cd,Cr,Co,Se,Ag,Tl	6020	Sb,As,Be,Cd,Cr,Co,Cu,Se,Ag,Tl

---

From: Dean, Juliana/VBO
Sent: Tuesday, October 22, 2013 8:45 AM
To: 'Cynthia Clark' .
Cc: Zamboni, Michael/WDC
Subject: Picric Acid SMI Processing

Hi Cynthia,

I just wanted to outline the new SMI processing that was discussed with Mike so we all have it for our records.

We are resampling some SMI samples for UXO 9, 10, 14, 18, where the ground LCS was outside acceptance limits. The following procedure will be followed. In addition, a new ground LCS will need to be analyzed per site, following this new procedure. Only one additional ground LCS (to be associated with all samples) will need to be prepared following this modification to the SMI processing. This also ONLY needs to be spiked for picric acid.

1. **No change to field procedures except mark COC for "SMI Processing MOD #1". This replaces "Add. 2 WS #28-0 SMI Processing prior to analysis".**
2. **The laboratory shall treat picric acid like one of the metals. An aliquot is removed prior to machine grounding. That aliquot is then hand-ground.**
3. **Picric acid shall be a separate extraction from explosives (UFP-SAP describes picric acid from same extraction as explosives).**
    a. **Lab creates a new sample for the picric acid fraction only. For reporting hand-ground picric acid, tack an "A" onto the end of the sample ID and use the same date/time collected.**
4. **Although picric acid is treated similar to metals, these samples will not actually require metals analysis. They are resampled for 8330B (and then picric acid if SMI and if that is rejected as well).**

5. The laboratory should narrate that the SMI processing procedure was modified from that described in the UFP-SAP.

There are still a handful (~5-10) of SMI samples that have not yet been collected in UXO 12 and UXO 14. The following procedure will be followed for these samples.

1. No change to field procedures except mark COC for "SMI Processing MOD #2". This replaces "Add. 2 WS #28-0 SMI Processing prior to analysis".
2. When removing an aliquot prior to grinding (for metals, WCHEM, etc.) also include an aliquot for picric acid. This is hand-ground.
    a. Picric acid shall be a separate extraction from explosives (UFP-SAP describes picric acid from same extraction as explosives).
    b. Lab creates a new sample. For reporting hand-ground picric acid, tack an "A" onto the end of the sample ID and use the same date/time collected.
3. Picric acid is then also ground, extracted (with 8330B), and analyzed as usual. A new ground LCS should also be prepared following these procedures *for picric acid only* since the UXO 14 ground LCS was already analyzed and recovered outside of acceptance limits. Again, only one LCS is needed to be associated with all of the remaining samples (it should just be one batch).
4. The laboratory should narrate that the SMI processing procedure was modified from that described in the UFP-SAP. This only applies to the additional picric acid analysis, though.

Just let me know if you have any questions!

Thank you!

Juliana Dean

Chemist I
CH2M Hill
5701 Cleveland St, Suite 200
Virginia Beach, VA 23462
757-671-6232

Matrix Spike Recoveries

EPA 8330B EXPLOSIVES-SOIL

APPL ID: **131121S-89023 MS - 183460**
Batch ID: #833BS-131121A
Sample ID: AY89023
Client ID: VE-UXO18-01SMI02-1113

APPL Inc.
908 North Temperance Avenue
Clovis, CA 93611

Compound Name	Spike Lvl mg/kg	Matrix Result mg/kg	SPK Result mg/kg	DUP Result mg/kg	SPK % Recovery	DUP % Recovery	Recovery Limits	RPD %	RPD Limits
1,3,5-TRINITROBENZENE	2.00	ND	1.86	1.81	93.0	90.5	75-125	2.7	20
1,3-DINITROBENZENE	2.00	ND	1.92	1.87	96.0	93.5	80-125	2.6	20
2,4,6-TRINITROTOLUENE	2.00	ND	2.01	1.95	100	97.5	55-140	3.0	20
2,4-DINITROTOLUENE	2.00	ND	3.70	3.51	185 #	176 #	80-125	5.3	20
2,6-DINITROTOLUENE	2.00	ND	4.01	3.96	201 #	198 #	80-120	1.3	20
2-AMINO-4,6-DINITROTOLUENE	2.00	ND	2.08	2.02	104	101	80-125	2.9	20
2-NITROTOLUENE	2.00	ND	1.91	1.87	95.5	93.5	80-125	2.1	20
3-NITROTOLUENE	2.00	ND	2.46	2.43	123 #	122 #	75-120	1.2	20
4-AMINO-2,6-DINITROTOLUENE	2.00	ND	2.05	1.99	102	99.5	80-125	3.0	20
4-NITROTOLUENE	2.00	ND	1.97	1.93	98.5	96.5	75-125	2.1	20
HMX	2.00	ND	1.69	1.70	84.5	85.0	75-125	0.59	20
NITROBENZENE	2.00	ND	2.02	1.97	101	98.5	75-125	2.5	20
NITROGLYCERIN	2.00	ND	2.08	2.08	104	104	68-131	0.0	20
PETN	2.00	ND	43.3	41.0	2165 #	2050 #	69-132	5.5	20
RDX	2.00	ND	1.80	1.75	90.0	87.5	70-135	2.8	20
TETRYL	2.00	ND	1.55	1.46	77.5	73.0	10-150	6.0	20
SURROGATE: 1,2-DINITROBENZENE (S)	2.00	NA	2.03	1.97	101	98.5	70-130		

= Recovery is outside QC limits.

Comments:

Primary	SPK	DUP
Quant Method :	W130907.M	W130907.M
Extraction Date :	11/21/13	11/21/13
Analysis Date :	11/22/13	11/22/13
Instrument :	Waldorf	Waldorf
Run :	1120_000090	1120_000091
Initials :	PY	

Printed: 12/12/13 12:57:54 PM
APPL MSD SCII

Appendix C

Data Validation Checklists

YES NO N/A

PACKAGE COMPLETENESS AND DELIVERABLES

CASE NUMBER:_____ SDG# 72181

LAB: APPL Inc SITE: Vieques

METHODS VALIDATED: 8330 & 8321A

1.0 Introduction

1.1 The attached Standard Operating Procedure (SOP) is applicable to nitro substituted aromatic and nitro substituted amines by High Performance Liquid Chromatography (HPLC)data. Its scope is not only to facilitate the data validation process of the data reported by the contracting laboratory, but also to ensure the data is being reviewed in a uniform manner.

1.2 This SOP is based upon the quality control assurance requirements specified in analytical SW 846 Method 8330A Revision 1, January 1998, and the National Function Guidlines, January 2005.

2.0 Responsibilities

2.1 The reviewer must be knowledgeable of the analytical method and its criteria.

2.2 The reviewer must complete and/or file the following:

Data Assessment Checklist - The data reviewer evaluates Each criterion carefully and checks if data is in compliance, non-compliace or not applicable.

Data Assessment Narrative - The data reviewer must present professional judgement, address areas of concern and comment on the validity of the overall data package. The reviewer must explain the reasons for rejecting and or qualifying the data.

Telephone Record Log - All phone conservations must be transcribed by the reviewer. Upon completion of the data review, the original telephone log is attached to the data assessment narrative.

YES NO N/A

3.0 Data Completeness and Deliverables

3.1 Has all the data been submitted in CLP deliverable format? [✓] ___ ___

3.2 Have any missing deliverables been received and added to the data package? [ ] [✓] ___

ACTION: Call lab for explanation/resubmittal of any missing deliverables. If lab cannot provide them, note the effect on review of the data in the reviewer narrative.

4.0 Cover Letter, SDG Narrative

4.1 Is a laboratory narrative or cover letter present? [✓] ___ ___

4.2 Are the case number and/or SDG number contained in the narrative or cover letter? [✓] ___ ___

5.0 Data Validation Checklist

5.1 Does this data package contain:

Water data? [✓] ___ ___

Waste data? [ ] ___ [✓]

Soil/solid data? [✓] ___ ___

6.0 Traffic Reports and Laboratory Narrative

6.1 Are traffic report and chain-of-custody forms present for all samples? [✓] ___ ___

ACTION: If no, contact lab for replacement of missing or illegible copies.

6.2 Do the traffic reports, chain-of-custody forms or SDG narrative indicate any problems with sample receipt, condition of the samples, analytical problems or

YES NO N/A

special circumstances affecting the quality of the data? ___ [✓] ___

ACTION: If any sample analyzed as a soil, contains 50%-90% water, all data should be qualified as estimated, "J." If a soil sample contains more than 90% water, non detects shall be qualified as unusable, "R."

ACTION: If samples were not iced or if the ice was melted upon arrival at the laboratory and the temperature of the cooler was elevated (> 10° C), flag all positive results "J" and all non-detects "UJ".

7.0 Special QC *-VCS1

7.1 Prior to preparation of stock solutions; acetonitrile, methanol, and water should be analyzed to determine possible interferences with analyte peaks. A different batch of solvent should be used if contamination is present.

7.2 Chromatograms are to be submitted showing that there are no interferences with analyte peaks.

Are these chromatograms present in package? [ ] ___ [✓]

Are the chromatograms free of interferences? [ ] ___ ___

Action: Ask lab for resubmittals. If deliverables are unavailable, judge the effect of the validity of the data. If questionable, contact SMO and note in data assessment.

8.0 Holding Times

8.1 Have any nitroaromatics and nitroamines technical holding times, determined from date of collection to date of extraction, been exceeded? ___ [✓] ___

Water and waste samples must be properly perseved (cooled to 4° +/- 2°), and nitro substituted aromatics and amines analysis must be extracted within 7 days of the date of collection. Extracts must be analyzed within 40 days of

YES NO N/A

the date of extraction. Soils and solid samples must be extracted within 14 days of collection and analyzed within 40 days of extraction.

ACTION: If technical holding times are exceeded, flag all positive results as estimated, "J," and sample quantitation limits "UJ" and document in the narrative that holding times were exceeded. If analyses were done more than 14 days beyond holding time, either on the first analysis or upon re-analysis, the reviewer must use professional judgement to determine the reliability of the data and the effects of additional storage on the sample results. At a minimum, all the data should at least be qualified "J", but the reviewer may determine that non-detects are unusable,"R." (Table 1)

Table 1. Holding Time Criteria

Matrix	Preserved	Criteria	Action	
			Detected compounds	Non-detected compounds
Aqueous	No	≤ 7 days(extraction) ≤ 40 days(analysis)	Use professional judgement	
	No	> 7 days(extraction) > 14 days(analysis)	Use professional judgement	
	Yes	≤ 7 days(extraction) ≤ 40 days(analysis)	No qualification	
	Yes	> 7 days(extraction) > 40 days(analysis)	J	UJ
	Yes/No	Grossly exceeded	J	UJ or R
Non-aqueous	No	≤ 14days(extraction) ≤ 40 days (analysis)	Use professional judgement	
	No	> 14days(extraction) >40 days(analysis)	Use professional judgement	
	Yes	≤ 14days(extraction) ≤ 40 days(analysis)	No qualification	
	Yes	> 14days(extraction) > 40 days(analysis)	J	UJ
	Yes/No	Grossly Exceeded	J	UJ or R

YES NO N/A

9.0 Surrogate Recovery (Form II)

9.1 The analyst most monitor the performance of the extraction and analytical system as well as the effectiveness of the method in dealing with each sample matrix by spiking each sample, standard and reagent water blank with one or two surrogates (e.g., analytes not expected to be present in the sample).

9.2 Were the recoveries of the surrogate spikes presented on CLP Surrogate Recovery Summary forms (Form II), or equivalent, for each of the following matrices?

a. Water/Waste [✓] ___ ___
b. Soil/Solid [ ] ___ ___

ACTION: Call lab for explanation/resubmittals. If missing deliverables or information are unavailable, document the effect in the data assessment.

9.3 Are all the pesticide samples listed on the appropriate surrogate recovery form for each of the following matrices?

a. Water [✓] ___ ___

b. Waste [ ] ___ ✓

c. Soil/Solid [✓] ___ ___

9.4 The laboratory must evaluate the surrogate data from individual samples versus the surrogate control limits developed by the laboratory. Method 8000C, Sec 9.0 details evaluating surrogate data and updating surrogate limits. If laboratory established recovery limits are not established, use surrogate recovery between 70 - 130% for all samples, including MS, MSDs, LCSs, and all blanks. Are surrogate recovery limits met? [✓] ___ ___

ACTION: Circle all outliers in red. Follow surrogate action Table 2.

YES NO N/A

9.5 Were surrogate retention times (RT) within the windows established during the initial 5-point analysis? [✓] ___ ___

ACTION: Follow surrogate action, Table 2 below.

Table 2. Surrogate Recovery Criteria

Criteria	Action	
	Detected Target Compounds	**Non-detected Target Compounds**
%R > 200%	J	Use professional judgement
130% < %R ≤ 200%	J	No qualification
70% ≤ %R ≤ 130%	No qualification	
10% ≤ %R < 70%	J	UJ
%R < 10% (sample dilution not a factor)	J	R
%R < 10% (sample dilution is a factor)	Use professional judgement	
RT out of RT window	Use professional judgement	
RT within RT window	No qualification	

9.6 Are there any transcription/calculation errors between raw data and Form II? [ ] [✓] ___

ACTION: If large errors exist, call lab for explanation/resubmittal. Make any necessary corrections and document the effect in data assessments.

10.0 Laboratory Control Sample

10.1 Is the LCS prepared, extracted, analyzed, and reported once for every 20 field samples of a similar matrix, per SDG. [✓] ___ ___

YES NO N/A

ACTION: If any Laboratory Control Sample data are missing, call the lab for explanation/ resubmittals. Make note in the data assessment.

10.2 Are raw data and percent recoveries present for all Laboratory Control samples as required by Method 8000C (section 9.5). [✓] ___ ___

Verify that QC check samples were extracted and analyzed by the same procedures used for the actual samples.

ACTION: If any Laboratory Control Sample data are missing, call the lab for explanation/ resubmittals. Make note in the data assessment.

Note: When the results for matrix spike analysis indicates a problem due to sample matrix effects, the LCS results are used to verify the laboratory can perform the analysis in a clean sample.

10.3 Were the Laboratory Control Samples analyzed for all the nitroaromatics and nitroamines analytes that the samples are analyzed for.
[✓] ___ ___

10.4 Were Laboratory Control Samples analyzed at the required concentration as specified in Method 8000C(sec 9.5)(near the middle of the calibration range) for all target analytes.
[✓] ___ ___

ACTION: If Laboratory Control Samples were not analyzed at the required concentration or the required frequency, make note in the data assessment and use professional judgement to determined the affect on the data.

10.5 Did laboratory calculate in-house performance criteria for LCS recoveries according to Method 8000C section 9.7, and were recoveries met?
[✓] ___ ___

10.6 If in house LCS recoveries performance criteria were not generated, the laboratory should use 70 - 130% criteria, and was this criteria met? [ ] ___ ✓

10.7 If LCS recovery criteria were not met, were Laboratory Control Samples re-analyzed?
[ ] ___ ✓

YES NO N/A

ACTION: If QC check samples were not re-analyzed, or a general system problem is indicated by repeated failure to meet the QC acceptance criteria specified in the method, make note in the data assessment and use Table 3 recovery actions criteria.

Table 3. LCS Recovery Actions

Criteria	Action	
	Detected Associated Compounds	**Non-Detected Compounds**
%R > Upper Acceptance Limit	J	No qualification
%R < Lower Acceptance Limit	J	R
Lower Acceptance Limit ≤ %R ≤ Upper Acceptance Limit	No qualifications	

11.0 Matrix Spikes (Form III)

11.1 Are all data for one matrix spike and matrix duplicate (unspiked) pair (MS/Dup) or matrix spike/matric spike duplicate (MS/MSD)present and complete for each matrix. [✓] ___ ___

NOTE: For soil and waste samples showing detectable amounts of organics, the lab may substitute replicate samples in place of the matrix spike spike.

11.2 Have MS/Dup or MS/MSD results been summarized on modified CLP Form III? [✓] ___ ___

ACTION: If any data are missing take action as specified in section 3.2 above.

11.3 Were matrix spikes analyzed at the required frequency for each of the following matrices? (One MS/Dup, MS/MSD must be performed for every 20 samples of similar matrix or concentration level.

a. Water [✓] ✓ ___
b. Waste [ ] ___ ___
c. Soil/Solid [✓] ___ ___

ACTION: If any MS/Dup or MS/MSD data are missing,take the action specified in 3.2 above.

11.4 Were the Matrix Spike Samples spiked and analyzed for all the nitroaromatics and nitroamines analytes that the samples are analyzed for (Same analytes as LCS). [✓] ___ ___

YES NO N/A

ACTION: If no, did the lab use the optional QC acceptance criteria discussed in Method 8000C(section 9.7)?

List the criteria used and make note in data assessment.

Criteria used SOP

11.5 Were Laboratory Control Samples analyzed at the required concentration as specified in Method 8000C(sec (9.5)(Same concentration as LCS) for all target analytes? [✓] ___ ___

11.6 Did laboratory calculate in-house performance criteria for matrix spike recoveries according to Method 8000C section 9.7, and were recoveries met? [✓] ___ ___

11.7 If in house LCS recoveries performance criteria were not generated, the laboratory should use 70 - 130% criteria, and was this criteria met? [ ] ___ ✓

11.8 How many matrix spike recoveries are outside the in-house performance criteria or QC limits of 70 - 130%?

NA Water out of ___ 8 Soil out of 34

11.9 How many RPDs for the Matrix Spike and Matrix Spike Duplicate (if applicable)recoveries are greater than the QC limit of 20%?

NA Water out of ___ 0 Soil out of 17

11.8 Were the matrix spike and matrix spike duplicate recovery and RPD limits met as specified in Table 4. Note: No qualification of the data is necessary on MS and MSD data alone. Use professional judgement to use the MS and MSD results in conjunction with other QC criteria to determine the need for some qualification of the data. If any MS and MSD, percent recovery, or RPD results in the nitroaromatics and nitroamines fraction is out of specification (Table 4), use professional judgement to qualify data to include the consideration of the existence interference in the raw data. In some instances it may be determined that only the replicate or spiked samples are affected. Alternatively, the data may suggest that the laboratory is having a systematic problem with one or more analytes, thereby affecting all associated samples. Use professional judgement to determine the need for qualification of detects of non-spiked compounds.

YES NO N/A

Table 4. MS/MSD Actions for Analysis

Criteria	Action	
	Detected Associated Compounds	**Non-Detected Compounds**
%R or RPD > Upper Acceptance Limit	J	No qualification
20% ≤ %R < Lower Acceptance Limit	J	UJ
%R < 20%	J	Use professional judgement
Lower Acceptance Limit ≤ %R ≤ Upper Acceptance Limit	No qualifications	

12.0 Blanks (Form IV) *-VCS2

12.1 Was reagent blank data reported on CLP equivalent Method Blank Summary form(s) (Form IV)? [✓] ___ ___

12.2 Frequency of Analysis: Has a reagent blank been analyzed for every 20 (or less) samples of similar matrix or concentration or each extraction batch? [✓] ___ ___

ACTION: If any blank data are missing, take action as specified above (section 3.2). If blank data is not available, reject (R) all associated positive data. However, using professional judgement, the data reviewer may substitute field blank data for missing method blank data.

12.3 Chromatography: review the blank raw data - chromatograms, quant reports or data system printouts.

Is the chromatographic performance (baseline stability) for each instrument acceptable for nitroaromatics and nitramines? [✓] ___ ___

13.0 Contamination

YES NO N/A

NOTE: "Water blanks", "distilled water blanks" and "drilling water blanks" are validated like any other sample and are not used to qualify the data. Do not confuse them with the other QC blanks discussed below.

13.1 Do any method/instrument/reagent/cleanup blanks have positive results for nitroaromatics or nitramines?When applied as described below, the contaminant concentration in these blanks are multiplied by the sample Dilution Factor and corrected for % moisture when necessary.

___ [✓] ___

13.2Do any field/rinse blanks have positive nitroaromatics or nitramines results?

___ [✓] ___

ACTION: Prepare a list of the samples associated with each of the contaminated blanks. (Attach a separate sheet.)

NOTE: All field blank results associated to a particular group of samples (may exceed one per case or one per day) may be used to qualify data. Blanks may not be qualified because of contamination in another blank. Field blanks must be qualified for surrogate, or calibration QC problems.

ACTION: Follow the directions in Table 5 below to qualify sample results due to contamination. Use the largest value from all the associated blanks.

Table 5. Blank Contamination Criteria

YES NO N/A

Blank Type	Blank Result	Sample Result	Action for Samples
Method, Clean up, Instrument, Field	Detects	Not detected	No qualification
	< CRQL	< CRQL	Report CRQL value with a U
		≥ CRQL	Use professional judgement
	> CRQL	< CRQL	Report CRQL value with a U
		≥ CRQL and < blank contamination	Report the concentration for the sample with a U, or quanity the data as unusable R
		≥ CRQL and ≥ blank contamination	Use professional judgement
	= CRQL	< CRQL	Report CRQL value with a U
		≥ CRQL	Use professional judgement
	Gross contamination	Detects	Qualify results as unusable R

NOTE: If gross blank contamination exists(e.g., saturated peaks, "hump-o-grams," "junk" peaks), all affected positive compounds in the associated samples should be qualified as unusable "R", due to interference. Non-detected pesticide target compounds do not require qualification unless the contamination is so high that it interferes with the analyses of non-detected compounds.

13.3Are there field/rinse/equipment blanks associated with every sample? ☑ ___ ___

ACTION: For low level samples, note in data assessment that there is no associated field/rinse/ equipment blank. Exception: samples taken from a drinking water tap do not have associated field blanks.

14.0 HPLC Apparatus and Materials

YES NO N/A

14.1 Was the proper HPLC chromatographic column used for the analysis of nitroaromatics or nitramines?

Action: Check raw data, instrument logs, or contact the lab to determine what type of columns were used. (Method 8330A, section 4.1) [✓] ___ ___

14.2 Indicate the specific type of HPLC column.

column 1: Agilent

column 2: _____

ACTION: Note any changes to the suggested materials in section 14.1 above in the data assessment. Also note the impact (positive or negative) such changes have on the analytical results.

15.0 Calibration and HPLC Performance *-VCS-3,4,5

15.1 Are the following liquid chromatograms and data systems printouts for both columns present for all samples, blanks, MS, replicates?

a. Samples [✓] ___ ___
b. All blanks [✓] ___ ___

c. Matrix spike samples [✓] ___ ___
d. 5 pt. initial calibration standards [✓] ___ ___

e. Calibration verification standards [✓] ___ ___

f. Laboratory Control samples (LCS) [✓] ___ ___

ACTION: If no, take action specified in 3.2 above.

15.2 Are data summary forms (containing calibration factors or response factors) for the initial 5 pt. calibration and daily calibration verification standards present and complete for each column and each analytical sequence? [✓] ___ ___

NOTE: External standard calibration procedures are used (Method 8000C (section 11.4.2), therefore calibration factors must be used.

ACTION: If any data are missing or it cannot be determined how the laboratory calculated calibration factors, contact the lab for explanation/resubmittals. Make necessary corrections and note any problems in the data assessment.

YES NO N/A

15.3 Are there any transcription/calculation errors between raw data and data summary forms? ___ ☑ ___

ACTION: If large errors exist, call lab for explanation/resubmittal, make necessary corrections and document the effect in data assessments.

15.4 Are standard retention time (RT) windows for each nitroaromatics and nitramines peak of interest presented on modified CLP summary forms? ☑ ___ ___

ACTION: If any data are missing, or it cannot be determined how RT windows were calculated, call the lab for explanation/resubmittals. Note any problems in the data assessment.

NOTE: Retention time windows for all nitroaromatics and nitramines are established using retention times from three calibration standards analyzed during the entire analytical sequence (Method 8000C section 11.6).

Best results are obtained using retention times which span the entire sequence; i.e., using the calibration verification/continuing calibration standards analyzed every 12 hours.

15.5 Were RT windows on the confirmation column established using three standards as described above? ☑ ___ ___

NOTE: RT windows for the confirmation column should be established using a 3 pt. calibration, preferably spanning the entire analytical sequence as described in 15.4 above. If RT windows on one column are tighter than the other, this may result in false negatives when attempting to identify compounds in the samples.

ACTION: Note potential problems, if any, in the data assessment.

15.6 Do all standard retention times in each level of the initial 5 pt. calibrations for nitroaromatics and nitramines fall within the windows established during the initial calibration sequence? ☑ ___ ___

ACTION i: If no, all samples in the entire analytical sequence are potentially affected. Check to see if three standards spanning the entire sequence were used to obtained RT windows. If the lab used three standards from the 5 pt., RT windows may be too tight. If so, RT windows should be recalculated as per Method 80000C(section 11.6).

ii. Alternatively, check to see if the chromatograms contain peaks within an expanded window surrounding the expected retention times.

YES NO N/A

If no peaks are found and the surrogates are visible, non-detects are valid. If peaks are present but cannot be discerned through pattern recognition or by using revised RT windows, qualify all positive results and non-detects as unusable, "R".

15.7 Has the linearity criteria for the initial calibration standards been satisfied for both columns? (% RSD for the calibration factors (CFs)must be < 20.0% for all analytes).

[✓] ___ ___

ACTION: If no, follow Table 6 criteria.

Table 6. Initial Calibration CF Action for Nitroaromatic and Nitramine Analysis

Criteria	Action	
	Detected Associated Compounds	Non-Detected Associatedd Compounds
% RSD > 20%	J	UJ
% RSD within allowable limits	No qualifications	

15.8 Does the calibration verification/continuing calibration standard contain the nitroaromatics or nitramines peaks of interest, analyzed on each working day, prior to sample analyses?

[✓] ___ ___

15.9 Has a calibration verification/continuing calibration standard been analyzed after every 10 samples and at the end of each analytical sequence

[✓] ___ ___

ACTION: If no, take action as specified in section 3.2 above.

15.10 Has the percent difference (%D) between the Calibration Factor (CF) of the peaks used to identify the nitroaromatics and nitramines in the CCV and the CF from these peaks in the initial calibration exceeded ± 15%.

___ [✓] ___

15.11 Has a new 5 pt. initial calibration curve been generated for those nitroaromatics and nitramines analytes which failed in the calibration verification/continuing calibration

YES NO N/A

standard (8000C, section 11.7.3), and all samples which followed the out-of-control calibration verification/standard continuing calibration standard? [✓] ___ ___

ACTION: If the %D for any analyte exceeded the ± 15% criterion and the instrument was not recalibrated for those analytes, qualify positive results for all associated samples (those which followed the out-of-control standard) "J" and sample quantitation limits "UJ". (Table 7)

15.12 Have retention time (RT) windows been properly calculated for each analyte of interest (Method 8000C, section 11.6), using RTs from the associated calibration verification/continuing standard? [✓] ___ ___

ACTION: If no, take action specified in section 3.2 above

15.13 Do all standard retention times for each calibration verification/continuing calibration standard fall within the windows established during the initial calibration sequence? [✓] ___ ___

15.14 Do all standard retention times for each mid-concentration standard (analyzed after every 10 samples) fall within the daily RT windows. [✓] ___ ___

ACTION: If the answer to either 15.12 or 15.13 above is no, check the chromatograms of all samples which followed the last in-control standard. All samples analyzed after the last in-control standard must be re-injected, if initial analysis indicated the presence of the specific analyte that exceeded the retention time criteria). If samples were not re-analyzed, document under Contract Non-compliance in the Data Assessment.

Reviewer has two options to determine how to qualify questionable sample data. First option is to determine if possible peaks are present within daily retention time window. If no possible peaks are found, non-detects are valid. If possible peaks are found (or interference), qualify positive hits as presumptively present "NJ" and non-detects are rejected "R". Second option is to use the ratio of the retention time of the analyte over the retention time of either surrogate. The passing criteria is ± 0.06 RRT units of the RRT of the standard component. Reject "R" all questionable analytes exceeding criteria, and "NJ" all other positive hits.

15.15 Has no more than 14 hours elapsed from the injection of the opening CCV and the end of the analytical sequence (closing CCV). (Table 7) [✓] ___ ___

Table 7. CCV Criteria

Criteria	Action	
	Detected Associated	Non-Detected Associated

YES NO N/A

	Compounds	Compounds
RT out of RT window	Use professional judgement (Sec 15.14)	
%D not within +/- 15%	J	UJ
Time elapsed greater than section 15.15 criteria.	R	
%D, time elapsed, RT are all within acceptable limits.	No qualifications	

15.16 Are there any transcription/calculation errors between raw data and data summary forms? ___ [✓] ___

ACTION: If large errors exists call lab for explanation/resubmittal, make any necessary corrections and document the effect in data assessments under "Conclusions".

16.0 Analytical Sequence Check (Form VIII-nitroaromatics and nitramines)

16.1 Have all samples been listed on CLP Form VIII or equivalent, and are separate forms present for each column? [✓] ___ ___

ACTION: If no, take action specified in 3.2 above.

16.2 Was the proper analytical sequence followed for each initial calibration and subsequent analyses? [✓] ___ ___

Note: Sequence is as follows: 5 point initial calibration, method blank, LCS, CCS, 10 sample extracts, CCV, 10 sample extract, and so on. The sequence must always end with a CCV. As long as the first CCV is within QC, the initial calibration does not have to be rerun.

ACTION: If no, use professional judgement to determine the severity of the effect on the data and qualify it accordingly. Generally, the effect is negligible unless the sequence was grossly altered or the calibration was also out of limits.

16.3 Were the surrogate RTs for the samples within the mean surrogate RT from the initial calibration? [✓] ___ ___

Action: If no, see "Action" in section 15.14 above

17.0 Extraction Techniques for Sample Preparation

YES NO N/A

Method 8330A permits a variety of extraction techniques to be used for sample preparation. Which extraction procedure was used?

17.1 Aqueous samples:

1. Low Level (salting-out extraction)) [✓] ___ ___
2. High-level (Sample filtration) [ ] ___ ___
3. Solid phase extraction (Method 3535) [ ] ___ ___
4. Other [ ] ___ ___

17.2 Soil and sediment samples:

1. Sonication [✓] ___ ___
2. Other [ ] ___ ___

18.0 Nitroaromatics and Nitramines Identification*-VCS6

18.1 Has CLP Form X or equivalent, showing retention time data for positive results on the two HPLC columns, been completed for every sample in which a nitroaromatics or nitramines was detected? [✓] ___ ___

ACTION: If no, take action specified in 3.2 above, or compile a list comparing the retention times for all sample hits on the two columns.

18.2 Are there any transcription/calculation errors between raw data and data summary forms (initial calibration summaries, calibration verification summaries, analytical sequence summaries. ___ [✓] ___

ACTION: If large errors exist, call lab for explanation/resubmittal, make necessary corrections and note error in the data assessment.

18.3 Are retention times (RT) of sample compounds within the established RT windows for both columns/analyses? [✓] ___ ___

ACTION: Qualify as unusable (R) all positive results which were not confirmed by second HPLC column analysis. Also qualify "R", unusable, all positive results not within RT windows unless associated standard compounds are similarly biased. The reviewer should use professional judgement to assign an appropriate quantitation limit.

YES NO N/A

18.4 Check chromatograms for false negatives, especially if RT windows on each column were established differently. Were there any false negatives? ___ [✓] ___

ACTION: Use professional judgement to decide if the compound should be reported. If there is reason to believe that peaks outside retention RT windows should be reported, make corrections to data summary forms (Form I) and note in data assessment.

18.5 Is the percent difference (%D) calculated for the positive sample results on the two HPLC columns<25.0%? [ ] ___ [✓]

NOTE: The method requires quantitation from one column. The second column is to confirm the presence of an analyte. It is the reviewer's responsibility to verify from the project plan what the lab was required to report. If the lab was required to report concentrations from both columns, continue with validation for % Difference. If required, but not reported, either contact the lab for results or calculate the concentrations from the calibration. If not required, skip this section. Document actions in Data Assessment.

ACTION: If the reviewer finds neither column shows interference for the positive hits, the data should be qualified as follows:

% Difference	Qualifier
0-25%	none
26-70%	"J"
71-100%	"NJ"
101-200% (No Interference)	"R"
101-200% (Interference detected)**	"NJ"
>50% (Analyte value is <CRQL)	"U"
>200%	"R"

Note: The lower of the two values is reported on Form I. If using professional judgement, the reviewer determines that he higher result was more acceptable, the reviewer should replace the value and indicate the reason for the change in the data assessment.

19.0 Compound Quantitation and Reported Detection Limits

19.1 Are there any transcription/calculation errors in Form I results? Check at least two positive values. Were any errors found? ___ [✓] ___

YES NO N/A

NOTE: Nitroaromatics and Nitramines peak results can be checked for rough agreement between quantitative results obtained on the two HPLC columns. The reviewer should use professional judgement to decide whether a much larger concentration obtained on one column versus the other indicates the presence of an interfering compound. If an interference is suspected, the lower of the two values should be reported and qualified according to section 18.5 above. This necessitates a determination of an estimated concentration on the confirmation column. The narrative should indicate that the presence of interferences has led to the quantitation of the second column confirmation results.

19.2 Are the EDLs (Estimated Detection Limits) adjusted to reflect sample dilutions and, for soils,% moisture? [✓] ___ ___

ACTION: If errors are large, call lab for explanation/resubmittal, make any necessary corrections and document effect in data assessments.

ACTION: When a sample is analyzed at more than one dilution, the lowest EDLs are used (unless a QC exceedance dictates the use of the higher EDL data from the diluted sample analysis). Replace concentrations that exceed the calibration range in the original analysis by crossing out the value on the original Form I and substituting it with data from the analysis of diluted sample. Specify which Form I is to be used, then draw a red "X" across the entire page of all Form I's that should not be used, including any in the summary package.

ACTION: EDLs affected by large, off-scale peaks should be qualified as unusable, "R". If the interference is on-scale, the reviewer can provide a modified EDL flagged "UJ" for each affected compound.

14.0 Chromatogram Quality

14.1 Were baselines stable? [✓] ___ ___

14.2 Were any electropositive displacement (negative peaks) or unusual peaks seen? ___ [✓] ___

ACTION: Note all system performance problems in the data assessment.

15.0 Field Duplicates *VCS-7, 8

15.1 Were any field duplicates submitted for Nitroaromatics and Nitramines. [✓] ___ ___

YES NO N/A

ACTION: Compare the reported results for field duplicates and calculate the relative percent difference.

ACTION: Any gross variation between field duplicate results must be addressed in the reviewer narrative. However, if large differences exist, the identity of the field duplicates is questionable. An attempt should be made to determine the proper identification of field duplicates.

Validata Chemical Services Addendum to Explosives Checklist
Clarification of Policies Where Region II and SAP Requirements Differ
(See Numbered References in Checklist)

Analysis	Checklist Required Element	Validator Criteria and Action
Explosives (8330)		
1.	Acetonitrile, methanol and water should be analyzed prior possible interferences	Our Professional Judgment is no qualification because there is no SAP Limit.
2.	Blanks	Validata will qualify data in accordance with Region II approach.
3.	Initial Calibration (%RSD <20%)	If using ISTD calibration, %RSD <15% If using External calibration, %RSD <20%
4.	Second Source (ICV)	SAP limit %D<20%. List outliers in narrative.
	Since this element is not addressed by Region II there will be no qualification.	
5.	Continuing Calibration (%D <15%)	SAP limit %D <20% Use SAP Limit, but qualify per Region II.
6.	Column %D (<25%)	SAP limit <40% Validata will flag only J if >40%.
7.	Field Duplicates (compare and calculate RPD)	SAP For SB, SD and SMI <30% Validata will not qualify outliers.
8.	Laboratory Triplicates	SAP for SMI <20%; calculated when results are greater than the LOQ. required one per batch. Validata will not qualify outliers.
9.*	Ground LCS – This is not a Region II requirement, but a SAP requirement (SMI only)	SAP limits are used for the ground LCS which are performed at the rate of one per site.

Appendix B
Data Quality Evaluation

Data Quality Evaluation Contents

Section Page

B Data Quality Evaluation B-1

B.0 Data Quality Assessment B-1

B.0.1 Laboratory Internal Quality Control Review B-1

B.0.2 Data Validation B-1

B.0.3 Primary Data Validation Qualifiers B-3

B.0.4 Impact of Data Quality on Project Data Quality Objectives and Data Usability B-4

B.0.5 Comparison of Nondetects to Screening Levels B-5

B.0.6 Laboratory Qualifications, Data Validation Qualifiers, Data Validation Reason Codes, Data Availability, and Data Use B-7

B.1 Vieques Cayo la Chiva Soil B-7

B.1.1 Soil SVOCs B-7

B.1.2 Soil Explosives B-7

B.1.3 Soil Metals B-8

B.1.4 Soil Wet Chemistry B-9

B.2 PARCC Considerations B-9

B.2.1 Precision B-9

B.2.2 Accuracy B-9

B.2.3 Representativeness B-9

B.2.4 Completeness B-9

B.2.5 Comparability B-10

B.2.6 Sensitivity B-10

B.3 References B-10

APPENDIX B

Data Quality Evaluation

B.0 Data Quality Assessment

This data quality evaluation assesses the effect of the overall analytical process on the "availability" of the analytical data. "Availability" in this context refers to whether results can be used by the project team based on their analytical soundness. If a result is analytically sound, it is available for use for evaluating the potential releases, nature and extent of contamination, and estimating potentially associated human health and ecological risks. However, a particular result or group of results may not be "usable" for these purposes if other conditions apply. For example, if there were a hypothetical site where a TCE spill had occurred and the TCE data for many or all of the samples were rejected, the data may not be usable for making site-specific determinations even if all the non-TCE data were analytically sound and available for use by the project team. In order to avoid confusion of terms, this data quality evaluation differentiates the "availability" of results from "usability" of results. "Available" results are analytically sound and available for use by the project team to make decisions, even if they are not usable for a particular purpose.

The three major categories of data evaluation are laboratory performance, field collection performance (i.e. blank contamination), and matrix interferences. Evaluation of laboratory performance is a check for compliance with the method requirements; in other words, a check of whether the laboratory analyzed the samples within the limits of the analytical method. Additionally, a third-party validator (Validata Chemical Services, Inc.) conducted a review of the laboratory data to assess whether the analytical methods were within required control limits at the time of analysis. Evaluation of potential matrix interferences involves the review of several areas of results, including surrogate spike recoveries, matrix spike recoveries, and duplicate sample results. Evaluation of field collection performance, such as blank contamination and field duplicates, involves the review of field QC and the determination of their effect on the sample results.

The data evaluation and validation is a multi-tiered approach. The process begins with an internal laboratory review, continues with a review by a third-party data validator, and ends with an overall review by the Navy contractor project chemistry team. The process provides a medium for essential communication between the laboratory, validator, and project team, and allows for data quality to be thoroughly evaluated.

This document presents the results of the data quality evaluation performed on the data set corresponding to Cayo la Chiva (site), discrete soil and incremental surface soil (matrix), and June 12-13, 2013 and November 15, 2013 (date range).

B.0.1 Laboratory Internal Quality Control Review

Prior to releasing the analytical data, the laboratory (Agriculture and Priority Pollutants (APPL), Inc.) reviewed both the sample and QC data to verify sample identity, instrument calibration, LOQs, dilution factors, numerical computations, accuracy of transcriptions, and chemical interpretations. In addition, the QC data were tabulated and the results reviewed to ascertain whether they were within the contract-required or laboratory-defined limits for accuracy and precision. Any non-conforming data were discussed in the data package cover letter and case narrative. The case narrative was then reviewed by the data validator and incorporated into the data validation report. If necessary, the exceedances were verified and qualifiers were applied based on this information.

B.0.2 Data Validation

A third-party data validator reviewed all data packages using the validation criteria outlined in the site-specific UFP-SAP Worksheets #34-36 (CH2M HILL, 2013a). For the most part, these Worksheets reference the appropriate Region II SOP if such an SOP exists for that analysis method. Then, UFP-SAP limits are used in place of those referenced in the SOP. If a Region II SOP does not exist for the analysis method, then the

data are validated against the limits in the UFP-SAP. Guidance and qualifiers are taken from related Region II SOPs and guidance is taken from National Functional Guidelines. The following protocol was used for validation:

- For SVOC via SW-846 8270D_SIM:
  - "Validation of Data, Semivolatile Organic Compounds by SW-846, Method 8270 (SOP HW-22, Rev. 24)" (August, 2008)
  - UFP-SAP limits for accuracy/precision (CH2M Hill, 2013a and CH2M Hill, 2013b)

- For EXPLO via SW-846 8330B and 8321:
  - "Validation of Data, Nitroaromatics and Nitroamines by HPLC, SW-846, Method 8330A (SOP HW-16, Rev. 2.1)" (December, 2010)
  - UFP-SAP limits for accuracy/precision (CH2M Hill, 2013a and CH2M Hill, 2013b)

- For EXPLO via SW-846 6850:
  - UFP-SAP limits for accuracy/precision (CH2M Hill, 2013a and CH2M Hill, 2013b)
  - Data qualifiers from "ICP-MS Data Validation" (SOP HW-2b, Rev. 15) (December, 2012)
  - Guidance from "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review" (EPA, January, 2010) as needed

- For METAL and FMETAL via SW-846 6010C:
  - "ICP-AES Data Validation" (SOP HW-2a, Rev. 15)" (December, 2012)
  - UFP-SAP limits for accuracy/precision (CH2M Hill, 2013a and CH2M Hill, 2013b)
  - Guidance from "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review" (EPA, January, 2010) as needed

- For METAL and FMETAL via SW-846 6020A:
  - "ICP-MS Data Validation" (SOP HW-2b, Rev. 15)" (December, 2012)
  - UFP-SAP limits for accuracy/precision (CH2M Hill, 2013a and CH2M Hill, 2013b)
  - Guidance from "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review" (EPA, January, 2010) as needed

- For METAL and FMETAL via SW-846 7196A
  - UFP-SAP limits for accuracy/precision (CH2M Hill, 2013a and CH2M Hill, 2013b)
  - Guidance and qualifiers from "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review" (EPA, January, 2010) as needed.

Although not subject to such stringent data validation, WCHEM data were still subject to the verification and validation procedures outlined in Worksheets #34-46.

As stated above, the data validation process was separate from the laboratory's internal review. The process was specifically focused on the effects of the laboratory's performance and sample matrix on the analytical results. Example areas of review include holding time compliance, surrogate recovery accuracy, matrix spiked sample precision and accuracy, blank contamination, initial and continuing calibration accuracy and precision, laboratory control sample accuracy, internal standard response and retention time accuracy, instrument tune criteria accuracy, and duplicate sample precision (laboratory replicates and field duplicates). Please refer to the complete data validation report for full areas of review.

Multiple analyses are most-often the result of concentrations exceeding the calibration range or QC results outside of control limits. When multiple analyses were performed, the "best result" was selected for purposes of this data quality evaluation. Among multiple valid and/or invalid results, the "best result" is:

1. The non-rejected result

2. The result from the appropriate concentration range (dilution factor)
3. The detect when one or more result is detected and one or more result is nondetect
4. The greater of detects, and
5. The lesser of nondetects (U-Values)

Qualification of data is not an unusual occurrence. To define a laboratory QC exceedance and when a laboratory QC exceedance occurs, the laboratory refers to its in-house SOPs. The SOPs are based on DOD requirements, the requested analytical method, and accumulated laboratory experience. When a laboratory QC exceedance occurs, the situation may be acceptable or it may require further action by the laboratory, such as application of a laboratory qualifier or re-extraction and/or reanalysis of the sample. The data validator uses a separate set of QC criteria, based on guidance from the EPA region that applies to the samples. A laboratory QC exceedance may not constitute a data validation exceedance and a data validation exceedance may not constitute a laboratory QC exceedance. Data validation criteria exceedances may result in the qualification of or rejection of data, as deemed appropriate by the data validator.

The data validator examines each data point and determines any effects that QC exceedances have had. Most often, these effects dictate that the result or limit of detection (LOD) should be considered estimated, but is still available for use. The J-qualification, J^+-qualification, UJ-qualification, and U-qualification of results are common occurrences and have no adverse effect on the availability of that result to the project team for making decisions. J-qualified, and J^+-qualified results are available, at the reported result, for use as detects as long as they are considered “estimated” by the project team. Human health risk assessment guidance suggests that these qualifiers “indicate uncertainty in the reported concentration of the chemical, but not in its assigned identity. Therefore, these data can be used just as positive data with no qualifiers or codes.” In addition, the same risk assessment guidance (EPA, 1989) suggests that one should use “J-qualified concentrations the same way as positive data that do not have this qualifier.” U-qualified and UJ-qualified results are available, at the reported LOD or level, for use as nondetects as long as they are considered “nondetect or not detected at significantly greater than that in an associated blank” or “nondetect, estimated LOD,” as appropriate.

In extreme cases, a result is rejected and deemed to be unusable. “Unusable” in this instance is defined as a result that is not analytically sound and is not generally considered available for use by the project team. In some cases, the project team may still decide to use a rejected result. An example of this occurrence would be if a result is rejected because it is biased extremely high, yet it is still below the screening level (SL). A conservative decision may be made to consider this result a non-exceedance, even if its concentration was rejected. For that reason, it is important to examine why a result was rejected. For the most part, however, rejected results are not usable, and the R-qualifier is the only qualifier that has an adverse effect on the availability of data.

In large data sets, rejected results are often inconsequential because there are sufficient non-rejected data available to the project team. If there are enough non-rejected data or the project team is able to infer results from adjacent sampling locations or there is other site-specific information that can provide additional lines of evidence, it may not be necessary to know the concentrations of some rejected constituents. It may also not be necessary to prove a constituent’s absence if there are sufficient additional lines of evidence.

B.0.3 Primary Data Validation Qualifiers

The following data validation qualifiers were applied to one or more analytical results:

- **U** - Not detected. Sample was analyzed for this parameter, but it was not detected at greater than the reported LOD. The data validator may also apply this qualifier to indicate that a concentration was not detected at significantly greater than that in an associated blank. Thus, this qualifier does not necessarily indicate a quality control exceedance.

- **UJ** – Not detected, LOD estimated. Sample was analyzed for this parameter, but it was not detected above the reported LOD. The LOD for this parameter is estimated due to a quality control exceedance.
- **J** - Concentration estimated. The parameter was positively identified and the associated numerical value is the approximate concentration of the parameter in the sample. Often, a J-qualifier is applied simply because the result was less than the limit of quantitation and thus does not necessarily indicate a quality control exceedance.
- **J^+** - Concentration estimated and potentially biased high. The parameter was positively identified and the associated numerical value is the approximate concentration of the parameter in the sample.
- **R** - Rejected. The result was rejected because quality control limits were exceeded. It may or may not have been detected by the laboratory. The presence or absence of the parameter cannot be verified and the result generally is not usable as detected or not detected.
- **[none] -** Detected. Qualification was not warranted.

B.0.4 Impact of Data Quality on Project Data Quality Objectives and Data Usability

The laboratories analyzed the samples in accordance with EPA SW-846 methods. The data packages were reviewed by a data validator taking guidance from USEPA Region II Validation procedures. Field QC samples were collected and analyzed at the planned frequencies with the exception of one duplicate sample (VE-UXO18-01SS01P-0001), which was not analyzed for metals due to limited sample volume. The UXO 18 sampling was part of a multi-UXO site sampling effort where multiple duplicate soil samples were collected for metals analysis. The laboratory results for these samples indicated there were no precision or sampling issues that could affect data quality and usability.

The laboratory utilized various qualifiers to represent “below reporting limit,” “nondetect,” and “detected.” Any other extraneous laboratory qualifiers were superseded by data validation qualifiers. The data validator utilized J-qualifiers, J^+-qualifiers, UJ-qualifiers, U-qualifiers, and R-qualifiers to represent “estimated,” “estimated, biased high,” “estimated, biased low,” “nondetect, estimated LOD,” “nondetect or not detected at significantly greater than that in an associated blank,” and “rejected,” respectively. The only time the data validator changed a result’s detect status was when J-qualifiers were changed to U-qualifiers (detect to nondetect) as a result of blank contamination.

The J-, J^+-, and UJ-qualifiers indicate that some results are estimated. These qualifiers indicate that data are available for use as detects, and nondetects, respectively. These qualifiers do not necessarily indicate a problem that adversely affects the availability of data. For example, J-qualifiers are often applied simply because results are below the quantitation limit.

Region II data validation guidance mandates the use of J- and UJ-qualifiers when QA/QC exceedances dictate their necessity. For this data set, the data validator used J^+-qualifiers to indicate that data are biased high. In Region II, if a result is attributable to blank contamination, it is U-qualified and is no longer distinguishable from results that are simply nondetect. The U-qualified value is elevated to the LOD if necessary. For METALS only, if an analyte is detected in a blank sample, an associated result is J^+-qualified if it is greater than the LOD but less than 10X the blank result. The J^+-qualification is used to indicate that it may be biased high due to blank contamination but is available for use as a detection. This supports the practice that J-qualified results, while estimated, are available for use as detects at their qualified concentration and U- and UJ-qualifiers are available for use as nondetects at their qualified LOD or level. In general, J-, J^+-, UJ-, and U-qualified results are available for use as qualified for evaluating potential releases, the nature and extent of contamination, and estimating potentially associated human health and ecological risks.

It is a common occurrence for achieved LODs to be greater than SLs or for LODs to be elevated above what was expected or requested. In many cases, SLs are simply unreasonably low or the laboratory was forced, by the analytical method or sample matrices, to raise limits for various reasons. In the instance where nondetect LODs are greater than SLs, the results are available for use as nondetects, but their use adds

uncertainty to the conclusions drawn. There are a variety of typical and potentially unavoidable reasons why the reporting limits of nondetect results may exceed SLs:

- If an SL is unreasonably low, current instrumentation technology may not be able to achieve a LOD less than the SL.
- The laboratory-specific limits may have been established at a time when the SL was higher (less stringent) or not present, but the reporting is being done using new (more stringent) criteria. Published screening levels, such as EPA Regional Screening Levels, may change periodically as toxicity values are updated.
- If a target compound or analyte is present at an elevated level, the laboratory will dilute the entire sample in order to report that concentration within the instrument's linear calibration range. It may not be possible to analyze the sample at a lesser dilution if the target compound's high concentration is likely to damage or saturate the instrument. The high concentration of a non-target compound or analyte may also necessitate initial dilution for the same reason.
- If matrix effects mask low concentrations, the laboratory may be forced to elevate their limits to demonstrate the fact that low concentrations cannot be detected.
- If matrix effects are particularly strong, the laboratory may be forced to analyze the sample at an initial dilution in an attempt to dilute the matrix effects.
- If historical concentrations warrant, the laboratory detects an odor or the field team designates a sample as "expected high concentration," the laboratory may pre-screen the sample and initially dilute it.
- If the sample appearance indicates possible high concentrations, the laboratory may be forced to analyze the sample at a concentration range different from what is requested. For example, if a sample is designated as "groundwater," but is actually an emulsion or sludge, the laboratory may be forced to analyze the sample using the "medium" instead of the "low" or "SIM" concentration range.
- If the field team cannot provide the full sample volume, the laboratory may be forced to dilute the sample by adding water until the minimum volume is achieved.
- If a soil or sediment sample is characterized by high percent moisture, the reporting limits will be elevated such that the concentrations and quantitation limits are reported on a dry-weight basis.

B.0.5 Comparison of Nondetects to Screening Levels

When evaluating the data and making decisions, the project team compares detected sample results to SLs in order to determine exceedances. For this project, the SLs are as follows:

- Discrete soil and incremental soil samples are compared to the appropriate Vieques East Soil Background, Adjusted Residential Soil EPA RSLs (November, 2013), Adjusted Industrial Soil EPA RSLs (November, 2013), SSLs (risk-based if no MCL-based) and Vieques Soil ESVs.

Nondetect results are also compared to SLs, typically during a risk assessment or exceedance screening, by comparing one-half the LOD to the SL. However, this is only done when the same constituent was detected in another sample of the same matrix at the same site. The assumption is that, if the constituent is present in a given sample of a particular matrix at a site, then it may also be present at low concentrations (less than the LOD) in a nondetect sample of the same matrix from the same site. However, when a constituent was not detected in any samples of a particular matrix at a site, then it is considered not present at the site in that matrix. In this instance, it is important to compare the nondetect results to the SL. If the nondetect results (LODs) are not low enough when compared to the SL, then it may be possible that the constituent is present in a sample at greater than the SL but not detected or reported by the laboratory instrumentation. This situation is a common occurrence and is not cause for alarm. There are various typical reasons why this occurs and is expected. Please refer to section B.0.4, above. Then, refer to Table B-1. It should be noted that whenever a nondetect U-value exceeded one or more applicable SLs (with the exception of thallium), the SSL was the lesser of applicable SLs. For the purpose of performing this comparison, the minimum of applicable SLs for each matrix (SSLs for all analytes except thallium; Adjusted Residential Soil RSL for

thallium) is considered to be the SL for each combination of matrix, analysis group, and analyte. One row (combination of matrix, analysis group, and analyte) was generated if there was at least one instance where a nondetect U-Value (LOD or detected result U-qualified due to blank contamination) exceeded a SL.

The minimum and maximum U-Values are further presented in Table B-1. The minimum U-Value is generally understood as the lowest LOD that the instrumentation can practically report considering the conditions at the site. The maximum U-Value is then generally understood as the LOD adjusted for the worst conditions (i.e. greatest dilution factors, matrix interference, and percent moisture). There are 206 nondetect (U- or UJ-qualified) data points in the soil data set. Of these, 125 nondetect data points exceeded the minimum SL. They corresponded to four nondetect data points (1 analyte; hexachloroethane) in the SVOC fraction, 104 nondetect data points (13 analytes) in the EXPLO fraction, and 17 nondetect data points (four analytes; antimony, arsenic, hexavalent chromium, and thallium) in the METAL fraction. In two cases (antimony and thallium), the maximum U-Value exceeded the SSL but the minimum U-Value did not. These are instances where the LOD is usually low enough, but conditions necessitated elevating the LOD in one or more samples. In the remaining cases, the minimum U-Value exceeded the minimum SL. These are instances where the concentration range is not low enough to practically report an LOD at less than the SL. In these instances, however, where the LOD > SL, the instrumentation may still be able to report a result, if an analyte is detected in a sample at greater than the SL, when the DL is less than the SL.

Therefore, when a U-Value exceeds a SL, it is worthwhile to consider the DL. Note that DLs, as reported by the laboratory and as presented in Table B-1, are “Adjusted DLs” in that they are adjusted for dilution factors, matrix interference, etc. This is synonymous with the adjustment of nondetect results (U-Values or LODs), and also detected results. The DL is the level at which the laboratory is able to distinguish a detection from noise, and therefore is able to report a detection. Furthermore, the laboratory will report (J-qualified as applicable) any detections at greater than the DL. The minimum and maximum DLs are also presented in Table B-1. Unshaded rows are those where the U-Value is greater than the SL, but the DL is less than the SL for all nondetect samples. A total of 2 rows (combinations of analysis group and constituent; corresponding to ten nondetect results) correspond to instances where the U-Value is greater than the SL but the DL is still less than the SSL. A total of two rows (corresponding to 15 results, shown in orange) correspond to instances where the U-value is greater than the SL and at least one nondetect DL is also greater than the SL. A total of 14 rows (corresponding to 108 results, shown in pink) correspond to instances where the U-Value is greater than the SL and the DL is also greater than the SL for all nondetect results.

Looking at Table B-1 from an analytical group standpoint, one can see that there nearly all analytes for SVOCs and EXPLOs are affected and only a few analytes are affected for METALs. This phenomenon is due to unrealistically low SSLs (established without considering current instrumentation technology), which the reporting limits could not meet.

For these instances where the DL is greater than the SL, the data user must understand that an analyte may be present in a sample at or at greater than the SL, but the laboratory instrumentation may not be sensitive enough to detect it. This phenomenon is unavoidable when projects are interested in an analytical group of constituents of concern and the project team is not able to focus on individual analytes. This is most-common for projects in the early stages of investigation. It is also worth noting that the achieved reporting limits for EXPLOs and SVOCs are comparable to those required by the UFP-SAP and Addendum and so the laboratory performed the analyses at the concentration ranges specified in the approved work plan. In fact, the achieved reporting limits for hexachloroethane were two orders of magnitude lower than expected as the laboratory was able to analyze this compound by SW-846 8270D_SIM. For the affected METALs, some samples required dilution prior to analysis (refer to section X.0.4), which resulted in elevated reporting limits.

It is important to note that all nondetect U-values were below the Adjusted Residential Soil RSL, Adjusted Industrial Soil RSL and Vieques ESVs for all SVOCs and EXPLOs. In addition, there was only one nondetect U value greater than the ESV for METALs (one analyte, selenium); however, this value was below the Vieques

East background level. There were ten nondetect U-values at greater than the Residential RSL (two analytes, chromium (hexavalent) and thallium).

B.0.6 Laboratory Qualifications, Data Validation Qualifiers, Data Validation Reason Codes, Data Availability, and Data Use

Please refer to Table B-2. For the complete data set, all combinations of laboratory qualifier, data validation qualifier, and data validation qualifier are provided. To help identify trends, for each combination, the count (number of results that possess this combination) is provided as well as the determination of whether such a result is affected by a bias, is available for use as reported, is available for use as qualified, or is not available for use (rejected). Totals for each are provided. In addition, the procedure used for qualification is described in addition to the reason for qualification.

A total of 63.1% of the data are available for use as reported by the laboratory. A total of 19.59% of the data are available for use as qualified by the data validator. Altogether, a total of 82.69% of the data are available for use, qualified as applicable. However, there are no data gaps because all R-qualified data necessitated resampling and subsequent analysis. Those resampled results are available for use, qualified as applicable. Although the UFP-SAP project completeness goal of “95% available data” was technically not met for this data set because rejected results are reportable, this is inconsequential because an available data point was generated for each corresponding rejected point. There are available data points for all those which were planned.

B.1 Vieques Cayo la Chiva Soil

The purpose of this data quality evaluation is to summarize the findings of the data validation and any effects on the availability of the incremental soil and discrete surface soil data within Vieques Cayo la Chiva, as well as to provide an assessment of data usability. Soil samples were collected by CH2M HILL, Inc. on June 12-13, 2013 and November 15, 2013. Please refer to Table B-2 for a complete listing and description (Comment column) of all data validation qualifiers (DV_Qual column) and reason codes (DV_Qual_Code column) that are presented in the following subsections.

B.1.1 Soil SVOCs

Hexachloroethane was analyzed via SW-846 8270D-SIM. The validation process resulted in the following qualifiers for results in the SVOA fraction:

Validator Qualifier	Reason Code	Count	Percent
U	[none]	4	100.00%
		4	100.00%

100.00% not R-flagged and available for use

B.1.2 Soil Explosives

8330B-list nitroaromatics/nitroamines, including PETN and nitroglycerin, were analyzed via SW-846 8330B, picric acid was analyzed via SW-846 8321 and perchlorate was analyzed via SW-846 6850. The validation process resulted in the following qualifiers for results in the EXPLO fraction:

Validator Qualifier	Reason Code	Count	Percent
U	[none]	140	66.04%
R	CC	64	30.19%
UJ	GBSL	4	1.89%
R	GBSL	4	1.89%
		212	100.00%

67.92% not R-flagged and available for use

All 8330B results were rejected for the incremental soil samples collected June 12, 2013 due to a time exceedance of the CCV frequency. While all method QC requirements were met, Region II validation mandates that all data (detects and nondetects) be R-flagged if more than 14 hours passes between the opening CCV and the end of the analytical sequence. All picric acid results were also rejected for the incremental soil samples collected June 12, 2013 due to poor recovery in the ground LCS. All incremental soil samples were recollected on November 15, 2013 and analyzed via 8330B and also for picric acid. Because it was determined that mechanical grinding is not appropriate for picric acid (based on previous low ground LCS recoveries), resampled fractions for picric acid were not mechanically ground prior to analysis. Instead, they were hand-ground similar to the preparation procedure for metals analysis on incremental samples. The hand-ground LCS recovered within acceptance limits for picric acid in the recollected samples. All explosives results from the recollected samples are available for use, qualified as applicable.

B.1.3 Soil Metals

TAL metals were analyzed via SW-846 6010C and 6020A and hexavalent chromium was analyzed via SW-846 7196A. The validation process resulted in the following qualifiers for results in the METAL fraction:

Validator Qualifier	Reason Code	Count	Percent
[none]	[none]	54	33.33%
UJ	MSL	23	14.20%
U	[none]	23	14.20%
J	MSL	20	12.35%
J	[none]	12	7.41%
U	EBL	11	6.79%
J	MSH	10	6.17%
J	LD	4	2.47%
J^+	EBL	3	1.85%
U	CCBL	1	0.62%
J	SD	1	0.62%
		162	100.00%

100.00% not R-flagged and available for use

B.1.4 Soil Wet Chemistry

Wet chemistry (pH, ORP, and TOC) were analyzed via SW-846 9045C, ASTM D1498, and Walkley-Black, respectively. No qualifiers were deemed necessary or applied.

B.2 PARCC Considerations

B.2.1 Precision

Precision is defined as the agreement between duplicate results and was characterized by comparing duplicate matrix spike recoveries, laboratory replicates, and field duplicate sample results. There is no actual significant negative impact on precision because no data points were deemed unusable (rejected) due to precision exceedances. In addition, only 1.27% of the data points were qualified due to field duplicate, laboratory replicate, or serial dilution precision exceedance.

B.2.2 Accuracy

Accuracy is a measure of the agreement between an experimental determination and the true value of the parameter being measured. For organic analyses, each sample was spiked with surrogate compounds; and for organic and inorganic analyses, an MS/MSD and LCS were spiked with a known parameter concentration before preparation. Internal standards also provide a measure of accuracy. Internal standards, surrogates and MS/MSD provide a measure of the matrix effects on the analytical accuracy. LCS demonstrates accuracy of the method and the laboratory's ability to meet the method criteria. Accuracy is also assessed by calibration recoveries. Potential biases and trends were evaluated by first determining whether a QA/QC exceedance may indicate a potential bias or trend. If so, then the exceedance was examined to determine whether the bias or trend was significant enough to warrant rejection of data. A significant negative bias was identified as evidenced by rejection of nondetect picric acid results due to low ground LCS recovery. However, because it was determined that these results would be rejected, and thus would not be available for use, a proactive decision was made to recollect the samples and modify the grinding procedure. Replacement points were acceptable, there are no data gaps, and there is no impact on the project decisions made using the data. Therefore, there is no negative impact on accuracy because no data points were deemed unusable (rejected) due to accuracy exceedances. With the exception of the rejected explosives results which were resampled, only 14.76% of the data points were qualified due to MS/MSD, LCS, or calibration exceedances.

B.2.3 Representativeness

Representativeness is a qualitative measure of the degree to which sample data accurately and precisely represent a characteristic environmental condition (in this case, nature and extent of contamination). Representativeness is a subjective parameter and is used to evaluate the efficacy of the sample planning design. In terms of data quality, representativeness was assured because the sampling team followed approved standard operating procedures for sample collection and handling, and the laboratory followed approved standard operating procedures for sample handling, preparation, and analysis. Because mechanical grinding was not appropriate for picric acid, all samples recollected for picric acid analysis were hand-ground in a fashion similar to that for metals. Otherwise, all field samples were collected and analyzed as proposed in the UFP-SAP.

B.2.4 Completeness

For purposes of this DQE, completeness is defined as the percentage of measurements that are judged to be valid; validity being defined by the DQOs. Therefore, completeness is calculated as the number of analytically-sound results that are available for use compared to the total number of measurements made. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review; EPA 540/R-

99/008; October, 1999; SOP HW-24 Validation of Organic Data Acquired Using SW-846 Method 8260B (Rev. 2, August, 2008), SOP HW-22 Validation of Organic Data Acquired Using SW-846 Method 8270D (Rev. 3, October, 2006); SOP HW-44 Validation of Organic Data Acquired Using SW-846 Method 8081B (Rev. 1, October, 2006) designate all results except those R-qualified as "rejected" to be available for use as analytically-sound results. The R-qualifier is the only qualifier that negatively affects a data point's availability. Completeness is provided, above, for each combination of matrix and analysis group.

All field and QA/QC samples were collected and analyzed as planned. All 8330B compounds and picric acid results were rejected for the incremental soil samples, but the samples were recollected and reanalyzed to prevent data gaps (refer to section X.1.2). When those unnecessary data points are not considered, the data set is 100% complete.

B.2.5 Comparability

Comparability is a qualitative measure designed to express the confidence with which one data set may be compared to another. Factors that affect comparability are sample collection and handling techniques, sample matrix, and analytical methods. In this case, because approved standard operating procedures were used for sample collection and handling, a common sample matrix was evaluated (sediment and soil) and EPA SW-846 methods were utilized, the data user may express confidence in the fact that this data set is comparable to others of acceptable data quality. In addition, comparability is controlled by the other PARCC parameters because data sets can be compared with confidence only when precision and accuracy are known. Precision and accuracy were demonstrated to be acceptable, and the data user may be confident that this data set is comparable to others of high data quality.

B.2.6 Sensitivity

Refer to sections B.0.4 and B.0.5, above.

B.3 References

CH2M HILL. 2013a. *Final Master Sampling and Analysis Plan, East Vieques Terrestrial UXO Sites*. January.

CH2M HILL. 2013b. *Master Sampling and Analysis Plan Addendum 2, East Vieques Terrestrial UXO Sites*. February.

EPA. 2012. *ICP-MS Data Validation.* December.

EPA. 2012. *ICP-AES Data Validation.* December.

EPA. 2010. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.* January.

EPA. 1989. *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual.* EPA/540/1-89/002, Part A, October.

TABLE B-1

Comparison of Nondetects to Screening Levels

Remedial Investigation / Feasibility Study Report UXO 18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Matrix	Analysis Group	Analyte	CAS	RSL[1]	SSL[2]	Units	# Detects	min Detect	max Detect	# Exceeds	# ND	min ND[1]	max ND[1]	# U > SL	min ND DL[1]	max ND DL[1]	# ND DL > SL	# ND DL > SL when no Related Exceedance
SOIL	SVOC	Hexachloroethane	67-72-1	4,300	0.48	UG_KG	-	-	-	-	4	1.9	2.1	4	1	1.1	4	4
SOIL	EXPLO	1,3-Dinitrobenzene	99-65-0	610	1.4	UG_KG	-	-	-	-	8	200	200	8	63	63	8	8
SOIL	EXPLO	2,4,6-Trinitrotoluene	118-96-7	360	13	UG_KG	-	-	-	-	8	200	200	8	83	83	8	8
SOIL	EXPLO	2,4-Dinitrotoluene	121-14-2	1600	0.28	UG_KG	-	-	-	-	8	200	200	8	83	83	8	8
SOIL	EXPLO	2,6-Dinitrotoluene	606-20-2	330	0.058	UG_KG	-	-	-	-	8	200	200	8	83	83	8	8
SOIL	EXPLO	2-Amino-4,6-dinitrotoluene	35572-78-2	15,000	23	UG_KG	-	-	-	-	8	200	200	8	75	75	8	8
SOIL	EXPLO	2-Nitrotoluene	88-72-2	2900	0.25	UG_KG	-	-	-	-	8	200	200	8	66	66	8	8
SOIL	EXPLO	3-Nitrotoluene	99-08-1	610	1.2	UG_KG	-	-	-	-	8	200	200	8	71	71	8	8
SOIL	EXPLO	4-Amino-2,6-dinitrotoluene	19406-51-0	15000	23	UG_KG	-	-	-	-	8	200	200	8	75	75	8	8
SOIL	EXPLO	4-Nitrotoluene	99-99-0	24,000	3	UG_KG	-	-	-	-	8	200	200	8	80	80	8	8
SOIL	EXPLO	Nitrobenzene	98-95-3	4800	0.079	UG_KG	-	-	-	-	8	200	200	8	75	75	8	8
SOIL	EXPLO	Nitroglycerin	55-63-0	610	1	UG_KG	-	-	-	-	8	200	200	8	85	85	8	8
SOIL	EXPLO	PETN	78-11-5	12000	24	UG_KG	-	-	-	-	8	1000	1000	8	579	579	8	8
SOIL	EXPLO	RDX	121-82-4	5600	0.23	UG_KG	-	-	-	-	8	200	200	8	80	80	8	8
SOIL	METAL	Antimony	7440-36-0	3.1	0.27	MG_KG	-	-	-	-	7	0.2	1.3	3	0.1	0.63	3	2
SOIL	METAL	Arsenic	7440-02-0	0.61	0.29	MG_KG	3	2.2	4.8	3	4	0.3	0.3	4	0.08	0.08	-	-
SOIL	METAL	Chromium (hexavalent)	7440-28-0	0.29	0.00059	MG_KG	-	-	-	-	8	4	12	8	2.3	7	8	7
SOIL	METAL	Thallium	7440-62-2	0.078	0.14	MG_KG	1	0.55	0.55	1	6	0.05	0.31	2	0.02	0.12	-	-

Notes:

1. "RSLs" are Adjusted Residential Soil RSLs and are current as of November, 2013.
2. "SSLs" are risk-based if no MCL-based and are current as of November, 2013.

One row is provided for each analyte where at least one nondetect U-Value exceeds the screening level.
Rows are shaded in orange if at least one nondetect DL exceeds a screening level without a related exceedance (detected exceedance in the same analysis group for the same sample)
Rows are shaded in pink if all nondetect DLs exceed a screening level without a related exceedance (detected exceedance in the same analysis group for the same sample)

TABLE B-2
Data Availability and Use
Remedial Investigation / Feasibility Study Report UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Lab_Qual	DV_Qual[1]	DV_Qual_Code[2,3]	Count	Percent	Available as Reported	Available as Qualified	Not Available	Comment
[none]	[none]	[none]	69	17.56%	17.56%			Detected by the laboratory. No further qualification was necessary.
J	J	[none]	12	3.053%	3.05%			Detected by the laboratory at less than the LOQ. No further qualification was necessary. The result is available for use at the reported value as long as the data user understands that it is "estimated".
[none]	J	LD	4	1.018%		1.02%		Detected by the laboratory. The result is available for use at the reported value as long as the data user understands that it is "estimated" due to laboratory replicate precision exceedance.
[none]	J	MSH	7	1.781%		1.78%		Detected by the laboratory. The result is available for use at the reported value as long as the data user understands that it is "estimated" due to high matrix spike recovery.
J	J	MSH	3	0.7634%		0.76%		Detected by the laboratory. The result is available for use at the reported value as long as the data user understands that it is "estimated" due to low matrix spike recovery.
[none]	J	MSL	11	2.799%		2.80%		Detected by the laboratory. The result is available for use at the reported value as long as the data user understands that it is "estimated" due to low matrix spike recovery.
J	J	MSL	9	2.290%		2.29%		Detected by the laboratory at less than the LOQ. The result is available for use at the reported value as long as the data user understands that it is "estimated" due to low matrix spike recovery.
[none]	J	SD	1	0.2545%		0.25%		Detected by the laboratory. The result is available for use at the reported value as long as the data user understands that it is "estimated" due to serial dilution precision exceedance.
J	J^+	EBL	3	0.7634%		0.76%		Detected by the laboratory at less than the LOQ. The result is available for use at the reported value as long as the data user understands that it is "estimated, biased high" due to a detection in the associated equipment blank.
U	R	CC	64	16.28%			16.28%	Not detected by the laboratory. The result is not available for use due to continuing calibration exceedance. Note that these rejected results resulted in sample recollection and generation of available data.
U	R	GBSL	4	1.018%			1.02%	Not detected by the laboratory. The result is not available for use due to low ground spike recovery. Note that these rejected results resulted in sample recollection and generation of available data.
U	U	[none]	167	42.49%	42.49%			Not detected by the laboratory. The reported result is the LOD. No further qualification was necessary.
J	U	CCBL	1	0.2545%		0.25%		Detected by the laboratory at less than the LOQ. The data validator determined that the detection is not significantly greater than that in an associated continuing calibration blank, applied a U-flag, and raised the result to the LOD (if less than the LOD). The result is available for use as a nondetect as long as the data user understands that it was detected then subsequently deemed "not detected" due to continuing calibration blank contamination.
J	U	EBL	11	2.799%		2.80%		Detected by the laboratory at less than the LOQ. The data validator determined that the detection is not significantly greater than that in an associated equipment blank, applied a U-flag, and raised the result to the LOD (if less than the LOD). The result is available for use as a nondetect as long as the data user understands that it was detected then subsequently deemed "not detected" due to equipment blank contamination.
U	UJ	GBSL	4	1.018%		1.02%		Not detected by the laboratory. The reported result is the LOD. The result is available for use at the reported LOD as long as the data user understands that it is "not detected, LOD estimated" due to low ground spike recovery.
U	UJ	MSL	23	5.852%		5.85%		Not detected by the laboratory. The reported result is the LOD. The result is available for use at the reported LOD as long as the data user understands that it is "not detected, LOD estimated" due to low matrix spike recovery.
		Totals:	393	100.00%	63.10%	19.59%	17.30%	

1. The following qualifiers suggest a potential high bias: J^+
2. The following reason codes suggest a potential high bias: MSH
3. The following reason codes suggest a potential low bias: MSL, GBSL

Appendix C
Raw Analytical Data Summary Table

Appendix C

Raw Analytical Data

UXO 18 RI/FS

Former Vieques Naval Training Range

Vieques, Puerto Rico

Station ID	VE-UXO18-01DU01								
Sample ID	VE-UXO18-01SMI01-0613	VE-UXO18-01SMI01T-0613	VE-UXO18-01SMI01TT-0613	VE-UXO18-01SMI01-1113	VE-UXO18-01SMI01-1113A*	VE-UXO18-01SMI01T-1113	VE-UXO18-01SMI01T-1113A*	VE-UXO18-01SMI01TT-1113	VE-UXO18-01SMI01TT-1113A*
Sample Date	06/12/13	06/12/13	06/12/13	11/15/13	11/15/13	11/15/13	11/15/13	11/15/13	11/15/13
Chemical Name									
Semivolatile Organic Compounds (µg/kg)									
Hexachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA
Explosives (µg/kg)									
1,3,5-Trinitrobenzene	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
1,3-Dinitrobenzene	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
2,4,6-Trinitrotoluene	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
2,4-Dinitrotoluene	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
2,6-Dinitrotoluene	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
2-Amino-4,6-dinitrotoluene	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
2-Nitrotoluene	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
3-Nitrotoluene	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
4-Amino-2,6-dinitrotoluene	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
4-Nitrotoluene	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
HMX	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
Nitrobenzene	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
Nitroglycerin	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
Perchlorate	4 UJ	4 UJ	4 UJ	NA	NA	NA	NA	NA	NA
PETN	1,000 R	1,000 R	1,000 R	1,000 U	NA	1,000 U	NA	1,000 U	NA
Picric Acid	120 R	120 R	120 R	NA	120 U	NA	120 U	NA	120 U
RDX	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
Tetryl	200 R	200 R	200 R	200 U	NA	200 U	NA	200 U	NA
Total Metals (mg/kg)									
Aluminum	18.4 J	42.5 J	262 J	NA	NA	NA	NA	NA	NA
Antimony	0.2 UJ	0.2 UJ	0.2 UJ	NA	NA	NA	NA	NA	NA
Arsenic	0.3 U	0.3 U	0.3 U	NA	NA	NA	NA	NA	NA
Barium	2.4	2.1	1.8	NA	NA	NA	NA	NA	NA
Beryllium	0.2 UJ	0.2 UJ	0.2 UJ	NA	NA	NA	NA	NA	NA
Cadmium	0.08 U	0.08 U	0.08 U	NA	NA	NA	NA	NA	NA
Calcium	38,300	41,300	31,500	NA	NA	NA	NA	NA	NA
Chromium	0.2 U	0.21 J	0.69	NA	NA	NA	NA	NA	NA
Chromium (hexavalent)	4 U	4 U	4 U	NA	NA	NA	NA	NA	NA
Cobalt	0.057 J	0.061 J	0.098 J	NA	NA	NA	NA	NA	NA
Copper	0.4 UJ	0.4 UJ	0.46 J	NA	NA	NA	NA	NA	NA
Iron	4 J	13	185	NA	NA	NA	NA	NA	NA
Lead	0.4 UJ	0.4 UJ	0.2 J	NA	NA	NA	NA	NA	NA
Magnesium	1,240 J	1,430 J	1,300 J	NA	NA	NA	NA	NA	NA
Manganese	19.3	17.1	14.9	NA	NA	NA	NA	NA	NA
Nickel	0.4 UJ	0.4 UJ	0.17 J	NA	NA	NA	NA	NA	NA
Potassium	62 J	42.8 J	70.9 J	NA	NA	NA	NA	NA	NA
Selenium	0.1 U	0.1 U	0.1 U	NA	NA	NA	NA	NA	NA
Silver	0.05 U	0.05 U	0.05 U	NA	NA	NA	NA	NA	NA
Sodium	294	271	202	NA	NA	NA	NA	NA	NA
Thallium	0.05 UJ	0.05 UJ	0.05 UJ	NA	NA	NA	NA	NA	NA
Vanadium	0.4 UJ	0.4 UJ	0.5 J	NA	NA	NA	NA	NA	NA
Zinc	2.4 J	2.7 J	3.6 J	NA	NA	NA	NA	NA	NA
Wet Chemistry									
pH (pH units)	7.6	NA	NA	NA	NA	NA	NA	NA	NA
Redox (MV)	164	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC) (mg/kg)	19,900	NA	NA	NA	NA	NA	NA	NA	NA

\\vbofpp01\Proj\CLEANII\BASES\Vieques\UXO 18\RIFS\DRAFT FINAL\Appendix C - Raw Analytical Data Summary\Native Files\[Raw table.xlsx], jdean6, 02/13/2014

(Loaded Discrete and Incremental Soil Raw Analytical Data 2013)

Notes:

Shading indicates detections

J - Analyte present, value may or may not be accurate or precise

J+ - Analyte present, value may be biased high, actual value may be lower

NA - Not analyzed

R - Rejected Result

U - Nondetect

UJ - Nondetect, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

MV - Millivolts

µg/kg - Micrograms per kilogram

*Sample IDs ending in "A" were analyzed for picric acid after being hand ground rather than ground following 8330B procedure for incremental samples.

Appendix C

Raw Analytical Data

UXO 18 RI/FS

Former Vieques Naval Training Range

Vieques, Puerto Rico

Station ID	VE-UXO18-01DU02			VE-UXO18-01SO01		VE-UXO18-01SO02	VE-UXO18-01SO03
Sample ID	VE-UXO18-01SMI02-0613	VE-UXO18-01SMI02-1113	VE-UXO18-01SMI02-1113A*	VE-UXO18-01SS01-0001	VE-UXO18-01SS01P-0001	VE-UXO18-01SS02-0001	VE-UXO18-01SS03-0001
Sample Date	06/12/13	11/15/13	11/15/13	06/12/13	06/12/13	06/12/13	06/12/13
Chemical Name							
Semivolatile Organic Compounds (µg/kg)							
Hexachloroethane	NA	NA	NA	1.9 U	1.9 U	2 U	2.1 U
Explosives (µg/kg)							
1,3,5-Trinitrobenzene	200 R	200 U	NA	200 U	200 U	200 U	200 U
1,3-Dinitrobenzene	200 R	200 U	NA	200 U	200 U	200 U	200 U
2,4,6-Trinitrotoluene	200 R	200 U	NA	200 U	200 U	200 U	200 U
2,4-Dinitrotoluene	200 R	200 U	NA	200 U	200 U	200 U	200 U
2,6-Dinitrotoluene	200 R	200 U	NA	200 U	200 U	200 U	200 U
2-Amino-4,6-dinitrotoluene	200 R	200 U	NA	200 U	200 U	200 U	200 U
2-Nitrotoluene	200 R	200 U	NA	200 U	200 U	200 U	200 U
3-Nitrotoluene	200 R	200 U	NA	200 U	200 U	200 U	200 U
4-Amino-2,6-dinitrotoluene	200 R	200 U	NA	200 U	200 U	200 U	200 U
4-Nitrotoluene	200 R	200 U	NA	200 U	200 U	200 U	200 U
HMX	200 R	200 U	NA	200 U	200 U	200 U	200 U
Nitrobenzene	200 R	200 U	NA	200 U	200 U	200 U	200 U
Nitroglycerin	200 R	200 U	NA	200 U	200 U	200 U	200 U
Perchlorate	4 UJ	NA	NA	4 U	4 U	4 U	4 U
PETN	1,000 R	1,000 U	NA	1,000 U	1,000 U	1,000 U	1,000 U
Picric Acid	120 R	NA	120 U	120 U	120 U	120 U	120 U
RDX	200 R	200 U	NA	200 U	200 U	200 U	200 U
Tetryl	200 R	200 U	NA	200 U	200 U	200 U	200 U
Total Metals (mg/kg)							
Aluminum	598 J	NA	NA	NA	3,630	4,470 J	9,720
Antimony	0.2 UJ	NA	NA	NA	1.1 U	1.2 U	1.3 U
Arsenic	0.3 U	NA	NA	NA	2.2 J	2.2 J	4.8
Barium	4.5	NA	NA	NA	34.5	49 J	43.3
Beryllium	0.2 UJ	NA	NA	NA	0.23 U	0.25 UJ	0.09 J
Cadmium	0.08 U	NA	NA	NA	0.18 J	0.32 J	0.25 J
Calcium	27,100	NA	NA	NA	265,000	238,000 J	229,000
Chromium	0.85	NA	NA	NA	6.3	9.2	11.4
Chromium (hexavalent)	10 U	NA	NA	4.5 U	4.6 U	12 U	5 U
Cobalt	0.24	NA	NA	NA	2.4	2.5	2.4
Copper	0.68 J	NA	NA	NA	8.1	13 J	13.6
Iron	316	NA	NA	NA	2,680	3,740 J	7,710
Lead	0.4 UJ	NA	NA	NA	0.46 U	0.49 UJ	2
Magnesium	620 J	NA	NA	NA	3,630	4,780 J	12,300
Manganese	54.6	NA	NA	NA	110	184 J	315
Nickel	0.36 J	NA	NA	NA	1.9	2.5 J	3.8
Potassium	184 J	NA	NA	NA	827	1,060	2,350
Selenium	0.12 J	NA	NA	NA	0.57 U	0.75 J+	0.98 J+
Silver	0.05 U	NA	NA	NA	0.28 U	0.31 U	0.31 U
Sodium	61.7 J	NA	NA	NA	452	627 J	494
Thallium	0.05 UJ	NA	NA	NA	0.28 U	0.31 U	0.55 J+
Vanadium	0.54 J	NA	NA	NA	5.1	7 J	14.6
Zinc	2.9 J	NA	NA	NA	10.1	21.3 J	23.7
Wet Chemistry							
pH (pH units)	7.5	NA	NA	7.8	NA	7.9	7.6
Redox (MV)	147	NA	NA	199	NA	209	224
Total organic carbon (TOC) (mg/kg)	86,700	NA	NA	48,000	NA	64,000	68,000

\\vbofpp01\Proj\CLEANIII\BASES\Vieques\UXO 18\RIFS\DRAFT FINAL\Appendix C - Raw Analytical

(Loaded Discrete and Incremental Soil Raw Analytical Data 2013)

Notes:

Shading indicates detections

J - Analyte present, value may or may not be accurate or precise

J+ - Analyte present, value may be biased high, actual value may be lower

NA - Not analyzed

R - Rejected Result

U - Nondetect

UJ - Nondetect, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

MV - Millivolts

µg/kg - Micrograms per kilogram

*Sample IDs ending in "A" were analyzed for picric acid after being hand ground rather than ground following 8330B procedure for incremental samples.

Appendix D
Human Health Risk Assessment

Human Health Risk Assessment Contents

Acronyms and Abbreviations v

Introduction 1-1
- 1.1 Overview 1-1
- 1.2 Scope of the Risk Assessment 1-1
- 1.3 Potential Receptors 1-1

Data Evaluation 2-1
- 2.1 Data Used in the HHRA 2-1
- 2.2 Selection of Chemicals of Potential Concern 2-1
  - 2.2.1 COPC Screening Levels 2-1
  - 2.2.2 COPC Screening Results 2-2
- 2.3 Hot Spot Evaluation 2-2
- 2.4 Background Comparisons 2-2

Exposure Assessment 3-1
- 3.1 Exposure Pathways Quantified 3-1
- 3.2 Quantification of Exposure 3-1
  - 3.2.1 Exposure Point Concentrations 3-1
  - 3.2.2 Exposure Factors 3-1

Toxicity Assessment 4-1
- 4.1 Non-Carcinogenic Toxicity Values 4-1
- 4.2 Carcinogenic Toxicity Values 4-1
- 4.3 Derivation of Dermal Toxicity Values 4-1

Risk Characterization 5-1
- 5.1 Approach for Potential Non-Carcinogenic Effects 5-1
- 5.2 Approach for Potential Carcinogenic Effects 5-2
- 5.3 Summary of Risk Estimates 5-2
- 5.4 Chemicals of Concern 5-3
- 5.5 Uncertainty Analysis 5-3
  - 5.5.1 Data Evaluation 5-3
  - 5.5.2 Exposure Point Concentrations 5-3
  - 5.5.3 Exposure Assumptions 5-3
  - 5.5.4 Chemicals 100% Non-Detected in a Matrix 5-4

References 6-1

Table

5-1 Uncertainties in the Human Health Risk Assessment 5-4

Attachments

D-1 RAGS Part D Tables
D-2 Figures
D-3 Tables
D-4 Analytical Data Used in the HHRA
D-5 Comparison of Detection Limits and LOQs to Screening Levels
D-6 Comparison of Maximum Detection Limit and LOQ to Adjusted RSLs

Acronyms and Abbreviations

ABS_{GI}	gastrointestinal absorption factor
Cal/EPA	California Environmental Protection Agency
CDI	Chronic Daily Intake
CCP	Comprehensive Conservation Plan
COC	Chemical of Concern
COPC	Chemical of Potential Concern
CSF	Cancer Slope Factor
CSM	conceptual site model
DOI	Department of Interior
EC	Exposure Concentration
ELCR	Excess Lifetime Cancer Risk
EPA	U.S. Environmental Protection Agency
EPC	Exposure Point Concentration
ERP	Environmental Restoration Program
FWS	U.S. Fish and Wildlife Service
HHEM	Human Health Evaluation Manual
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IRIS	Integrated Risk Information System
IUR	Inhalation Unit Risk
IS	incremental sample
MCL	Maximum Contaminant Level
MRL	minimal risk level
PEF	Particulate Emission Factor
PPRTV	Provisional Peer-Reviewed Toxicity Value
RAGS	Risk Assessment Guidance for Superfund
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
SVOC	Semivolatile Organic compound
UCL	Upper Confidence Limit
VNTR	Vieques Naval Training Range
VOC	Volatile Organic Compound
mg/m^3	milligram per cubic meter
mg/kg	milligram per kilogram
mg/kg-day	milligram per kilogram per day
$\mu g/m^3$	microgram per cubic meter
µg/kg	microgram per kilogram

SECTION 1

Introduction

1.1 Overview

This human health risk assessment (HHRA) was prepared for Cayo La Chiva (UXO 18) ("the Site"), Atlantic Fleet Weapons Training Area – Former Vieques Naval Training Range, Vieques, Puerto Rico, based on the analytical data collected for the Remedial Investigation. The approach and assumptions used in the HHRA were presented in the *Master Sampling and Analysis Plan, East Vieques Terrestrial UXO Sites* (hereinafter referred to as the SAP; **CH2M HILL, 2013**) and the *Master Standard Operating Procedures, Protocols, and Plans* (**CH2M HILL, 2010**), hereinafter referred to as the Vieques Master HHRA protocol, for sites in the Vieques Environmental Restoration Program (ERP).

As presented in the HHRA protocol contained in the Vieques Master HHRA protocol, for sites in the Vieques ERP, and in accordance with the U.S. Environmental Protection Agency (EPA) guidance documents, this HHRA consists of a four-step evaluation process comprised of:

- Data evaluation
- Exposure assessment
- Toxicity assessment
- Risk characterization

1.2 Scope of the Risk Assessment

The HHRA was prepared in accordance with the SAP and the Vieques Master HHRA protocol. The protocol is consistent with EPA Region II policy and EPA guidance, including: *Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual, Parts A, D, E, and F* (**EPA, 1989, 2001, 2004, 2009a**), and *Human Health Evaluation Manual (HHEM)*, Supplemental Guidance: of Standard Default Exposure Factors (EPA, 2014a). In addition, other EPA guidance documents were used and are cited in the text and tables.

1.3 Potential Receptors

UXO 18 consists of a 12-acre small island south of the Eastern Maneuver Area of the Former Vieques Naval Training Range. The island is surrounded by the Caribbean Sea and is within swimming distance from a public beach, Blue Beach. UXO 18 is comprised primarily of limestone and dolomite exposed at the ground surface. The shoreline is not sandy and not a suitable turtle nesting area. Groundwater is likely within bedrock and saline due to seawater intrusion. The Former Vieques Naval Training Range was transferred to the Department of the Interior in 2003 to be managed by the U.S. Fish and Wildlife Service (FWS) as a National Wildlife Refuge and, in some places, a Wilderness Area pursuant to Section 1049 of the National Defense Authorization Act for Fiscal Year 2002 (Public Law 107-107) and is to be administered as a wilderness area under the Wilderness Act (16 U.S.C. 1131 et seq); access to the public is to be denied. The site will continue to be managed as part of the wildlife refuge; however, the site has known trespassing activities. The site is designated as a conservation zone (TEC, 2002).

Based on the mandated land use, the only potential receptors present on-site are occasional trespassers and Workers. The Vieques Master HHRA protocol indicates that when sites cannot be released for unrestricted use (e.g., sites within lands Congressionally-mandated as wilderness areas), the Navy may choose not to evaluate the residential land use or other infeasible exposure scenarios. Therefore, the following potential receptors will be evaluated in the HHRA:

- Current Trespassers/Future Recreational Users – adults, youths, and children who may access the site
- Current/Future Workers – workers who may conduct wildlife management activities onsite (conservatively assumed as no future maintenance activities are planned).

The human health conceptual site model (CSM) presents potential exposure media, exposure points, receptors (current and future), and exposure routes, and is provided in **Table 1 of Attachment D-1** and graphically in **Figure 1 of Attachment D-2**.

SECTION 2

Data Evaluation

2.1 Data Used in the HHRA

Soil samples collected in June and November 2013 for the Remedial Investigation (RI) as described in the SAP for the Eastern East Vieques Terrestrial UXO Sites (**CH2M HILL, 2013**) were used in the HHRA. The soil dataset consists of three discrete soil samples collected from the 0-1 feet interval (where smoke canisters had been found) and 2 incremental samples (IS) collected from the 0-2.5 inch interval (from the areas where munitions and explosives constituent items were identified).

Soil data were grouped into a single dataset based on potential exposure scenarios at the site. Subsurface soil (deeper than 1 feet) was not identified as an exposure medium for potentially complete exposure pathways (and was not collected at the site; therefore, subsurface exposures were not addressed in the HHRA

Sampling locations for soil are depicted on **Figure 2-1** of the RI report. **Table 1** of **Attachment D-3** lists samples used in the HHRA. Discrete soil samples were analyzed for one semi-volatile organic compound (SVOC; hexachloroethane), inorganics, explosives, and hexavalent chromium; IS soil samples were analyzed for inorganics, explosives, and hexavalent chromium. A copy of the analytical dataset for the samples used in the HHRA is included in Excel format as **Attachment D-4**.

2.2 Selection of Chemicals of Potential Concern

The chemicals of potential concern (COPCs) are those chemicals that have the greatest potential to cause adverse human health effects if receptors come in contact with site media. COPCs were selected in accordance with the Vieques Master HHRA protocol (**CH2M HILL, 2010**). Chemicals that were 100 percent non-detected in the soil samples used in the HHRA were not selected as COPCs. For samples with field duplicate and triplicate analyses, the highest detected concentration was used when the chemical was detected in any of the samples and the lowest LOQ was used when all values were non-detected.

2.2.1 COPC Screening Levels

The approach used to screen data is consistent with the Vieques Master HHRA protocol. *USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites* (**USEPA, 2013a**) were used to screen site data. The maximum detected concentrations in surface soil were compared to RSLs to identify COPCs for the HHRA. The RSLs are based on a target excess lifetime cancer risk (ELCR) of $1x10^{-6}$ and a non-cancer hazard quotient (HQ) of 1. The RSLs for non-carcinogenic effects were adjusted downward by a factor of 10 to account for cumulative non-cancer effects, with the exception of lead.

EPA considers lead to be a special case because of the difficulty in identifying the classic "threshold" needed to develop an RfD. The screening levels used in the COPC screening for lead were obtained from the *USEPA RSLs for Chemical Contaminants at Superfund Sites* (**USEPA, 2013a**). The industrial soil RSL for lead is 800 mg/kg and is based upon the Adult Lead Methodology (**USEPA, 2009b**) for blood lead levels in workers. The residential RSL for lead is 400 mg/kg and is based upon the IEUBK Model (**USEPA, 1994**) for blood lead levels in children. The lead RSLs are not adjusted downward by a factor of 10.

For trespassers/recreational users, in accordance with the Vieques Master HHRA protocol, concentrations detected in soil were compared to adjusted residential soil RSLs to evaluate COPCs for direct contact exposures with soil. The Vieques Master HHRA protocol does not indicate how media concentrations should be screened for Workers. Therefore, the chemicals detected in soil were screened using the industrial soil RSLs to evaluate direct contact with soil. Since the industrial soil RSLs are based on a default exposure frequency of 250 days/year for 25 years, whereas the site-specific Worker exposure frequency is much lower, the soil screening levels are conservative for the site.

In summary, the RSLs used for each receptor/sample population are indicated below:

- ***Trespassers/Recreational Users*** – Concentrations detected in soil samples collected from the 0-1 foot interval were compared to adjusted residential soil RSLs to evaluate COPCs for direct contact exposures with soil.
- ***Workers*** – Concentrations detected in soil samples collected from the 0-1 foot interval were compared to adjusted industrial soil RSLs to evaluate COPCs for direct contact exposures with soil.

2.2.2 COPC Screening Results

The analytes with maximum detected concentrations exceeding screening levels were identified as COPCs. Results of the COPC screening process for each receptor group are presented in Tables 2.1 and 2.2 of Attachment D-1 and are summarized below:

Trespassers/Recreational Users:

- Six metals (aluminum, arsenic, cobalt, iron, manganese, and thallium) were identified as COPCs in surface soil for the direct contact exposure pathways (**Table 2.1 of Attachment D-1**).

Workers:

- One metal (arsenic) was identified as a COPC in surface soil for the direct contact exposure pathways (**Table 2.2 of Attachment D-1**).

2.3 Hot Spot Evaluation

A review of site data was conducted to determine if potential hot spots were present in exposure media that may require a separate exposure evaluation. The detected concentrations were compared to 10 times the adjusted residential and industrial soil RSLs (i.e., resulting in an HQ = 1 and ELCR of $1x10^{-5}$) to determine the presence (if any) of a discrete area where concentrations are considerably higher than those present in the surrounding area. No detected concentrations exceeded 10 times their respective residential or industrial soil RSLs. Therefore, it was concluded that no discrete hot spots are present that warrant separate risk evaluation.

2.4 Background Comparisons

The maximum detected concentrations of inorganics in surface soil were also compared to background soil concentrations established for East Vieques (TI soil type). With the exception of thallium, the maximum detected concentrations of all inorganicsin site surface soil were less than their respective background concentrations (**Table 2.1 of Appendix D-1**); however, these constituents were not eliminated as COPCs based on comparison to background.

SECTION 3

Exposure Assessment

3.1 Exposure Pathways Quantified

Because the Master HHRA protocol does not provide exposure factors for the specific receptors at UXO 18 (trespassers and Workers), conservative approaches were used for these site-specific receptors based on default approaches for receptors with more exposure potential that are presented in the protocol. Potential exposure pathways quantified for these two receptor groups are presented below:

- **Trespassers/Recreational Users** – Ingestion, dermal contact, and inhalation exposure to COPCs in surface soil (0-1 ft) were quantified for adult, youth, and child trespassers/recreational users; exposure point concentrations (EPCs) are presented in **Table 3.1. RME of Attachment D-1**. Ambient air concentrations calculated using the EPCs in surface soil and the site particulate emission factor (PEF) are presented in **Table 3.1. RME Supplement A of Attachment D-1**.
- **Workers** – Ingestion, dermal contact, and inhalation exposure to the COPC in surface soil (0-1 ft) was quantified for Workers; the EPC is presented in **Table 3.2. RME of Attachment D-1**. The ambient air concentration calculated using the EPC in surface soil and the site PEF is presented in **Table 3.2. RME Supplement A of Attachment D-1**.

3.2 Quantification of Exposure

To evaluate the potentially complete exposure pathways further, the magnitude, frequency, and duration of exposures were estimated and quantified. EPCs were identified and pathway-specific intakes were estimated. EPA guidance (1989) recommends selecting intake variable values for a given pathway so that the combination of all intake variable values results in an estimate of the reasonable maximum exposure (RME) for that pathway. EPA recommends using upper-bound parameter values (as opposed to average values) for exposure frequency and exposure duration. EPA guidance also recommends that the contact rate be a value representing the 95th percentile.

3.2.1 Exposure Point Concentrations

For each soil COPC identified for the receptor groups, a sufficient number of samples (eight or more samples) to calculate the 95 percent upper confidence limit on the mean was not available in the dataset. Therefore, the maximum detected concentration of each COPC was used as the EPC in the HHRA.

3.2.2 Exposure Factors

An RME scenario was quantified for potential current and future receptors (**EPA, 1989**). The exposure factors used **i**n the intake calculations are presented in **Tables 4.1. RME** and **4.2. RME** of **Attachment D-1.** The primary references for exposure factors are standard default exposure factors presented in EPA guidance **(EPA, 2004; 2014a)**. Based on information provided in SAP Worksheet #10o (CH2MHILL, 2013), the shoreline is not a suitable turtle nesting area. In addition, there are no surface water features on the small (12-acre) island. Based on professional judgment, the primary purpose for current or future workers to be present onsite is for general wildlife and/or recreational management activities; 35 days/year is expected to be a reasonable exposure frequency for current and future site workers.

A site-specific PEF was calculated for use in estimating current and future inhalation exposures for trespassers/recreational users and Workers (**Table 4 RME Supplement A** of **Attachment D-1**). The PEF was calculated using Equation 4-5 and Exhibit D-2 of the *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (**EPA, 2002**). Climate Zone 9 (based on Miami, FL) and a 0.09-acre aerial extent of site contamination (based on the area of screening level exceedances) were used in the site-specific PEF calculations.

In accordance with EPA Region II policy, the dermal exposure route for soil was quantified for COPCs with dermal absorption fraction from soil (DABS) values presented in Exhibit 3-4 of the EPA's *Risk Assessment Guidance for*

Superfund Volume I: Human Health Evaluation Manual - Part E, Supplemental Guidance for Dermal Risk Assessment (**EPA, 2004**). The DABS values used in this HHRA are presented in **Table 4 RME Supplement B** of **Attachment D-1.**

SECTION 4

Toxicity Assessment

The following hierarchy of sources was used to obtain toxicity data for COPCs (**EPA, 2003**):

- Tier 1: EPA's IRIS database (**EPA, 2014**)
- Tier 2: Provisional Peer-Reviewed Toxicity Value (PPRTV) database maintained by the EPA's National Center for Environmental Assessment and the Superfund Health Risk Technical Support Center
- Tier 3: Other peer-reviewed federal and state toxicity values (**EPA, 2013b**)
  - Minimal risk levels (MRL) identified by the Agency for Toxic Substances and Disease Registry
  - California Environmental Protection Agency Toxicity Criteria Database (Cal/EPA, **2014**)
  - Screening toxicity values presented in an appendix to certain PPRTV assessments

Non-cancer toxicity values used in the HHRA are presented in **Tables 5.1 and 5.2 of Attachment D-1**. Cancer toxicity values for COPCs are provided in **Tables 6.1 and 6.2 of Attachment D-1**.

4.1 Non-Carcinogenic Toxicity Values

Non-carcinogenic toxicity values (oral reference doses [RfDs] and inhalation reference concentrations [RfCs]) were used in estimating potential adverse health effects associated with exposure to COPCs. Chronic toxicity data for potential non-carcinogenic effects of COPCs are presented in **Tables 5.1 and 5.2 of Attachment D-1**.

4.2 Carcinogenic Toxicity Values

Carcinogenic toxicity values (cancer slope factors [CSFs] and inhalation unit risks [IURs]) were used in evaluating potential carcinogenic effects associated with exposure to known, probable, or possible carcinogens having an EPA weight-of-evidence classification of A, B, or C, respectively. CSFs and IURs were used to estimate upper-bound lifetime statistical probabilities of a hypothetical individual developing cancer as a result of exposure to a potential carcinogen. Toxicity data for potential carcinogenic effects for COPCs are presented in **Tables 6.1 and 6.2 of Attachment D-1**.

4.3 Derivation of Dermal Toxicity Values

In general, oral RfDs and CSFs are converted to dermal RfDs and CSFs using a gastrointestinal absorption factor (ABS_{GI}). The values used for this conversion were obtained from *RAGS Part E* Section 4.2 and Exhibit 4-1 (**EPA, 2004**). Following EPA's recommendation (**EPA, 2004**), such a conversion is necessary only when a chemical has an ABS_{GI} of less than 50%. If a chemical-specific gastrointestinal absorption factor was not available, gastrointestinal absorption of the chemical was assumed to be 100% and the oral RfD (or oral CSF) was used as the dermal RfD (or dermal CSF) without adjustment.

SECTION 5

Risk Characterization

Potential human health risks are discussed separately for carcinogenic and non-carcinogenic COPCs due to the different toxicological endpoints, relevant exposure durations, and methods used to estimate risk. EPA Superfund guidance considers an acceptable site ELCR range to be within 1 to 100 in a million ($1x10^{-6}$ to $1x10^{-4}$). Generally, remedial actions are not warranted for site media with an ELCR of $1x10^{-4}$ or below, or a Hazard Index (HI) of 1 or less, although it may be warranted if a standard (e.g., maximum contaminant level [MCL]) is exceeded, or if other site-specific information suggests to risk managers that action is appropriate.

5.1 Approach for Potential Non-Carcinogenic Effects

The HHRA evaluated the potential for non-carcinogenic effects by comparing exposure intakes of each COPC over a specified time period (chronic) with RfDs derived for similar exposure periods. In EPA methodology, this ratio of exposure to toxicity is referred to as a HQ. The HQ assumes that there is a level of exposure below which it is unlikely for even sensitive populations to experience adverse health effects. If the exposure level exceeds this threshold, there is the potential for non-cancer health effects to occur. The HQ is calculated as follows:

$$HQ = \frac{I}{RfD}$$

Where:

HQ = Hazard quotient

I = Intake level (mg/kg-day)

RfD = Reference dose (mg/kg-day)

Intake and RfD are expressed in the same units (mg/kg-day) and represent the same exposure period. A HQ that exceeds 1 (i.e., intake exceeds the RfD) indicates that there is a potential for adverse health effects associated with exposure to that COPC.

To assess the potential for non-carcinogenic health effects posed by exposure to multiple COPCs and exposure routes, an HI approach was used (**EPA, 1989**). This approach assumes that non-carcinogenic hazards associated with exposure to more than one COPC and exposure route are additive. Synergistic or antagonistic interactions between COPCs are not quantified. The HI may exceed 1 even if all of the individual HQs are less than 1. The HI is equal to the sum of the HQs and is calculated as follows:

$$HI = \frac{I_1}{RfD_1} + \frac{I_2}{RfD_2} + \ldots \frac{I_i}{RfD_i}$$

Where:

HI = Hazard index

I = Intake level (mg/kg-day)

RfD = Reference dose (mg/kg-day)

I_i = Intake level for the "*i*"th constituent

RfD_i = Reference dose for the "*i*"th constituent

5.2 Approach for Potential Carcinogenic Effects

The potential for carcinogenic effects due to exposure to site media was evaluated by estimating the ELCR. The ELCR is the incremental increase in the probability of developing cancer during one's lifetime (as a result of exposure to site media) above the probability of developing cancer from non-site exposures.

Potential ELCRs associated with exposure to individual carcinogens were calculated using CSFs and chronic daily intakes (CDIs) for oral and dermal contact exposures and IURs and exposure concentrations (ECs) for inhalation exposures. The linear low-dose equation was used to estimate the incremental probability of an individual developing cancer over a lifetime as a result of exposure to potential carcinogens. Estimated ELCRs are calculated by multiplying the CDI by the CSF or EC by the IUR:

$$ELCR = CDI \times CSF \quad \text{or} \quad ELCR = EC \times IUR$$

Where:

ELCR = unitless probability of developing cancer

CDI = chronic daily intake (mg/kg-day)

CSF = cancer slope factor $(mg/kg\text{-}day)^{-1}$

EC = exposure concentration [microgram per cubic meter ($\mu g/m^3$)]

IUR = inhalation unit risk $(\mu g/m^3)^{-1}$

The theoretical probability of developing cancer as a consequence of exposure to two or more COPCs and by two or more exposure pathways was calculated by summing the risk estimates for each COPC in the appropriate scenarios using the following equation:

$$Total\ ELCR = (CDI_1 \times CSF_1) + (CDI_2 \times CSF_2) + \ldots (CDI_i \times CSF_i) + (EC_1 \times IUR_1) + (EC_2 \times IUR_2) + \ldots (EC_i \times IUR_j)$$

Where:

CDI = Chronic daily intake (mg/kg-day)

CSF = Cancer slope factor $(mg/kg\text{-}day)^{-1}$

CDI_i = Chronic daily intake for the '*i*'th constituent

CSF_i = Cancer slope factor for the '*i*'th constituent

EC = Exposure concentration ($\mu g/m^3$)

IUR = Inhalation unit risk $(\mu g/m^3)^{-1}$

EC_j = Exposure concentration for the 'j'th constituent

IUR_j = Inhalation unit risk for the '*j*'th constituent

5.3 Summary of Risk Estimates

Potential risk associated with exposures to COPCs in soil were quantified for the RME scenarios identified below. The calculated ELCRs and HIs are as follows:

- **Trespassers/Recreational Users – Current/Future Scenarios**

  Surface soil (ingestion, dermal contact, and inhalation)

  - Adult: $1x10^{-6}$ ELCR, all target organ-specific HI <1 (**Table 7.1 RME**, summarized **in Table 9.1 RME of Attachment D-1**)
  - Youth: $9x10^{-7}$ ELCR, all target organ-specific HI <1 (**Table 7.2 RME**, summarized **in Table 9.2 RME of Attachment D-1**)

- Child: $3x10^{-6}$ ELCR, all target organ-specific HI<1 (**Table 7.3 RME**, summarized **in Table 9.3 RME of Attachment D-1**)

- **Workers – Current/Future Scenarios**

  Surface Soil (ingestion, dermal contact, and inhalation)

  - $4x10^{-7}$ cumulative ELCR, all target organ specific HI<1 (**Table 7.4 RME**, summarized in **Table 9.4 RME of Attachment D-1**)

5.4 Chemicals of Concern

In general, chemicals of concern (COCs) are identified when the potential ELCR or HI for a receptor group exceeds EPA threshold values (a total ELCR of $1x10^{-4}$ or a target organ-specific HI of 1) and concentrations are site-related and above background levels. When a potential ELCR of $1x10^{-4}$ is exceeded for an exposure medium for a receptor group, the COPCs above background levels and posing an individual ELCR greater than $1x10^{-6}$ in the environmental medium responsible for the unacceptable risks are identified as COCs. When a potential target organ-specific HI exceeds 1 for an exposure medium for a receptor group, the COPCs above background levels and posing a HQ greater than 0.1 for that target organ in the environmental medium responsible for the unacceptable HI are identified as COCs. Factors such as nature of contamination source, laboratory contamination, and common pesticide use (unrelated to spills, improper storage disposal or use) are typically considered when identifying COCs.

Risk estimates for current and future receptor groups were within EPA acceptable levels. The potential ELCRs for the exposure scenarios evaluated at the site were within or less than the target ELCR range of $1x10^{-6}$ to $1x10^{-4}$. Additionally, all estimated target organ-specific HIs were less than the threshold of 1. Additionally, the maximum detected concentration of all COPCs identified in surface soil except thallium are below their respective background concentrations. Therefore, no COCs were identified at the site.

5.5 Uncertainty Analysis

The assumptions used in the HHRA have inherent uncertainty. While it is theoretically possible that this leads to underestimates of potential risk, the use of numerous upper-bound assumptions most likely results in conservative estimates of potential risk. A receptor group's potential exposure and subsequent potential risk are influenced by the exposure scenario and dose/response and vary on a case-by-case basis. The key assumptions in the HHRA and their influence on the numerical risk estimates are presented in **Table 5-1** below. Additionally, specific uncertainties associated with the HHRA f are discussed below.

5.5.1 Data Evaluation

The purpose of data evaluation is to determine which constituents, if any, are present at the site at concentrations requiring evaluation in the HHRA. Uncertainty with respect to data evaluation can arise from many sources, such as the quality of data used to characterize the site and the process used to select data and COPCs in the HHRA.

5.5.2 Exposure Point Concentrations

The maximum detected concentrations of COPCs in surface soil were selected as EPCs because there were less than eight surface soil samples in the dataset. Using the maximum detected concentrations as EPCs will likely lead to an overestimation of actual exposure because receptors are assumed to be exposed to COPCs at the maximum detected concentration for their entire exposure duration. The ITRC's online Incremental Sampling Methodology (ISM) Calculator was used to calculate 95% UCLs of the incremental samples using both Chebyshev and Student's-t methods (Table 1 of Attachment D-5). The maximum detected concentrations (between the three replicates) were used to represent the sampling unit with the replicates, consistent with the SAP (CH2MHILL, 2013). The calculated 95% UCLs were higher than the maximum detected concentrations of the two incremental samples, but lower than the maximum detected concentrations of the discrete samples (Table 2 of Attachment D-5).

5.5.3 Exposure Assumptions

In accordance with EPA guidance and the Vieques Master HHRA protocol (CH2M HILL, 2010), exposure estimates were calculated for a RME scenario. A RME scenario results in upper-bound exposure estimates and likely overestimates actual site exposures. The Master HHRA Protocol does not provide exposure factors for the specific

receptors at UXO 18 (trespassers and Workers) and the RME scenarios on which exposure estimates were calculated were based on receptors with more exposure potential; therefore, the exposure assumptions used in this HHRA are expected to be very conservative. For example, it was assumed that trespassers are exposed at a frequency of 104 days/year and Workers are exposed at a frequency of 35 days/year. A RME scenario results in upper-bound exposure estimates and likely overestimates actual site exposures. Any actual risks are likely to be less than the potential risks presented in this HHRA.

5.5.4 Chemicals 100% Non-Detected in a Matrix

For chemicals that were 100 percent non-detected in surface soil, the maximum detection limits and LOQs were compared to the EPA RSLs for residential soil (adjusted to an HI of 0.1). The comparison is provided in **Attachment D-5**. The maximum LOQs of all 100% non-detected chemicals were below the adjusted residential soil RSLs except 2,6-dinitrotoluene and hexavalent chromium.

Although the maximum LOQ of 2,6-dinitrotoluene is above its RSL (based on an ELCR of $1x10^{-6}$), its detection limit was below its RSL. This results in little impact on the overall risk outcome. If the chemical was actually present at a concentration above the detection limit, then typically the laboratory would have reported it as an estimated concentration ("J" qualified) instead of a non-detect.

The maximum detection limits and LOQs of hexavalent chromium were above its RSL (based on an ELCR of $1x10^{-6}$). However, the maximum detection limit and LOQ were within EPA's acceptable risk range (10^{-6} to 10^{-4}). Therefore, the elevated detection limits and LOQs result in little impact on the overall risk results. In addition, it is notable that the range of inorganic concentrations detected at the site was comparable to background levels, indicating no evidence of a metals release at the site.

TABLE 5-1
Uncertainties In the Human Health Risk Assessment

Category	Methodology	Probable Effect on Site-Related Risk Estimates
DATA EVALUATION		
Chemicals that were 100% non-detected	100% non-detected chemicals were assumed to be not present in soil	No significant impact
Selection of COPCs	Chemicals detected in soil at concentrations below background levels were retained as COPCs	Overestimates
EXPOSURE ASSESSMENT		
Selection of exposure scenarios and exposure pathways	Conservative exposure assumptions were used to quantify chemical exposure by trespassers and Workers	Overestimates
Exposure point concentrations	Receptors are assumed to be exposed to COPCs at the maximum detected concentration for the entire exposure duration	Likely overestimates
TOXICITY ASSESSMENT		
Missing toxicity values	Inhalation non-cancer toxicity values are missing for iron and thallium	May underestimate
Study selection	Not all toxicity values represent the same degree of certainty; all values are subject to change as new evidence becomes available	Under- or overestimates
Toxicity values derived primarily from high doses (whereas most environmental exposures occur at low doses)	Assumes linearity at low doses and tends to have conservative exposure assumptions	Under- or overestimates
RISK CHARACTERIZATION		
Risk from multiple chemicals	Assumes additivity of risks from multiple chemicals; chemical mixtures may actually have synergistic or antagonistic effects	May under- or overestimate
Combination of several upper-bound assumptions	Various upper-bound exposure and toxicity assumptions are combined	Overestimates

SECTION 6

References

California EPA (Cal/EPA). 2014. Toxicity Criteria Database. Office of Environmental Health Hazard Assessment. [Online]. Available: http://www.oehha.ca.gov/risk/ChemicalDB/index.asp.

CH2M HILL. 2010. Final Master Standard Operating Procedures, Protocols, and Plans for the Environmental Restoration Program, Vieques, Puerto Rico. April.

CH2M HILL. 2011. Remedial Investigation Sampling and Analysis Plan, Eastern Conservation Area, Former Vieques Naval Training Range, Vieques, Puerto Rico. January.

CH2M HILL. 2013. Final Master Sampling and Analysis Plan East Vieques Terrestrial UXO Sites. Atlantic Fleet Weapons Training Area – Vieques, Former Vieques Naval Training Range, Vieques, Puerto Rico. April.

U.S. Environmental Protection Agency (EPA). 1989. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response. EPA/540/1-89/002. December.

EPA. 1994. Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. OSWER Directive 9355.4-12

EPA. 1997. *Exposure Factors Handbook.* Office of Research and Development. EPA/600/P-95/002F. August.

EPA. 2000. *Bioaccumulation testing and interpretation for the purpose of sediment quality assessment - status and needs*. EPA/823/R-00/001.

EPA. 2001. *Risk Assessment Guidance for Superfund (RAGS); Volume I - Human Health Evaluation Manual* (Part D, Standardized Planning, Reporting and Review of Superfund Risk Assessments). Final. December.

EPA. 2002. *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.* Office of Solid Waste and Emergency Response. OSWER 9355.4-24. December.

EPA. 2003. *Human Health Toxicity Values in Superfund Risk Assessments.* OSWER Directive 9285.7-53. December 5.

EPA. 2004. *Risk Assessment Guidance for Superfund, Volume I: HHEM (Part E, Supplemental Guidance for Dermal Risk Assessment).* Final. EPA/540/R-99/005. July.

EPA. 2009a. *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment).* EPA-540-R-070-002. OSWER 9285.7.82. January.

EPA. 2009b. *Update of the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters.* OSWER 9200.2-82. June 2009.

EPA. 2013a. *Regional Screening Levels for Chemical Contaminants at Superfund Sites*. [Online]. Available: http://www.epa.gov/region09/waste/sfund/prg/index.html. November.

EPA. 2013b. *Tier 3 Toxicity Value White Paper*. OSWER 9285.7-86. May.

EPA. 2014. *Integrated Risk Information System (IRIS) Database*. [Online]. Available: http://www.epa.gov/iris/index.html.

EPA. 2014a. Memorandum, Subject: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 6, 2014.

TEC. 2002. *Environmental Assessment for Proposed Cessation of Navy and Marine Corps Training at Vieques Naval Training Range (VNTR)*, *Vieques Island, Puerto Rico*. November.

Attachment D-1
RAGS Part D Tables

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
Cayo La Chiva (UXO-18)
Former Vieques Naval Training Range
Vieques, Puerto Rico

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population (1)	Receptor Age (2)	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Soil	Surface Soil (0-1 feet)	Surface Soil (0-1 feet)	Trespasser	Adult/Youth/Child	Dermal	On-site	Quant	Trespassers may contact surface soil while at the site.
						Ingestion	On-site	Quant	
		Ambient Air	Emissions from Surface Soil	Trespasser	Adult/Youth/Child	Inhalation	On-site	Quant	Trespassers may inhale dust from surface soil while at the site.
Current/Future		Surface Soil (0-1 feet)	Surface Soil (0-1 feet)	Worker	Adult	Dermal	On-site	Quant	Based on likely occupational duties, it is assumed that FWS workers may come in contact with surface soil.
						Ingestion	On-site	Quant	
		Ambient Air	Emissions from Surface Soil	Worker	Adult	Inhalation	On-site	Quant	Based on likely occupational duties, it is assumed that FWS workers may inhale dust from surface soil.
Future		Surface Soil (0-1 feet)	Surface Soil (0-1 feet)	Recreational User	Adult/Youth/Child	Dermal	On-site	Quant	Recreational users may contact surface soil while at the site.
						Ingestion	On-site	Quant	
		Ambient Air	Emissions from Surface Soil	Recreational User	Adult/Youth/Child	Inhalation	On-site	Quant	Recreational users inhale dust from surface soil while at the site.

Notes:
(1) Because of the similar exposure characteristics, risks were evaluated for current trespassers and future recreational users together.
(2) The age group for a child is 1-6 and the age group for youth is 6-16 years old.
Quant: Quantitative

TABLE 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Cayo La Chiva (UXO-18)

Former Vieques Naval Training Range

Vieques, Puerto Rico

Scenario Timeframe: Current (Trespasser)/Future (Recreational User)
Medium: Soil
Exposure Medium: Surface Soil (0-1 feet)

Exposure Point	CAS Number	Chemical	Minimum Concentration Qualifier		Maximum Concentration Qualifier		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Selection or Deletion (4)
Surface Soil (0 - 1 feet)	7429-90-5	Aluminum	2.62E+02	J	9.72E+03		mg/kg	VE-UXO18-01SO03	5 / 5	-	9.72E+03	3.50E+04	7.70E+03	nc	NA	NA	Yes	ASL
	7440-38-2	Arsenic	2.20E+00	J	4.80E+00		mg/kg	VE-UXO18-01SO03	3 / 5	0.3 - 0.3	4.80E+00	9.20E+00	6.10E-01	ca	NA	NA	Yes	ASL
	7440-39-3	Barium	2.40E+00		4.90E+01	J	mg/kg	VE-UXO18-01SO02	5 / 5	-	4.90E+01	2.12E+02	1.50E+03	nc	NA	NA	No	BSL
	7440-41-7	Beryllium	9.00E-02	J	9.00E-02	J	mg/kg	VE-UXO18-01SO03	1 / 5	0.2 - 0.25	9.00E-02	9.50E-01	1.60E+01	nc	NA	NA	No	BSL
	7440-43-9	Cadmium	1.80E-01	J	3.20E-01	J	mg/kg	VE-UXO18-01SO02	3 / 5	0.08 - 0.08	3.20E-01	2.40E+00	7.00E+00	nc	NA	NA	No	BSL
	7440-70-2	Calcium	2.71E+04		2.65E+05		mg/kg	VE-UXO18-01SO01	5 / 5	-	2.65E+05	4.17E+05	NUT	-	NA	NA	No	NUT
	7440-47-3	Chromium	6.90E-01		1.14E+01		mg/kg	VE-UXO18-01SO03	5 / 5	-	1.14E+01	7.00E+01	1.20E+04	nc	NA	NA	No	BSL
	7440-48-4	Cobalt	9.80E-02	J	2.50E+00		mg/kg	VE-UXO18-01SO02	5 / 5	-	2.50E+00	1.60E+01	2.30E+00	nc	NA	NA	Yes	ASL
	7440-50-8	Copper	4.60E-01	J	1.36E+01		mg/kg	VE-UXO18-01SO03	5 / 5	-	1.36E+01	9.40E+01	3.10E+02	nc	NA	NA	No	BSL
	7439-89-6	Iron	1.85E+02		7.71E+03		mg/kg	VE-UXO18-01SO03	5 / 5	-	7.71E+03	3.81E+04	5.50E+03	nc	NA	NA	Yes	ASL
	7439-92-1	Lead	2.00E-01	J	2.00E+00		mg/kg	VE-UXO18-01SO03	2 / 5	0.4 - 0.49	2.00E+00	1.60E+01	4.00E+02	IEUBK	NA	NA	No	BSL
	7439-95-4	Magnesium	6.20E+02	J	1.23E+04		mg/kg	VE-UXO18-01SO03	5 / 5	-	1.23E+04	2.22E+04	NUT	-	NA	NA	No	NUT
	7439-96-5	Manganese	1.93E+01		3.15E+02		mg/kg	VE-UXO18-01SO03	5 / 5	-	3.15E+02	1.63E+03	1.80E+02	nc	NA	NA	Yes	ASL
	7440-02-0	Nickel	1.70E-01	J	3.80E+00		mg/kg	VE-UXO18-01SO03	5 / 5	-	3.80E+00	4.10E+01	1.50E+02	nc	NA	NA	No	BSL
	7440-09-7	Potassium	7.09E+01	J	2.35E+03		mg/kg	VE-UXO18-01SO03	5 / 5	-	2.35E+03	1.08E+04	NUT	-	NA	NA	No	NUT
	7782-49-2	Selenium	1.20E-01	J	9.80E-01	J+	mg/kg	VE-UXO18-01SO03	3 / 5	0.1 - 0.57	9.80E-01	1.30E+00	3.90E+01	nc	NA	NA	No	BSL
	7440-23-5	Sodium	6.17E+01	J	6.27E+02	J	mg/kg	VE-UXO18-01SO02	5 / 5	-	6.27E+02	1.59E+03	NUT	-	NA	NA	No	NUT
	7440-28-0	Thallium	5.50E-01	J+	5.50E-01	J+	mg/kg	VE-UXO18-01SO03	1 / 5	0.05 - 0.31	5.50E-01	1.30E-01	7.80E-02	nc	NA	NA	Yes	ASL
	7440-62-2	Vanadium	5.00E-01	J	1.46E+01		mg/kg	VE-UXO18-01SO03	5 / 5	-	1.46E+01	5.60E+01	3.90E+01	nc	NA	NA	No	BSL
	7440-66-6	Zinc	2.90E+00	J	2.37E+01		mg/kg	VE-UXO18-01SO03	5 / 5	-	2.37E+01	3.20E+01	2.30E+03	nc	NA	NA	No	BSL

(1) Maximum concentration is used for screening.

(2) Background values are the 95 percent upper confidence limit of the 95th percentile (95/95 UTL) for East Vieques soil type TI.

(3) Regional Screening Levels for Residential Soil (November 2013). Concentrations based on non-carcinogenic health effects are adjusted using an HQ=0.1.

The SL for 'Cadmium (diet)' was used as the SL for Cadmium.
The SL for 'Chromium III' was used as the SL for Chromium.
The SL for Lead is based on the USEPA lead working group.
The SL for 'Manganese Non-diet' was used as the SL for Manganese.
The SL for 'Nickel Soluble Salts' was used as the SL for Nickel.
The SL for 'Vanadium and compounds' was used as the SL for Vanadium.
The SL for 'Zinc and compounds' was used as the SL for Zinc.

(4) Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
Essential Nutrient (NUT)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
ca = Carcinogenic
nc = Noncarcinogenic
HQ = Hazard quotient
NA = Not available
J - Estimated result
J+ - Estimated result; potential positive bias
SL = Screening Level
IEUBK = Integrated Exposure Uptake Biokinetic Model
mg/kg= milligrams/kilogram

TABLE 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
Cayo La Chiva (UXO-18)
Former Vieques Naval Training Range
Vieques, Puerto Rico

Scenario Timeframe: Current/Future (Worker)
Medium: Soil
Exposure Medium: Surface Soil (0-1 feet)

Exposure Point	CAS Number	Chemical	Minimum Concentration Qualifier		Maximum Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Selection or Deletion (4)
Surface Soil (0 - 1 feet)	7429-90-5	Aluminum	2.62E+02	J	9.72E+03	mg/kg	VE-UXO18-01SO03	5 / 5	-	9.72E+03	3.50E+04	9.90E+04	nc	NA	NA	No	BSL
	7440-38-2	Arsenic	2.20E+00	J	4.80E+00	mg/kg	VE-UXO18-01SO03	3 / 5	0.3 - 0.3	4.80E+00	9.20E+00	2.40E+00	ca	NA	NA	Yes	ASL
	7440-39-3	Barium	2.40E+00		4.90E+01	mg/kg	VE-UXO18-01SO02	5 / 5	-	4.90E+01	2.12E+02	1.90E+04	nc	NA	NA	No	BSL
	7440-41-7	Beryllium	9.00E-02	J	9.00E-02	mg/kg	VE-UXO18-01SO03	1 / 5	0.2 - 0.25	9.00E-02	9.50E-01	2.00E+02	nc	NA	NA	No	BSL
	7440-43-9	Cadmium	1.80E-01	J	3.20E-01	mg/kg	VE-UXO18-01SO02	3 / 5	0.08 - 0.08	3.20E-01	2.40E+00	8.00E+01	nc	NA	NA	No	BSL
	7440-70-2	Calcium	2.71E+04		2.65E+05	mg/kg	VE-UXO18-01SO01	5 / 5	-	2.65E+05	4.17E+05	NUT	-	NA	NA	No	NUT
	7440-47-3	Chromium	6.90E-01		1.14E+01	mg/kg	VE-UXO18-01SO03	5 / 5	-	1.14E+01	7.00E+01	1.00E+05	max	NA	NA	No	BSL
	7440-48-4	Cobalt	9.80E-02	J	2.50E+00	mg/kg	VE-UXO18-01SO02	5 / 5	-	2.50E+00	1.60E+01	3.00E+01	nc	NA	NA	No	BSL
	7440-50-8	Copper	4.60E-01	J	1.36E+01	mg/kg	VE-UXO18-01SO03	5 / 5	-	1.36E+01	9.40E+01	4.10E+03	nc	NA	NA	No	BSL
	7439-89-6	Iron	1.85E+02		7.71E+03	mg/kg	VE-UXO18-01SO03	5 / 5	-	7.71E+03	3.81E+04	7.20E+04	nc	NA	NA	No	BSL
	7439-92-1	Lead	2.00E-01	J	2.00E+00	mg/kg	VE-UXO18-01SO03	2 / 5	0.4 - 0.49	2.00E+00	1.60E+01	8.00E+02	IEUBK	NA	NA	No	BSL
	7439-95-4	Magnesium	6.20E+02	J	1.23E+04	mg/kg	VE-UXO18-01SO03	5 / 5	-	1.23E+04	2.22E+04	NUT	-	NA	NA	No	NUT
	7439-96-5	Manganese	1.93E+01		3.15E+02	mg/kg	VE-UXO18-01SO03	5 / 5	-	3.15E+02	1.63E+03	2.30E+03	nc	NA	NA	No	BSL
	7440-02-0	Nickel	1.70E-01	J	3.80E+00	mg/kg	VE-UXO18-01SO03	5 / 5	-	3.80E+00	4.10E+01	2.00E+03	nc	NA	NA	No	BSL
	7440-09-7	Potassium	7.09E+01	J	2.35E+03	mg/kg	VE-UXO18-01SO03	5 / 5	-	2.35E+03	1.08E+04	NUT	-	NA	NA	No	NUT
	7782-49-2	Selenium	1.20E-01	J	9.80E-01	mg/kg	VE-UXO18-01SO03	3 / 5	0.1 - 0.57	9.80E-01	1.30E+00	5.10E+02	nc	NA	NA	No	BSL
	7440-23-5	Sodium	6.17E+01	J	6.27E+02	mg/kg	VE-UXO18-01SO02	5 / 5	-	6.27E+02	1.59E+03	NUT	-	NA	NA	No	NUT
	7440-28-0	Thallium	5.50E-01	J+	5.50E-01	mg/kg	VE-UXO18-01SO03	1 / 5	0.05 - 0.31	5.50E-01	1.30E-01	1.00E+00	nc	NA	NA	No	BSL
	7440-62-2	Vanadium	5.00E-01	J	1.46E+01	mg/kg	VE-UXO18-01SO03	5 / 5	-	1.46E+01	5.60E+01	5.10E+02	nc	NA	NA	No	BSL
	7440-66-6	Zinc	2.90E+00	J	2.37E+01	mg/kg	VE-UXO18-01SO03	5 / 5	-	2.37E+01	3.20E+01	3.10E+04	nc	NA	NA	No	BSL

(1) Maximum concentration is used for screening.

(2) Background values are the 95 percent upper confidence limit of the 95th percentile (95/95 UTL) for East Vieques soil type TI.

(3) Regional Screening Levels for Industrial Soil (November 2013). Concentrations based on non-carcinogenic health effects are adjusted using an HQ=0.1.

The SL for 'Cadmium (diet)' was used as the SL for Cadmium.
The SL for 'Chromium III' was used as the SL for Chromium.
The SL for Lead is based on the USEPA lead working group.
The SL for 'Manganese Non-diet' was used as the SL for Manganese.
The SL for 'Nickel Soluble Salts' was used as the SL for Nickel.
The SL for 'Vanadium and compounds' was used as the SL for Vanadium.
The SL for 'Zinc and compounds' was used as the SL for Zinc.

(4) Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
Essential Nutrient (NUT)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
ca = Carcinogenic
nc = Noncarcinogenic
HQ = Hazard quotient
NA = Not available
J - Estimated result
J+ - Estimated result; potential positive bias
SL = Screening Level
IEUBK = Integrated Exposure Uptake Biokinetic Model
mg/kg= milligrams/kilogram

TABLE 3.1.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

Cayo La Chiva UXO-18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Scenario Timeframe: Current (Trespasser)/Future (Recreational User)
Medium: Soil
Exposure Medium: Surface Soil (0-1 feet)

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL	Maximum Concentration (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Surface Soil (0 - 1 feet)	Aluminum	mg/kg	3.74E+03	NA	9.7E+03		9.7E+03	mg/kg	Maximum Detected Concentration	(1)
	Arsenic	mg/kg	1.90E+00	NA	4.8E+00		4.8E+00	mg/kg	Maximum Detected Concentration	(1)
	Cobalt	mg/kg	1.53E+00	NA	2.5E+00		2.5E+00	mg/kg	Maximum Detected Concentration	(1)
	Iron	mg/kg	2.93E+03	NA	7.7E+03		7.7E+03	mg/kg	Maximum Detected Concentration	(1)
	Manganese	mg/kg	1.37E+02	NA	3.2E+02		3.2E+02	mg/kg	Maximum Detected Concentration	(1)
	Thallium	mg/kg	1.79E-01	NA	5.5E-01	J+	5.5E-01	mg/kg	Maximum Detected Concentration	(1)

(1) The maximum detected concentration was used for this chemical because there were less than 8 total samples.

mg/kg = milligrams/kilogram
J+ - Estimated result; potential positive bias
NA = Not applicable

TABLE 3.1.RME Supplement A

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

Cayo La Chiva UXO-18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Scenario Timeframe: Current (Trespasser)/Future (Recreational User)
Medium: Soil
Exposure Medium: Ambient Air

Exposure Point	Chemical of Potential Concern	Exposure Point Concentration in Soil		Exposure Point Concentration in Ambient Air	
		Value (1)	Units	Value (2)	Units
Emission from Surface Soil	Aluminum	9.7E+03	mg/kg	8.8E-06	mg/m^3
	Arsenic	4.8E+00	mg/kg	4.3E-09	mg/m^3
	Cobalt	2.5E+00	mg/kg	2.3E-09	mg/m^3
	Iron	7.7E+03	mg/kg	6.9E-06	mg/m^3
	Manganese	3.2E+02	mg/kg	2.8E-07	mg/m^3
	Thallium	5.5E-01	mg/kg	5.0E-10	mg/m^3

(1) Selection of exposure point concentrations presented on Table 3.1.RME.

(2) Ambient air exposure point concentration calculated using a Particulate Emission Factor (PEF) of 1.11×10^9 m^3/kg as shown below; derivation of PEF is presented on Table 4 RME Supplement A.

Concentration in ambient air (mg/m^3) = Concentration in soil (mg/kg) x [1/PEF (m^3/kg)]

mg/kg = milligrams/kilogram
mg/m^3 = milligram per cubic meter

TABLE 3.2.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
Cayo La Chiva UXO-18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Scenario Timeframe: Current/Future (Worker)
Medium: Soil
Exposure Medium: Surface Soil (0-1 feet)

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Surface Soil (0 - 1 feet)	Arsenic	mg/kg	1.90E+00	NA	4.8E+00	4.8E+00	mg/kg	Maximum Detected Concentration	(1)

(1) The maximum detected concentration was used for this chemical because there were less than 8 total samples.

mg/kg = milligrams/kilogram
NA = Not applicable

TABLE 3.2.RME Supplement A
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
Cayo La Chiva UXO-18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Scenario Timeframe: Current/Future (Worker)
Medium: Soil
Exposure Medium: Ambient Air

Exposure Point	Chemical of Potential Concern	Exposure Point Concentration in Soil		Exposure Point Concentration in Ambient Air	
		Value (1)	Units	Value (2)	Units
Emission from Surface Soil	Arsenic	4.8E+00	mg/kg	4.3E-09	mg/m^3

(1) Selection of exposure point concentrations presented on Table 3.2.RME.

(2) Ambient air exposure point concentration calculated using a Particulate Emission Factor (PEF) of 1.11×10^9 m^3/kg as shown below; derivation of PEF is presented on Table 4 RME Supplement A.

Concentration in ambient air (mg/m^3) = Concentration in soil (mg/kg) x [1/PEF (m^3/kg)]

mg/kg = milligrams/kilogram
mg/m^3 = milligram per cubic meter

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Cayo La Chiva (UXO-18)

Former Vieques Naval Training Range, Vieques, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil (0-1 feet)

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespasser/ Recreational User	Adult	Surface Soil (0 - 1 feet)	CS	Chemical Concentration in Soil	See Table 3s.RME	mg/kg	See Table 3s.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 2014	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	20	years	EPA, 2014	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	(4)	
		Youth	Surface Soil (0 - 1 feet)	CS	Chemical Concentration in Soil	See Table 3s.RME	mg/kg	See Table 3s.RME	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 2014	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	44	kg	EPA 2011 (2)	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	(4)	
		Child	Surface Soil (0 - 1 feet)	CS	Chemical Concentration in Soil	See Table 3s.RME	mg/kg	See Table 3s.RME	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 2014	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	6	years	EPA, 2014	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	(4)	
	Worker	Adult	Surface Soil (0 - 1 feet)	CS	Chemical Concentration in Soil	See Table 3s.RME	mg/kg	See Table 3s.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 2014 (5)	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	35	days/year	2 days/week, 4 months/yr	
				ED	Exposure Duration	25	years	EPA, 2014	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	(4)	
Dermal	Trespasser/ Recreational User	Adult	Surface Soil (0 - 1 feet)	CS	Chemical Concentration in Soil	See Table 3s.RME	mg/kg	See Table 3s.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	6,032	cm^2	EPA, 2014 (6)	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2014	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical-Specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	20	years	EPA, 2014	
				BW	Body Weight	80	kg	EPA, 2014	

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Cayo La Chiva (UXO-18)

Former Vieques Naval Training Range, Vieques, Puerto Rico

Scenario Timeframe: Current/Future

Medium: Soil

Exposure Medium: Surface Soil (0-1 feet)

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
				AT-N	Averaging Time (Non-Cancer)	7,300	days	(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	(4)	
		Youth	Surface Soil	CS	Chemical Concentration in Soil	See Table 3s.RME	mg/kg	See Table 3s.RME	CDI (mg/kg-day) =
			(0 - 1 feet)	SA	Skin Surface Area Available for Contact	4,530	cm^2	EPA, 2011 (6)	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2014	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical-Specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	44	kg	EPA 2011 (2)	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	(4)	
		Child	Surface Soil	CS	Chemical Concentration in Soil	See Table 3s.RME	mg/kg	See Table 3s.RME	CDI (mg/kg-day) =
			(0 - 1 feet)	SA	Skin Surface Area Available for Contact	2,690	cm^2	EPA, 2014 (6)	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2014	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical-Specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	6	years	EPA, 2014	
				BW	Body Weight	15	kg	EPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	(4)	
	Worker	Adult	Surface Soil	CS	Chemical Concentration in Soil	See Table 3s.RME	mg/kg	See Table 3s.RME	CDI (mg/kg-day) =
			(0 - 1 feet)	SA	Skin Surface Area Available for Contact	3,470	cm^2	EPA, 2014 (7)	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.12	mg/cm^2-day	EPA, 2014	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical-Specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	35	days/year	2 days/week, 4 months/yr	
				ED	Exposure Duration	25	years	EPA, 2014	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	(4)	

Notes:

(1) Based on best professional judgment.

(2) Youths from 6 to 16 years of age. Body weight is average of the mean values for boys and girls for ages 6 through 16.

(3) Calculated as the product of ED (years) x 365 days/year.

(4) Calculated as the product of 70 years assumed human lifetime x 365 days/year.

(5) Default value for outdoor workers.

(6) SA includes head, hands, forearms, lower legs, and feet.

(7) SA includes head, hands, and forearms.

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Cayo La Chiva (UXO-18)

Former Vieques Naval Training Range, Vieques, Puerto Rico

Scenario Timeframe: Current/Future

Medium: Soil

Exposure Medium: Surface Soil (0-1 feet)

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name

Sources:

EPA, 2004: Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual. Part E Supplemental Guidance for Dermal Risk Assessment) Final.

EPA, 2011: Exposure Factors Handbook (EFH): 2011 Edition. EPA/600/R-090/052F.

EPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February 6, 2014.

cm^2 = Square centimeter

kg = Kilogram

kg/mg = Kilogram per milligram

mg/kg = Milligram per kilogram

mg/kg-day = Milligram per kilogram per day

mg/cm^2-day = Milligram per square centimeter per day

mg/day = Milligram per day

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Cayo La Chiva (UXO-18)

Former Vieques Naval Training Range, Vieques, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Ambient Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Trespasser/ Recreational User	Adult	Emissions from Surface Soil	CS	Chemical Concentration in Soil	See Table 3s.RME	mg/kg	See Table 3s.RME	Exposure Concentration (EC) (mg/m^3) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	EPA, 2002	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emission Factor	1.11E+09	m^3/kg	see Table 4 Supp A	
				ET	Exposure Time	4	hr/day	(1)	CA (mg/m^3) = CS (1/PEF)
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	20	years	EPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	(2)	
				AT-C	Averaging Time (Cancer)	25,550	days	(3)	
				CF	Conversion Factor	1/24	day/hr	- -	
		Youth	Emissions from Surface Soil	CS	Chemical Concentration in Soil	See Table 3s.RME	mg/kg	See Table 3s.RME	EC (mg/m^3) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	EPA, 2002	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emission Factor	1.11E+09	m^3/kg	see Table 4 Supp A	
				ET	Exposure Time	4	hr/day	(1)	CA (mg/m^3) = CS (1/PEF)
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	10	years	(4)	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	(2)	
				AT-C	Averaging Time (Cancer)	25,550	days	(3)	
				CF	Conversion Factor	1/24	day/hr	- -	
		Child	Emissions from Surface Soil	CS	Chemical Concentration in Soil	See Table 3s.RME	mg/kg	See Table 3s.RME	EC (mg/m^3) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	EPA, 2002	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emission Factor	1.11E+09	m^3/kg	see Table 4 Supp A	
				ET	Exposure Time	4	hr/day	(1)	CA (mg/m^3) = CS (1/PEF)
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	6	years	EPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	(2)	
				AT-C	Averaging Time (Cancer)	25,550	days	(3)	
				CF	Conversion Factor	1/24	day/hr	- -	
	Worker	Adult	Emissions from Surface Soil	CS	Chemical Concentration in Soil	See Table 3s.RME	mg/kg	See Table 3s.RME	Exposure Concentration (EC) (mg/m^3) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	EPA, 2002	CA x ET x EF x ED x CF x 1/AT
				PEF	Particulate Emission Factor	1.11E+09	m^3/kg	see Table 4 Supp A	
				ET	Exposure Time	8	hr/day	EPA, 2014	CA (mg/m^3) = CS (1/PEF)
				EF	Exposure Frequency	35	days/year	2 days/week, 4 months/yr	
				ED	Exposure Duration	25	years	EPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	(2)	
				AT-C	Averaging Time (Cancer)	25,550	days	(3)	
				CF	Conversion Factor	1/24	day/hr	- -	

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Cayo La Chiva (UXO-18)

Former Vieques Naval Training Range, Vieques, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Ambient Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name

Notes:

(1) Based on best professional judgment.

(2) Calculated as the product of ED (years) x 365 days/year.

(3) Calculated as the product of 70 years assumed human lifetime x 365 days/year.

(4) Ages 6-16.

Sources:

EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December, 2002.

EPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February 6, 2014.

mg/kg = Milligram per kilogram

mg/m^3 = Milligram per cubic meter

m^3/kg = Cubic meter per kilogram

TABLE 4.RME Supplement A
Particulate Emission Factor - Trespasser/Recreational User and Worker
Cayo La Chiva (UXO-18)
Former Vieques Naval Training Range
Vieques, Puerto Rico

PEF Equations:

$$Q/C_{wind} = A \times \exp\left[\frac{(\ln A_{site} - B)^2}{C}\right]$$

Exhibit D-2 (EPA, 2002)

$$PEF = Q/C_{wind} \times \frac{3{,}600 \sec/\mathrm{hr}}{0.036 \times (1-V) \times \left(U_m/U_t\right)^3 \times F(x)}$$

Equation 4-5 (EPA, 2002)

PEF and Box Model Input Parameters

Parameter	Definition	Value	Units	Source
Q/C_{wind}	inverse ratio of the geometric mean air concentration to the emission flux at the center of a square source	**104**	m	calculated
A	Constant for Zone 9 (Miami, FL)	12.196	unitless	Exhibit D-2 (EPA, 2002)
B	Constant for Zone 9 (Miami, FL)	19.065	unitless	Exhibit D-2 (EPA, 2002)
C	Constant for Zone 9 (Miami, FL)	215.392	unitless	Exhibit D-2 (EPA, 2002)
A_{site}	Areal extent of site contamination	0.09	acres	Note 2 (site-specific)
PEF	particulate emission factor	**1.11E+09**	m^3/kg	calculated
V	fraction of vegetative cover	0.5	unitless	Default (Eqn. 4-5)
Um	mean annual windspeed	5.19	m/s	Note 2 (Dept. of Navy, 1979)
Ut	equivalent threshold value of windspeed at 7 m	11.32	m/s	Default (Eqn. 4-5)
F(x)	function dependent on Um/Ut derived using Cowherd et al. (1985)	0.194	unitless	Default (Eqn. 4-5)

Source:
Note 1 - Area extent of contamination was calculated assuming extent of contamination was limited to four 30 m^2 grids around each discrete site sample.
Note 2 - The daily average windspeed from measurements at Observation Post 5 on Vieques (10.1 knots = 5.19 m/s) was used.

Department of the Navy. 1979. Draft Environmental Impact Statement: Volume I – Continued Use of the Atlantic Fleet Weapons Training Facility Inner Range (Vieques). December.
EPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, EPA Office of Solid Waste and Emergency Response. OSWER 9355.4-24. December.

TABLE 4.RME Supplement B

DERMAL ABSORPTION FRACTION FROM SOIL

Cayo La Chiva (UXO-18)

Former Vieques Naval Training Range

Vieques, Puerto Rico

Chemical Group	CAS Number	Chemical	Dermal Absorption Fraction	Note
Metal	7429-90-5	Aluminum	NA	(1)
Metal	7440-38-2	Arsenic	0.03	USEPA, 2004
Metal	7440-48-4	Cobalt	NA	(1)
Metal	7439-89-6	Iron	NA	(1)
Metal	7439-96-5	Manganese	NA	(1)
Metal	7440-28-0	Thallium	NA	(1)

Notes:

Dermal Absorption Fraction was obtained from EPA RAGS Part E Exhibit 3-4 (USEPA, 2004)

(1) no default dermal absorption values are currently available for inorganics due to the lack of speciation-specific absorption data. Therefore, consistent with EPA RAGS Part E (USEPA, 2004) and RSL Table (USEPA, 2013), dermal exposure is not assessed for these constituents.

Sources:

USEPA, 2004: Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual.
(Part E, Supplemental Guidance for Dermal Risk Assessment) (Final). EPA/540/R/99/005. July.
USEPA, 2013: Regional Screening Levels for Chemical Contaminants at Superfund Sites. November

TABLE 4 Supplement C

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Cayo La Chiva (UXO-18)

Former Vieques Naval Training Range, Vieques, Puerto Rico

Age Group	**Years**	**Body Weight (kg) [1]**	**Skin Surface Area (m^2) [2]**									**Exposed Skin Surface (m^2) (Head, Hands, Forearms, Lower Legs, Feet)**	
					Foreams Calculation			**Lower Legs Calculation**					
			Head	Hands	Arms	Forearms/ Arms Ratio [3]	Forearms	Legs	Legs/Lower Legs Ratio [3]	Lower Legs	Feet	Sum	Weighted
6 to <11 years	5	31.8	0.066	0.051	0.151	0.39	0.0589	0.311	0.40	0.124	0.073	0.373	1.87
11 to <16 years	5	56.8	0.073	0.072	0.227	0.39	0.0885	0.483	0.40	0.193	0.105	0.532	2.66
Weighted Average (kg)		44						Weighted Average (m^2) >>					0.453
								Weighted Average (cm^2) [4] >>					4530

Note:

1) Recommended Values for Body Weight (male and female combined) (Table 8-1 of 2011 EFH).

2) Recommended Values for Surface Area of Body Parts (male and female combined) (Table 7-2 of 2011 EFH).

3) Ratio was estimated based on Mean Proportion (%) of Children's Total Skin Surface Area, by Body Part.

4) Rounded up with three significant figure.

Reference:

EPA. 2011. Exposure Factors Handbook (EFH): 2011 Edition. EPA/600/R-090/052F.

TABLE 5.1
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
Cayo La Chiva (UXO-18)
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD	
		Value	Units	(1)	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Aluminum	Chronic	1.0E+00	mg/kg-day	> 50%	1.0E+00	mg/kg-day	Neurotoxicity	100 / 1	PPRTV (3)	11/2003
Arsenic	Chronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin, Vascular Complications	3 / 1	IRIS	11/21/2013
Cobalt	Chronic	3.0E-04	mg/kg-day	> 50%	3.0E-04	mg/kg-day	Iodine uptake	3000 / 1	PPRTV (3)	11/2003
Iron	Chronic	7.0E-01	mg/kg-day	> 50%	7.0E-01	mg/kg-day	Gastrointestinal	1.5	PPRTV (3)	11/2003
Manganese (3)	Chronic	2.4E-02	mg/kg-day	4%	9.6E-04	mg/kg-day	CNS	1 / 1	IRIS (4)	11/21/2013
Thallium	Chronic	1.0E-05	mg/kg-day	100%	1.0E-05	mg/kg-day	Hair	3000	PPRTV (3)	11/2013

Note:
(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. Section 4.2 and Exhibit 4-1. USEPA recommends that the oral RfD should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%. Constituents that do not have oral absorption efficiencies reported on this table were assumed to have an oral absorption efficiency of 100%.
(2) Adjusted based on RAGS Part E.
(3) As cited in Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites (USEPA, November 2013).
(3) The RfD (0.14 mg/kg-day) presented in IRIS includes manganese from all sources, including diet. This RfD was adjusted by subtracting the dietary contribution from the normal U.S. diet (an upper limit of 5 mg/day) and applying a modifying factor of 3 to address uncertainties associated with non-food manganese exposure sources.

Definitions:
CNS = Central Nervous System
IRIS = Integrated Risk Information System
NA = Not Available
PPRTV = Provisional Peer-Reviewed Toxicity Value

TABLE 5.2
NON-CANCER TOXICITY DATA -- INHALATION
Cayo La Chiva (UXO-18)
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Primary Target Organ(s) (2)	Combined Uncertainty/Modifying Factors	RfC	
		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Aluminum	Chronic	5.0E-03	mg/m^3	Psychomotor & cognitive impairment	300	PPRTV (1)	11/2013
Arsenic	Chronic	1.5E-05	mg/m^3	Developmental, Cardiovascular System, Nervous System	NA	Cal/EPA (1)	11/2013
Cobalt	Chronic	6.0E-06	mg/m^3	Respiratory	300 / 1	PPRTV (1)	11/2013
Iron	Chronic	NA	NA	NA	NA	NA	NA
Manganese	Chronic	5.0E-05	mg/m^3	Neurological	1000 / 1	IRIS	11/21/2013
Thallium	Chronic	NA	NA	NA	NA	NA	NA

Note:

(1) As cited in Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites (USEPA, November 2013).

Definitions:

Cal/EPA = California Environmental Protection Agency
IRIS = Integrated Risk Information System
NA = Not Available
PPRTV = Provisional Peer-Reviewed Toxicity Value

TABLE 6.1
CANCER TOXICITY DATA -- ORAL/DERMAL
Cayo La Chiva (UXO-18)
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	1.5E+00	$(mg/kg\text{-}day)^{-1}$	95%	1.5E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	11/21/2013
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	D	IRIS	11/21/2013
Thallium	NA	NA	NA	NA	NA	NA	NA	NA

Note:
(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. Section 4.2 and Exhibit 4-1. USEPA recommends that the oral slope factor should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%. Constituents that do not have oral absorption efficiencies reported on this table were assumed to have an oral absorption efficiency of 100%.
(2) Adjusted based on RAGS Part E.

Definitions:
IRIS = Integrated Risk Information System
NA = Not Available

Weight of Evidence definitions:
Group A chemicals (known human carcinogens) are agents for which there is sufficient evidence to support the causal association between exposure to the agents in humans and cancer.
Group D chemicals (not classifiable as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available.

TABLE 6.2
CANCER TOXICITY DATA -- INHALATION
Cayo La Chiva (UXO-18)
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical of Potential Concern	Unit Risk		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Aluminum	NA	NA	NA	NA	NA
Arsenic	4.3E-03	$(ug/m^3)^{-1}$	A	IRIS	11/21/2013
Cobalt	9.0E-03	$(ug/m^3)^{-1}$	B1	PPRTV (1)	11/2013
Iron	NA	NA	NA	NA	NA
Manganese	NA	NA	D	IRIS	11/21/2013
Thallium	NA	NA	NA	NA	NA

Note:
(1) As cited in Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites (USEPA, November 2013).

Definitions:
IRIS = Integrated Risk Information System
NA = Not Available
PPRTV = Provisional Peer-Reviewed Toxicity Value

Weight of Evidence definitions:
Group A chemicals (known human carcinogens) are agents for which there is sufficient evidence to support the causal association between exposure to the agents in humans and cancer.
Group B1 chemicals (probable human carcinogens) are agents for which there is limited evidence of possible carcinogenicity in humans.
Group D chemicals (not classifiable as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available.

Table 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Cayo La Chiva (UXO 18)

Former Vieques Naval Training Range

Vieques, Puerto Rico

Scenario Timeframe: Current/Future
Receptor Population: Trespasser/Recreational User
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil (0 -1 feet)	Surface Soil (0 -1 feet)	Ingestion	Aluminum	9.7E+03	mg/kg	1.4E-03	mg/kg-day	NA	NA	NA	4.0E-03	mg/kg-day	1.0E+00	mg/kg-day	4.0E-03
				Arsenic	4.8E+00	mg/kg	6.7E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	1.0E-06	2.0E-06	mg/kg-day	3.0E-04	mg/kg-day	6.5E-03
				Cobalt	2.5E+00	mg/kg	3.5E-07	mg/kg-day	NA	NA	NA	1.0E-06	mg/kg-day	3.0E-04	mg/kg-day	3.4E-03
				Iron	7.7E+03	mg/kg	1.1E-03	mg/kg-day	NA	NA	NA	3.1E-03	mg/kg-day	7.0E-01	mg/kg-day	4.5E-03
				Manganese	3.2E+02	mg/kg	4.4E-05	mg/kg-day	NA	NA	NA	1.3E-04	mg/kg-day	2.4E-02	mg/kg-day	5.3E-03
				Thallium	5.5E-01	mg/kg	7.7E-08	mg/kg-day	NA	NA	NA	2.2E-07	mg/kg-day	1.0E-05	mg/kg-day	2.2E-02
			Exp. Route Total								1.0E-06					4.6E-02
Soil	Surface Soil (0 -1 feet)	Surface Soil (0 -1 feet)	Dermal	Aluminum	9.7E+03	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	1.0E+00	mg/kg-day	NA
				Arsenic	4.8E+00	mg/kg	2.3E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	3.4E-07	6.7E-07	mg/kg-day	3.0E-04	mg/kg-day	2.2E-03
				Cobalt	2.5E+00	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	3.0E-04	mg/kg-day	NA
				Iron	7.7E+03	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	7.0E-01	mg/kg-day	NA
				Manganese	3.2E+02	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	9.6E-04	mg/kg-day	NA
				Thallium	5.5E-01	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	1.0E-05	mg/kg-day	NA
			Exp. Route Total								3.4E-07					2.2E-03
		Exposure Point Total									1.3E-06					4.8E-02
	Exposure Medium Total										1.3E-06					4.8E-02
Soil	Ambient Air	Emissions from Surface Soil	Inhalation	Aluminum	8.8E-06	mg/m^3	1.4E-07	mg/m^3	NA	$1/(ug/m^3)$	NA	4.2E-07	mg/m^3	5.0E-03	mg/m^3	8.3E-05
				Arsenic	4.3E-09	mg/m^3	7.0E-11	mg/m^3	4.3E-03	$1/(ug/m^3)$	3.0E-10	2.1E-10	mg/m^3	1.5E-05	mg/m^3	1.4E-05
				Cobalt	2.3E-09	mg/m^3	3.7E-11	mg/m^3	9.0E-03	$1/(ug/m^3)$	3.3E-10	1.1E-10	mg/m^3	6.0E-06	mg/m^3	1.8E-05
				Iron	6.9E-06	mg/m^3	1.1E-07	mg/m^3	NA	$1/(ug/m^3)$	NA	3.3E-07	mg/m^3	NA	NA	NA
				Manganese	2.8E-07	mg/m^3	4.6E-09	mg/m^3	NA	$1/(ug/m^3)$	NA	1.3E-08	mg/m^3	5.0E-05	mg/m^3	2.7E-04
				Thallium	5.0E-10	mg/m^3	8.1E-12	mg/m^3	NA	$1/(ug/m^3)$	NA	2.4E-11	mg/m^3	NA	NA	NA
			Exp. Route Total								6.3E-10					3.8E-04
		Exposure Point Total									6.3E-10					3.8E-04
	Exposure Medium Total										6.3E-10					3.8E-04
Soil Total											1.3E-06					4.9E-02
Receptor Total											1.3E-06					4.9E-02

NA = Not applicable or not available

Table 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Cayo La Chiva (UXO 18)

Former Vieques Naval Training Range

Vieques, Puerto Rico

Scenario Timeframe: Current/Future
Receptor Population: Trespasser/Recreational User
Receptor Age: Youth

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil (0 -1 feet)	Surface Soil (0 -1 feet)	Ingestion	Aluminum	9.7E+03	mg/kg	1.0E-03	mg/kg-day	NA	NA	NA	7.1E-03	mg/kg-day	1.0E+00	mg/kg-day	7.1E-03
				Arsenic	4.8E+00	mg/kg	5.0E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	7.5E-07	3.5E-06	mg/kg-day	3.0E-04	mg/kg-day	1.2E-02
				Cobalt	2.5E+00	mg/kg	2.6E-07	mg/kg-day	NA	NA	NA	1.8E-06	mg/kg-day	3.0E-04	mg/kg-day	6.1E-03
				Iron	7.7E+03	mg/kg	8.0E-04	mg/kg-day	NA	NA	NA	5.6E-03	mg/kg-day	7.0E-01	mg/kg-day	8.0E-03
				Manganese	3.2E+02	mg/kg	3.3E-05	mg/kg-day	NA	NA	NA	2.3E-04	mg/kg-day	2.4E-02	mg/kg-day	9.6E-03
				Thallium	5.5E-01	mg/kg	5.7E-08	mg/kg-day	NA	NA	NA	4.0E-07	mg/kg-day	1.0E-05	mg/kg-day	4.0E-02
			Exp. Route Total								7.5E-07					8.3E-02
Soil	Surface Soil (0 -1 feet)	Surface Soil (0 -1 feet)	Dermal	Aluminum	9.7E+03	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	1.0E+00	mg/kg-day	NA
				Arsenic	4.8E+00	mg/kg	1.2E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	1.8E-07	8.6E-07	mg/kg-day	3.0E-04	mg/kg-day	2.9E-03
				Cobalt	2.5E+00	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	3.0E-04	mg/kg-day	NA
				Iron	7.7E+03	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	7.0E-01	mg/kg-day	NA
				Manganese	3.2E+02	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	9.6E-04	mg/kg-day	NA
				Thallium	5.5E-01	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	1.0E-05	mg/kg-day	NA
			Exp. Route Total								1.8E-07					2.9E-03
		Exposure Point Total									9.4E-07					8.6E-02
	Exposure Medium Total										9.4E-07					8.6E-02
Soil	Ambient Air	Emissions from Surface Soil	Inhalation	Aluminum	8.8E-06	mg/m^3	5.9E-08	mg/m^3	NA	$1/(ug/m^3)$	NA	4.2E-07	mg/m^3	5.0E-03	mg/m^3	8.3E-05
				Arsenic	4.3E-09	mg/m^3	2.9E-11	mg/m^3	4.3E-03	$1/(ug/m^3)$	1.3E-10	2.1E-10	mg/m^3	1.5E-05	mg/m^3	1.4E-05
				Cobalt	2.3E-09	mg/m^3	1.5E-11	mg/m^3	9.0E-03	$1/(ug/m^3)$	1.4E-10	1.1E-10	mg/m^3	6.0E-06	mg/m^3	1.8E-05
				Iron	6.9E-06	mg/m^3	4.7E-08	mg/m^3	NA	$1/(ug/m^3)$	NA	3.3E-07	mg/m^3	NA	NA	NA
				Manganese	2.8E-07	mg/m^3	1.9E-09	mg/m^3	NA	$1/(ug/m^3)$	NA	1.3E-08	mg/m^3	5.0E-05	mg/m^3	2.7E-04
				Thallium	5.0E-10	mg/m^3	3.4E-12	mg/m^3	NA	$1/(ug/m^3)$	NA	2.4E-11	mg/m^3	NA	NA	NA
			Exp. Route Total								2.6E-10					3.8E-04
		Exposure Point Total									2.6E-10					3.8E-04
	Exposure Medium Total										2.6E-10					3.8E-04
Soil Total											9.4E-07					8.6E-02
Receptor Total											9.4E-07					8.6E-02

NA = Not applicable or not available

Table 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Cayo La Chiva (UXO 18)

Former Vieques Naval Training Range

Vieques, Puerto Rico

Scenario Timeframe: Current/Future
Receptor Population: Trespasser/Recreational User
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil (0 -1 feet)	Surface Soil (0 -1 feet)	Ingestion	Aluminum	9.7E+03	mg/kg	3.2E-03	mg/kg-day	NA	NA	NA	3.7E-02	mg/kg-day	1.0E+00	mg/kg-day	3.7E-02
				Arsenic	4.8E+00	mg/kg	1.6E-06	mg/kg-day	1.5E+00	1/(mg/kg-day)	2.3E-06	1.8E-05	mg/kg-day	3.0E-04	mg/kg-day	6.1E-02
				Cobalt	2.5E+00	mg/kg	8.1E-07	mg/kg-day	NA	NA	NA	9.5E-06	mg/kg-day	3.0E-04	mg/kg-day	3.2E-02
				Iron	7.7E+03	mg/kg	2.5E-03	mg/kg-day	NA	NA	NA	2.9E-02	mg/kg-day	7.0E-01	mg/kg-day	4.2E-02
				Manganese	3.2E+02	mg/kg	1.0E-04	mg/kg-day	NA	NA	NA	1.2E-03	mg/kg-day	2.4E-02	mg/kg-day	5.0E-02
				Thallium	5.5E-01	mg/kg	1.8E-07	mg/kg-day	NA	NA	NA	2.1E-06	mg/kg-day	1.0E-05	mg/kg-day	2.1E-01
			Exp. Route Total								2.3E-06					4.3E-01
Soil	Surface Soil (0 -1 feet)	Surface Soil (0 -1 feet)	Dermal	Aluminum	9.7E+03	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	1.0E+00	mg/kg-day	NA
				Arsenic	4.8E+00	mg/kg	1.3E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	2.0E-07	1.5E-06	mg/kg-day	3.0E-04	mg/kg-day	5.1E-03
				Cobalt	2.5E+00	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	3.0E-04	mg/kg-day	NA
				Iron	7.7E+03	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	7.0E-01	mg/kg-day	NA
				Manganese	3.2E+02	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	9.6E-04	mg/kg-day	NA
				Thallium	5.5E-01	mg/kg	--	mg/kg-day	NA	NA	NA	--	mg/kg-day	1.0E-05	mg/kg-day	NA
			Exp. Route Total								2.0E-07					5.1E-03
		Exposure Point Total									2.5E-06					4.4E-01
	Exposure Medium Total										2.5E-06					4.4E-01
Soil	Ambient Air	Emissions from Surface Soil	Inhalation	Aluminum	8.8E-06	mg/m^3	3.6E-08	mg/m^3	NA	$1/(ug/m^3)$	NA	4.2E-07	mg/m^3	5.0E-03	mg/m^3	8.3E-05
				Arsenic	4.3E-09	mg/m^3	1.8E-11	mg/m^3	4.3E-03	$1/(ug/m^3)$	7.6E-11	2.1E-10	mg/m^3	1.5E-05	mg/m^3	1.4E-05
				Cobalt	2.3E-09	mg/m^3	9.2E-12	mg/m^3	9.0E-03	$1/(ug/m^3)$	8.3E-11	1.1E-10	mg/m^3	6.0E-06	mg/m^3	1.8E-05
				Iron	6.9E-06	mg/m^3	2.8E-08	mg/m^3	NA	$1/(ug/m^3)$	NA	3.3E-07	mg/m^3	NA	NA	NA
				Manganese	2.8E-07	mg/m^3	1.2E-09	mg/m^3	NA	$1/(ug/m^3)$	NA	1.3E-08	mg/m^3	5.0E-05	mg/m^3	2.7E-04
				Thallium	5.0E-10	mg/m^3	2.0E-12	mg/m^3	NA	$1/(ug/m^3)$	NA	2.4E-11	mg/m^3	NA	NA	NA
			Exp. Route Total								1.6E-10					3.8E-04
		Exposure Point Total									1.6E-10					3.8E-04
	Exposure Medium Total										1.6E-10					3.8E-04
Soil Total											2.5E-06					4.4E-01
Receptor Total											2.5E-06					4.4E-01

NA = Not applicable or not available

Table 7.4.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Cayo La Chiva (UXO 18)

Former Vieques Naval Training Range

Vieques, Puerto Rico

Scenario Timeframe: Current/Future
Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil (0 -1 feet)	Surface Soil (0 -1 feet)	Ingestion	Arsenic	4.8E+00	mg/kg	2.3E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	3.5E-07	6.6E-07	mg/kg-day	3.0E-04	mg/kg-day	2.2E-03
			Exp. Route Total								3.5E-07					2.2E-03
Soil	Surface Soil (0 -1 feet)	Surface Soil (0 -1 feet)	Dermal	Arsenic	4.8E+00	mg/kg	3.5E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	5.3E-08	9.9E-08	mg/kg-day	3.0E-04	mg/kg-day	3.3E-04
			Exp. Route Total								5.3E-08					3.3E-04
		Exposure Point Total									4.1E-07					2.5E-03
	Exposure Medium Total										4.1E-07					2.5E-03
Soil	Ambient Air	Emissions from Surface Soil	Inhalation	Arsenic	4.3E-09	mg/m^3	6.2E-11	mg/m^3	4.3E-03	$1/(ug/m^3)$	2.7E-10	1.7E-10	mg/m^3	1.5E-05	mg/m^3	1.2E-05
			Exp. Route Total								2.7E-10					1.2E-05
		Exposure Point Total									2.7E-10					1.2E-05
	Exposure Medium Total										2.7E-10					1.2E-05
Soil Total											4.1E-07					2.5E-03
Receptor Total											4.1E-07					2.5E-03

NA = Not applicable or not available

Table 9.1 RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Cayo La Chiva (UXO 18)
Former Vieques Naval Training Range
Vieques, Puerto Rico

Scenario Timeframe: Current/Future
Receptor Population: Trespasser/Recreational User
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil (0 -1 feet)	Surface Soil (0 -1 feet)	Aluminum	NA	NA	NA	NA	Nervous System	4E-03	NA	NA	4E-03
			Arsenic	1E-06	NA	3E-07	1E-06	Skin, Cardiovascular System	7E-03	NA	2E-03	9E-03
			Cobalt	NA	NA	NA	NA	Iodine uptake	3E-03	NA	NA	3E-03
			Iron	NA	NA	NA	NA	Gastrointestinal	4E-03	NA	NA	4E-03
			Manganese	NA	NA	NA	NA	Nervous System	5E-03	NA	NA	5E-03
			Thallium	NA	NA	NA	NA	Hair	2E-02	NA	NA	2E-02
		Exposure Point Total		1E-06	NA	3E-07	1E-06		5E-02	NA	2E-03	5E-02
	Exposure Medium Total			1E-06	NA	3E-07	1E-06		5E-02	NA	2E-03	5E-02
	Ambient Air	Emissions from Surface Soil	Aluminum	NA	NA	NA	NA	Nervous System	NA	8E-05	NA	8E-05
			Arsenic	NA	3E-10	NA	3E-10	Developmental, Cardiovascular System, Nervous System	NA	1E-05	NA	1E-05
			Cobalt	NA	3E-10	NA	3E-10	Respiratory	NA	2E-05	NA	2E-05
			Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Manganese	NA	NA	NA	NA	Nervous System	NA	3E-04	NA	3E-04
			Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Exposure Point Total		NA	6E-10	NA	6E-10		NA	4E-04	NA	4E-04
	Exposure Medium Total			NA	6E-10	NA	6E-10		NA	4E-04	NA	4E-04
Medium Total				1E-06	6E-10	3E-07	1E-06		5E-02	4E-04	2E-03	5E-02
Receptor Total				1E-06	6E-10	3E-07	1E-06		5E-02	4E-04	2E-03	5E-02

NA = Not applicable or not available

Total Cardiovascular System HI Across Media =	9E-03
Total Developmental HI Across Media =	1E-05
Total Gastrointestinal HI Across Media =	4E-03
Total Hair HI Across Media =	2E-02
Total Iodine uptake HI Across Media =	3E-03
Total Nervous System HI Across Media =	1E-02
Total Respiratory HI Across Media =	2E-05
Total Skin HI Across Media =	9E-03

Table 9.2 RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Cayo La Chiva (UXO 18)
Former Vieques Naval Training Range
Vieques, Puerto Rico

Scenario Timeframe: Current/Future
Receptor Population: Trespasser/Recreational User
Receptor Age: Youth

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil (0 -1 feet)	Surface Soil (0 -1 feet)	Aluminum	NA	NA	NA	NA	Nervous System	7E-03	NA	NA	7E-03
			Arsenic	8E-07	NA	2E-07	9E-07	Skin, Cardiovascular System	1E-02	NA	3E-03	1E-02
			Cobalt	NA	NA	NA	NA	Iodine uptake	6E-03	NA	NA	6E-03
			Iron	NA	NA	NA	NA	Gastrointestinal	8E-03	NA	NA	8E-03
			Manganese	NA	NA	NA	NA	Nervous System	1E-02	NA	NA	1E-02
			Thallium	NA	NA	NA	NA	Hair	4E-02	NA	NA	4E-02
		Exposure Point Total		8E-07	NA	2E-07	9E-07		8E-02	NA	3E-03	9E-02
	Exposure Medium Total			8E-07	NA	2E-07	9E-07		8E-02	NA	3E-03	9E-02
	Ambient Air	Emissions from Surface Soil	Aluminum	NA	NA	NA	NA	Nervous System	NA	8E-05	NA	8E-05
			Arsenic	NA	1E-10	NA	1E-10	Developmental, Cardiovascular System, Nervous System	NA	1E-05	NA	1E-05
			Cobalt	NA	1E-10	NA	1E-10	Respiratory	NA	2E-05	NA	2E-05
			Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Manganese	NA	NA	NA	NA	Nervous System	NA	3E-04	NA	3E-04
			Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Exposure Point Total		NA	3E-10	NA	3E-10		NA	4E-04	NA	4E-04
	Exposure Medium Total			NA	3E-10	NA	3E-10		NA	4E-04	NA	4E-04
Medium Total				8E-07	3E-10	2E-07	9E-07		8E-02	4E-04	3E-03	9E-02
Receptor Total				8E-07	3E-10	2E-07	9E-07		8E-02	4E-04	3E-03	9E-02

NA = Not applicable or not available

Total Cardiovascular System HI Across Media =	1E-02
Total Developmental HI Across Media =	1E-05
Total Gastrointestinal HI Across Media =	8E-03
Total Hair HI Across Media =	4E-02
Total Iodine uptake HI Across Media =	6E-03
Total Nervous System HI Across Media =	2E-02
Total Respiratory HI Across Media =	2E-05
Total Skin HI Across Media =	1E-02

Table 9.3 RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Cayo La Chiva (UXO 18)
Former Vieques Naval Training Range
Vieques, Puerto Rico

Scenario Timeframe: Current/Future
Receptor Population: Trespasser/Recreational User
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil (0 -1 feet)	Surface Soil (0 -1 feet)	Aluminum	NA	NA	NA	NA	Nervous System	4E-02	NA	NA	4E-02
			Arsenic	2E-06	NA	2E-07	3E-06	Skin, Cardiovascular System	6E-02	NA	5E-03	7E-02
			Cobalt	NA	NA	NA	NA	Iodine uptake	3E-02	NA	NA	3E-02
			Iron	NA	NA	NA	NA	Gastrointestinal	4E-02	NA	NA	4E-02
			Manganese	NA	NA	NA	NA	Nervous System	5E-02	NA	NA	5E-02
			Thallium	NA	NA	NA	NA	Hair	2E-01	NA	NA	2E-01
		Exposure Point Total		2E-06	NA	2E-07	3E-06		4E-01	NA	5E-03	4E-01
	Exposure Medium Total			2E-06	NA	2E-07	3E-06		4E-01	NA	5E-03	4E-01
	Ambient Air	Emissions from Surface Soil	Aluminum	NA	NA	NA	NA	Nervous System	NA	8E-05	NA	8E-05
			Arsenic	NA	8E-11	NA	8E-11	Developmental, Cardiovascular System, Nervous System	NA	1E-05	NA	1E-05
			Cobalt	NA	8E-11	NA	8E-11	Respiratory	NA	2E-05	NA	2E-05
			Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Manganese	NA	NA	NA	NA	Nervous System	NA	3E-04	NA	3E-04
			Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Exposure Point Total		NA	2E-10	NA	2E-10		NA	4E-04	NA	4E-04
	Exposure Medium Total			NA	2E-10	NA	2E-10		NA	4E-04	NA	4E-04
Medium Total				2E-06	2E-10	2E-07	3E-06		4E-01	4E-04	5E-03	4E-01
Receptor Total				2E-06	2E-10	2E-07	3E-06		4E-01	4E-04	5E-03	4E-01

NA = Not applicable or not available

Total Cardiovascular System HI Across Media =	7E-02
Total Developmental HI Across Media =	1E-05
Total Gastrointestinal HI Across Media =	4E-02
Total Hair HI Across Media =	2E-01
Total Iodine uptake HI Across Media =	3E-02
Total Nervous System HI Across Media =	9E-02
Total Respiratory HI Across Media =	2E-05
Total Skin HI Across Media =	7E-02

Table 9.4 RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Cayo La Chiva (UXO 18)
Former Vieques Naval Training Range
Vieques, Puerto Rico

Scenario Timeframe: Current/Future
Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil (0 -1 feet)	Surface Soil (0 -1 feet)	Arsenic	4E-07	NA	5E-08	4E-07	Skin, Cardiovascular System	2E-03	NA	3E-04	3E-03
		Exposure Point Total		4E-07	NA	5E-08	4E-07		2E-03	NA	3E-04	3E-03
	Exposure Medium Total			4E-07	NA	5E-08	4E-07		2E-03	NA	3E-04	3E-03
	Ambient Air	Emissions from Surface Soil	Arsenic	NA	3E-10	NA	3E-10	Developmental, Cardiovascular System, Nervous System	NA	1E-05	NA	1E-05
		Exposure Point Total		NA	3E-10	NA	3E-10		NA	1E-05	NA	1E-05
	Exposure Medium Total			NA	3E-10	NA	3E-10		NA	1E-05	NA	1E-05
Medium Total				4E-07	3E-10	5E-08	4E-07		2E-03	1E-05	3E-04	3E-03
Receptor Total				4E-07	3E-10	5E-08	4E-07		2E-03	1E-05	3E-04	3E-03

NA = Not applicable or not available

Total Cardiovascular System HI Across Media =	3E-03
Total Developmental HI Across Media =	1E-05
Total Nervous System HI Across Media =	1E-05
Total Skin HI Across Media =	3E-03

Attachment D-2
Figures

Primary Source	Primary Release Mechanism	Secondary Source	Secondary Release Mechanism	Exposure Media	Exposure Route	Potential Human Receptors			
						Current/Future			
						Trespasser/Recreational User			Worker
						Adult	Youth	Child	
Munitions and Explosives	→			Surface Soil (0 to 1 foot bgs)	Ingestion	X	X	X	X
					Dermal Contact	X	X	X	X
					Inhalation	X	X	X	X

Legend
X – Potentially complete exposure pathways identified

Figure 1
Conceptual Site Model for HHRA
Cayo La Chiva (UXO 18)
Former Vieques Naval Training Range
Vieques, Puerto Rico

Attachment D-3
Tables

Table 1
HHRA Sample Assignments
Cayo La Chiva (UXO-18)
Former Vieques Naval Training Range
Vieques, Puerto Rico

StationID	SampleID	Date Collected	Matrix	Upper Depth (inches)	Lower Depth (inches)	Current/Future (Trespasser and FWS Worker)
VE-UXO18-01DU01	VE-UXO18-01SMI01-0613 (1)	6/12/2013	SMI	0	2.5	x
VE-UXO18-01DU02	VE-UXO18-01SMI02-0613	6/12/2013	SMI	0	2.5	x
VE-UXO18-01SO01	VE-UXO18-01SS01-0001 (1)	6/12/2013	SS	0	12	x
VE-UXO18-01SO02	VE-UXO18-01SS02-0001	6/12/2013	SS	0	12	x
VE-UXO18-01SO03	VE-UXO18-01SS03-0001	6/12/2013	SS	0	12	x
VE-UXO18-01DU01	VE-UXO18-01SMI01T-1113A (2)	11/15/2013	SMI	0	2.5	x
VE-UXO18-01DU01	VE-UXO18-01SMI01T-1113 (3)	11/15/2013	SMI	0	2.5	x
VE-UXO18-01DU01	VE-UXO18-01SMI01TT-1113A (4)	11/15/2013	SMI	0	2.5	x
VE-UXO18-01DU01	VE-UXO18-01SMI01TT-1113 (5)	11/15/2013	SMI	0	2.5	x
VE-UXO18-01DU01	VE-UXO18-01SMI01-1113A (6)	11/15/2013	SMI	0	2.5	x
VE-UXO18-01DU01	VE-UXO18-01SMI01-1113 (7)	11/15/2013	SMI	0	2.5	x
VE-UXO18-01DU02	VE-UXO18-01SMI02-1113A (8)	11/15/2013	SMI	0	2.5	x
VE-UXO18-01DU02	VE-UXO18-01SMI02-1113 (9)	11/15/2013	SMI	0	2.5	x

Notes:
Matrix: SMI - soil multi-incremental sampling; SS - surface soil
FWS - U.S. Fish and Wildlife Service

(1) For samples with a paired field duplicate or triplicate samples, the highest detected concentration was used when at least one value was detected and the lower value of the LOQs was used when all values were non-detects.
(2) Hand ground fraction of ve-uxo18-01smi01t-1113 for picric acid only
(3) Resample of ve-uxo18-01smi01t-0613 for 8330 only
(4) Hand ground fraction of ve-uxo18-01smi01tt-1113 for picric acid only
(5) Resample of ve-uxo18-01smi01tt-0613 for 8330 only
(6) Hand ground fraction of ve-uxo18-01smi01-1113 for picric acid only
(7) Resample of ve-uxo18-01smi01-0613 for 8330 only
(8) Hand ground fraction of ve-uxo18-01smi02-1113 for picric acid only
(9) Resample of ve-uxo18-01smi02-0613 for 8330 only; ms/msd collected

Attachment D-4
Analytical Data Used in the HHRA

Attachment D-4

Analytical Data Used in the HHRA for UXO-18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Location Name	Northing	Easting	Sample Name	Sample Beginning Depth	Sample Ending Depth	Sample Date	Sample Matrix	Sample Type	Analytical Group	CAS Number	Analyte Name	Result (mg/kg)	Units	Result Flag	MDL (mg/kg)	RL (mg/kg)	Detect
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113A	0	2.5	11/15/2013	SMI	FD	EXPLO	88-89-1	Picric Acid	0.12	MG/KG	U	0.06	0.2	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	SVOA	98-95-3	Nitrobenzene	0.2	MG/KG	U	0.075	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	99-65-0	1,3-Dinitrobenzene	0.2	MG/KG	U	0.063	0.45	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	SVOA	121-14-2	2,4-Dinitrotoluene	0.2	MG/KG	U	0.083	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	121-82-4	RDX	0.2	MG/KG	U	0.08	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	99-08-1	3-Nitrotoluene	0.2	MG/KG	U	0.071	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	88-72-2	2-Nitrotoluene	0.2	MG/KG	U	0.066	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	99-99-0	4-Nitrotoluene	0.2	MG/KG	U	0.08	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	2691-41-0	HMX	0.2	MG/KG	U	0.08	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	99-35-4	1,3,5-Trinitrobenzene	0.2	MG/KG	U	0.079	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	479-45-8	Tetryl	0.2	MG/KG	U	0.091	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	118-96-7	2,4,6-Trinitrotoluene	0.2	MG/KG	U	0.083	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	55-63-0	Nitroglycerin	0.2	MG/KG	U	0.085	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	78-11-5	PETN	1	MG/KG	U	0.579	2.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	35572-78-2	2-Amino-4,6-dinitrotoluene	0.2	MG/KG	U	0.075	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	19406-51-0	4-Amino-2,6-dinitrotoluene	0.2	MG/KG	U	0.075	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01T-1113	0	2.5	11/15/2013	SMI	FD	SVOA	606-20-2	2,6-Dinitrotoluene	0.2	MG/KG	U	0.083	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113A	0	2.5	11/15/2013	SMI	FD	EXPLO	88-89-1	Picric Acid	0.12	MG/KG	U	0.06	0.2	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	SVOA	98-95-3	Nitrobenzene	0.2	MG/KG	U	0.075	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	99-65-0	1,3-Dinitrobenzene	0.2	MG/KG	U	0.063	0.45	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	SVOA	121-14-2	2,4-Dinitrotoluene	0.2	MG/KG	U	0.083	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	121-82-4	RDX	0.2	MG/KG	U	0.08	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	99-08-1	3-Nitrotoluene	0.2	MG/KG	U	0.071	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	88-72-2	2-Nitrotoluene	0.2	MG/KG	U	0.066	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	99-99-0	4-Nitrotoluene	0.2	MG/KG	U	0.08	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	2691-41-0	HMX	0.2	MG/KG	U	0.08	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	99-35-4	1,3,5-Trinitrobenzene	0.2	MG/KG	U	0.079	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	479-45-8	Tetryl	0.2	MG/KG	U	0.091	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	118-96-7	2,4,6-Trinitrotoluene	0.2	MG/KG	U	0.083	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	55-63-0	Nitroglycerin	0.2	MG/KG	U	0.085	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	78-11-5	PETN	1	MG/KG	U	0.579	2.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	35572-78-2	2-Amino-4,6-dinitrotoluene	0.2	MG/KG	U	0.075	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	EXPLO	19406-51-0	4-Amino-2,6-dinitrotoluene	0.2	MG/KG	U	0.075	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01TT-1113	0	2.5	11/15/2013	SMI	FD	SVOA	606-20-2	2,6-Dinitrotoluene	0.2	MG/KG	U	0.083	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113A	0	2.5	11/15/2013	SMI	N	EXPLO	88-89-1	Picric Acid	0.12	MG/KG	U	0.06	0.2	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	SVOA	98-95-3	Nitrobenzene	0.2	MG/KG	U	0.075	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	EXPLO	99-65-0	1,3-Dinitrobenzene	0.2	MG/KG	U	0.063	0.45	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	SVOA	121-14-2	2,4-Dinitrotoluene	0.2	MG/KG	U	0.083	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	EXPLO	121-82-4	RDX	0.2	MG/KG	U	0.08	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	EXPLO	99-08-1	3-Nitrotoluene	0.2	MG/KG	U	0.071	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	EXPLO	88-72-2	2-Nitrotoluene	0.2	MG/KG	U	0.066	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	EXPLO	99-99-0	4-Nitrotoluene	0.2	MG/KG	U	0.08	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	EXPLO	2691-41-0	HMX	0.2	MG/KG	U	0.08	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	EXPLO	99-35-4	1,3,5-Trinitrobenzene	0.2	MG/KG	U	0.079	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	EXPLO	479-45-8	Tetryl	0.2	MG/KG	U	0.091	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	EXPLO	118-96-7	2,4,6-Trinitrotoluene	0.2	MG/KG	U	0.083	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	EXPLO	55-63-0	Nitroglycerin	0.2	MG/KG	U	0.085	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	EXPLO	78-11-5	PETN	1	MG/KG	U	0.579	2.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	EXPLO	35572-78-2	2-Amino-4,6-dinitrotoluene	0.2	MG/KG	U	0.075	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	EXPLO	19406-51-0	4-Amino-2,6-dinitrotoluene	0.2	MG/KG	U	0.075	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-1113	0	2.5	11/15/2013	SMI	N	SVOA	606-20-2	2,6-Dinitrotoluene	0.2	MG/KG	U	0.083	0.5	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113A	0	2.5	11/15/2013	SMI	N	EXPLO	88-89-1	Picric Acid	0.12	MG/KG	U	0.06	0.2	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	SVOA	98-95-3	Nitrobenzene	0.2	MG/KG	U	0.075	0.5	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	EXPLO	99-65-0	1,3-Dinitrobenzene	0.2	MG/KG	U	0.063	0.45	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	SVOA	121-14-2	2,4-Dinitrotoluene	0.2	MG/KG	U	0.083	0.5	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	EXPLO	121-82-4	RDX	0.2	MG/KG	U	0.08	0.5	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	EXPLO	99-08-1	3-Nitrotoluene	0.2	MG/KG	U	0.071	0.5	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	EXPLO	88-72-2	2-Nitrotoluene	0.2	MG/KG	U	0.066	0.5	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	EXPLO	99-99-0	4-Nitrotoluene	0.2	MG/KG	U	0.08	0.5	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	EXPLO	2691-41-0	HMX	0.2	MG/KG	U	0.08	0.5	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	EXPLO	99-35-4	1,3,5-Trinitrobenzene	0.2	MG/KG	U	0.079	0.5	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	EXPLO	479-45-8	Tetryl	0.2	MG/KG	U	0.091	0.5	No

Attachment D-4
Analytical Data Used in the HHRA for UXO-18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Location Name	Northing	Easting	Sample Name	Sample Beginning Depth	Sample Ending Depth	Sample Date	Sample Matrix	Sample Type	Analytical Group	CAS Number	Analyte Name	Result (mg/kg)	Units	Result Flag	MDL (mg/kg)	RL (mg/kg)	Detect
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	EXPLO	118-96-7	2,4,6-Trinitrotoluene	0.2	MG/KG	U	0.083	0.5	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	EXPLO	55-63-0	Nitroglycerin	0.2	MG/KG	U	0.085	0.5	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	EXPLO	78-11-5	PETN	1	MG/KG	U	0.579	2.5	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	EXPLO	35572-78-2	2-Amino-4,6-dinitrotoluene	0.2	MG/KG	U	0.075	0.5	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	EXPLO	19406-51-0	4-Amino-2,6-dinitrotoluene	0.2	MG/KG	U	0.075	0.5	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-1113	0	2.5	11/15/2013	SMI	N	SVOA	606-20-2	2,6-Dinitrotoluene	0.2	MG/KG	U	0.083	0.5	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7429-90-5	Aluminum	262	MG/KG	J	1.98	4	Yes
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-36-0	Antimony	0.2	MG/KG	UJ	0.1	0.2	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-38-2	Arsenic	0.3	MG/KG	U	0.08	0.3	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-39-3	Barium	2.4	MG/KG	=	0.075	0.4	Yes
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-41-7	Beryllium	0.2	MG/KG	UJ	0.044	0.2	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-43-9	Cadmium	0.08	MG/KG	U	0.03	0.08	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-70-2	Calcium	41300	MG/KG	=	500	800	Yes
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-47-3	Chromium	0.69	MG/KG	=	0.04	0.2	Yes
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	18540-29-9	Chromium (hexavalent)	4	MG/KG	U	2.3	4	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-48-4	Cobalt	0.098	MG/KG	J	0.02	0.08	Yes
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-50-8	Copper	0.46	MG/KG	J	0.094	0.4	Yes
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7439-89-6	Iron	185	MG/KG	=	0.85	4	Yes
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7439-92-1	Lead	0.2	MG/KG	J	0.16	0.4	Yes
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7439-95-4	Magnesium	1430	MG/KG	J	1.29	4	Yes
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7439-96-5	Manganese	19.3	MG/KG	=	0.13	0.4	Yes
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-02-0	Nickel	0.17	MG/KG	J	0.068	0.4	Yes
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-09-7	Potassium	70.9	MG/KG	J	13.9	50	Yes
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7782-49-2	Selenium	0.1	MG/KG	U	0.04	0.1	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-22-4	Silver	0.05	MG/KG	U	0.02	0.05	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-23-5	Sodium	294	MG/KG	=	11.1	50	Yes
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-28-0	Thallium	0.05	MG/KG	UJ	0.02	0.05	No
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-62-2	Vanadium	0.5	MG/KG	J	0.1	0.4	Yes
VE-UXO18-01DU01	2003938.347	247660.814	VE-UXO18-01SMI01-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-66-6	Zinc	3.6	MG/KG	J	1.15	4	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7429-90-5	Aluminum	598	MG/KG	J	1.98	4	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-36-0	Antimony	0.2	MG/KG	UJ	0.1	0.2	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-38-2	Arsenic	0.3	MG/KG	U	0.08	0.3	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-39-3	Barium	4.5	MG/KG	=	0.075	0.4	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-41-7	Beryllium	0.2	MG/KG	UJ	0.044	0.2	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-43-9	Cadmium	0.08	MG/KG	U	0.03	0.08	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-70-2	Calcium	27100	MG/KG	=	500	800	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-47-3	Chromium	0.85	MG/KG	=	0.04	0.2	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	18540-29-9	Chromium (hexavalent)	10	MG/KG	U	5.75	10	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-48-4	Cobalt	0.24	MG/KG	=	0.02	0.08	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-50-8	Copper	0.68	MG/KG	J	0.094	0.4	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7439-89-6	Iron	316	MG/KG	=	4.3	20	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7439-92-1	Lead	0.4	MG/KG	UJ	0.16	0.4	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7439-95-4	Magnesium	620	MG/KG	J	1.29	4	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7439-96-5	Manganese	54.6	MG/KG	=	0.65	2	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-02-0	Nickel	0.36	MG/KG	J	0.068	0.4	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-09-7	Potassium	184	MG/KG	J	13.9	50	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7782-49-2	Selenium	0.12	MG/KG	J	0.04	0.1	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-22-4	Silver	0.05	MG/KG	U	0.02	0.05	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-23-5	Sodium	61.7	MG/KG	J	11.1	50	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-28-0	Thallium	0.05	MG/KG	UJ	0.02	0.05	No
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-62-2	Vanadium	0.54	MG/KG	J	0.1	0.4	Yes
VE-UXO18-01DU02	2003669.099	247783.057	VE-UXO18-01SMI02-0613	0	2.5	6/12/2013	SMI	N	METALS	7440-66-6	Zinc	2.9	MG/KG	J	1.15	4	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7429-90-5	Aluminum	3630	MG/KG	=	2.3	4.6	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-36-0	Antimony	1.1	MG/KG	U	0.57	1.1	No
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-38-2	Arsenic	2.2	MG/KG	J	0.46	1.7	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-39-3	Barium	34.5	MG/KG	=	0.085	0.46	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-41-7	Beryllium	0.23	MG/KG	U	0.05	0.23	No
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-43-9	Cadmium	0.18	MG/KG	J	0.17	0.46	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-70-2	Calcium	265000	MG/KG	=	114	182	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-47-3	Chromium	6.3	MG/KG	=	0.2	1.1	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	18540-29-9	Chromium (hexavalent)	4.5	MG/KG	U	2.6	4.5	No
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-48-4	Cobalt	2.4	MG/KG	=	0.11	0.46	Yes

Attachment D-4

Analytical Data Used in the HHRA for UXO-18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Location Name	Northing	Easting	Sample Name	Sample Beginning Depth	Sample Ending Depth	Sample Date	Sample Matrix	Sample Type	Analytical Group	CAS Number	Analyte Name	Result (mg/kg)	Units	Result Flag	MDL (mg/kg)	RL (mg/kg)	Detect
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-50-8	Copper	8.1	MG/KG	=	0.11	0.46	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7439-89-6	Iron	2680	MG/KG	=	0.97	4.6	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7439-92-1	Lead	0.46	MG/KG	U	0.18	0.46	No
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7439-95-4	Magnesium	3630	MG/KG	=	1.5	4.6	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7439-96-5	Manganese	110	MG/KG	=	0.15	0.46	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-02-0	Nickel	1.9	MG/KG	=	0.077	0.46	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-09-7	Potassium	827	MG/KG	=	16	57	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7782-49-2	Selenium	0.57	MG/KG	U	0.23	0.57	No
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-22-4	Silver	0.28	MG/KG	U	0.11	0.28	No
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-23-5	Sodium	452	MG/KG	=	13	57	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-28-0	Thallium	0.28	MG/KG	U	0.11	0.28	No
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-62-2	Vanadium	5.1	MG/KG	=	0.11	0.46	Yes
VE-UXO18-01SO01	2003766.812	247704.448	VE-UXO18-01SS01-0001	0	12	6/12/2013	SS	N	METALS	7440-66-6	Zinc	10.1	MG/KG	=	1.3	4.6	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7429-90-5	Aluminum	4470	MG/KG	J	2.5	4.9	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-36-0	Antimony	1.2	MG/KG	U	0.61	1.2	No
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-38-2	Arsenic	2.2	MG/KG	J	0.49	1.8	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-39-3	Barium	49	MG/KG	J	0.092	0.49	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-41-7	Beryllium	0.25	MG/KG	UJ	0.054	0.25	No
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-43-9	Cadmium	0.32	MG/KG	J	0.18	0.49	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-70-2	Calcium	238000	MG/KG	J	123	196	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-47-3	Chromium	9.2	MG/KG	=	0.21	1.2	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	18540-29-9	Chromium (hexavalent)	12	MG/KG	U	7	12	No
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-48-4	Cobalt	2.5	MG/KG	=	0.12	0.49	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-50-8	Copper	13	MG/KG	J	0.12	0.49	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7439-89-6	Iron	3740	MG/KG	J	1	4.9	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7439-92-1	Lead	0.49	MG/KG	UJ	0.2	0.49	No
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7439-95-4	Magnesium	4780	MG/KG	J	1.6	4.9	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7439-96-5	Manganese	184	MG/KG	J	0.16	0.49	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-02-0	Nickel	2.5	MG/KG	J	0.083	0.49	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-09-7	Potassium	1060	MG/KG	=	17	61	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7782-49-2	Selenium	0.75	MG/KG	J+	0.25	0.61	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-22-4	Silver	0.31	MG/KG	U	0.12	0.31	No
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-23-5	Sodium	627	MG/KG	J	14	61	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-28-0	Thallium	0.31	MG/KG	U	0.12	0.31	No
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-62-2	Vanadium	7	MG/KG	J	0.12	0.49	Yes
VE-UXO18-01SO02	2003744.217	247717.92	VE-UXO18-01SS02-0001	0	12	6/12/2013	SS	N	METALS	7440-66-6	Zinc	21.3	MG/KG	J	1.4	4.9	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7429-90-5	Aluminum	9720	MG/KG	=	2.5	5	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-36-0	Antimony	1.3	MG/KG	U	0.63	1.3	No
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-38-2	Arsenic	4.8	MG/KG	=	0.5	1.9	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-39-3	Barium	43.3	MG/KG	=	0.094	0.5	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-41-7	Beryllium	0.09	MG/KG	J	0.055	0.25	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-43-9	Cadmium	0.25	MG/KG	J	0.19	0.5	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-70-2	Calcium	229000	MG/KG	=	126	201	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-47-3	Chromium	11.4	MG/KG	=	0.22	1.3	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	18540-29-9	Chromium (hexavalent)	5	MG/KG	U	2.9	5	No
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-48-4	Cobalt	2.4	MG/KG	=	0.13	0.5	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-50-8	Copper	13.6	MG/KG	=	0.12	0.5	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7439-89-6	Iron	7710	MG/KG	=	1.1	5	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7439-92-1	Lead	2	MG/KG	=	0.2	0.5	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7439-95-4	Magnesium	12300	MG/KG	=	1.6	5	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7439-96-5	Manganese	315	MG/KG	=	0.16	0.5	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-02-0	Nickel	3.8	MG/KG	=	0.085	0.5	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-09-7	Potassium	2350	MG/KG	=	17	63	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7782-49-2	Selenium	0.98	MG/KG	J+	0.25	0.63	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-22-4	Silver	0.31	MG/KG	U	0.13	0.31	No
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-23-5	Sodium	494	MG/KG	=	14	63	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-28-0	Thallium	0.55	MG/KG	J+	0.13	0.31	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-62-2	Vanadium	14.6	MG/KG	=	0.13	0.5	Yes
VE-UXO18-01SO03	2003913.735	247641.188	VE-UXO18-01SS03-0001	0	12	6/12/2013	SS	N	METALS	7440-66-6	Zinc	23.7	MG/KG	=	1.4	5	Yes

Attachment D-5
Comparison of Detection Limits and LOQs to Screening Levels

Attachment D-5 TABLE 1-A
Aluminum

ISM Calculator for 1-sided Upper Confidence Limit (UCL) for the Mean

Note on Selecting a UCL Method. This worksheet can be used to calculate a 95UCL from ISM data using both the Chebyshev and Student's-t methods. If you have discrete data or other knowledge that indicates the variability in contaminant concentrations within the DU is low, use the Student's t method. If discrete data or other knowledge suggests that the variability may be high or the variability is unknown, use the Chebyshev method. Because the Chebyshev method tends to yield higher UCL values for the same data set, it's statistical performance is desirable - it achieves the desired 95% coverage of the mean under conditions when the variability of concentrations throughout the DU are moderate or high (See Table 4-4). One drawback of this performance is that the Chebyshev will tend to more severely overestimate the true mean than Student's t. Nevertheless, if no discrete data are available to estimate this variability, then Chebyshev is generally preferred over Student's t. Do not mistake the standard deviation (SD) of replicates as a measure of this variability. The SD of replicates is a measure of consistency in estimates of the mean - this is considered a reliable indicator of the laboratory processing steps, but not an indicator of the degree of variability in the distribution of concentrations throughout the DU.

	Replicate Results		Summary Statistics		
Replicate Number	Data A	Data B	Stats A	Stats B	Notes
Rep 1	262		--	--	If you have replicate ISM results, enter data in the first section "Replicate Results"
Rep 2	598		--	--	If you have summary statistics, enter data in the second section "Summary Statistics"
Rep 3			--	--	
Rep 4			--	--	
Rep 5			--	--	
arithmetic mean	430.000				sample mean of replicate results
standard deviation	237.588				sample standard deviation of replicate results
CV = SD / mean	0.553				CV gives a measure of spread of the replicates, which is different from CV of underlying distribution
count (r)	2	0			For ISM, the sample size in the UCL calculation is the number of replicates, not the number of increments.
alpha (95% = 0.05)	0.05	0.05	0.05	0.05	standard choice is alpha = 0.05
t(alpha, df=r-1)	6.31				from Student's t distribution
Student's t UCL	1490.71				Note that the UCL for these relatively small sample sizes will typically exceed the maximum.
Chebychev UCL	1162.30				The calculated UCL should be used (do not use the maximum).

Attachment D-5 TABLE 1-B
Cobalt

ISM Calculator for 1-sided Upper Confidence Limit (UCL) for the Mean

Note on Selecting a UCL Method. This worksheet can be used to calculate a 95UCL from ISM data using both the Chebyshev and Student's-t methods. If you have discrete data or other knowledge that indicates the variability in contaminant concentrations within the DU is low, use the Student's t method. If discrete data or other knowledge suggests that the variability may be high or the variability is unknown, use the Chebyshev method. Because the Chebyshev method tends to yield higher UCL values for the same data set, it's statistical performance is desirable - it achieves the desired 95% coverage of the mean under conditions when the variability of concentrations throughout the DU are moderate or high (See Table 4-4). One drawback of this performance is that the Chebyshev will tend to more severely overestimate the true mean than Student's t. Nevertheless, if no discrete data are available to estimate this variability, then Chebyshev is generally preferred over Student's t. Do not mistake the standard deviation (SD) of replicates as a measure of this variability. The SD of replicates is a measure of consistency in estimates of the mean - this is considered a reliable indicator of the laboratory processing steps, but not an indicator of the degree of variability in the distribution of concentrations throughout the DU.

	Replicate Results		Summary Statistics		
Replicate Number	Data A	Data B	Stats A	Stats B	Notes
Rep 1	0.098		--	--	If you have replicate ISM results, enter data in the first section "Replicate Results"
Rep 2	0.24		--	--	If you have summary statistics, enter data in the second section "Summary Statistics"
Rep 3			--	--	
Rep 4			--	--	
Rep 5			--	--	
arithmetic mean	0.169				sample mean of replicate results
standard deviation	0.100				sample standard deviation of replicate results
CV = SD / mean	0.594				CV gives a measure of spread of the replicates, which is different from CV of underlying distribution
count (r)	2	0			For ISM, the sample size in the UCL calculation is the number of replicates, not the number of increments.
alpha (95% = 0.05)	0.05	0.05	0.05	0.05	standard choice is alpha = 0.05
t(alpha, df=r-1)	6.31				from Student's t distribution
Student's t UCL	0.62				Note that the UCL for these relatively small sample sizes will typically exceed the maximum.
Chebychev UCL	0.48				The calculated UCL should be used (do not use the maximum).

Attachment D-5 TABLE 1-C
Iron

ISM Calculator for 1-sided Upper Confidence Limit (UCL) for the Mean

Note on Selecting a UCL Method. This worksheet can be used to calculate a 95UCL from ISM data using both the Chebyshev and Student's-t methods. If you have discrete data or other knowledge that indicates the variability in contaminant concentrations within the DU is low, use the Student's t method. If discrete data or other knowledge suggests that the variability may be high or the variability is unknown, use the Chebyshev method. Because the Chebyshev method tends to yield higher UCL values for the same data set, it's statistical performance is desirable - it achieves the desired 95% coverage of the mean under conditions when the variability of concentrations throughout the DU are moderate or high (See Table 4-4). One drawback of this performance is that the Chebyshev will tend to more severely overestimate the true mean than Student's t. Nevertheless, if no discrete data are available to estimate this variability, then Chebyshev is generally preferred over Student's t. Do not mistake the standard deviation (SD) of replicates as a measure of this variability. The SD of replicates is a measure of consistency in estimates of the mean - this is considered a reliable indicator of the laboratory processing steps, but not an indicator of the degree of variability in the distribution of concentrations throughout the DU.

	Replicate Results		Summary Statistics		
Replicate Number	Data A	Data B	Stats A	Stats B	Notes
Rep 1	185		--	--	If you have replicate ISM results, enter data in the first section "Replicate Results"
Rep 2	316		--	--	If you have summary statistics, enter data in the second section "Summary Statistics"
Rep 3			--	--	
Rep 4			--	--	
Rep 5			--	--	
arithmetic mean	250.500				sample mean of replicate results
standard deviation	92.631				sample standard deviation of replicate results
CV = SD / mean	0.370				CV gives a measure of spread of the replicates, which is different from CV of underlying distribution
count (r)	2	0			For ISM, the sample size in the UCL calculation is the number of replicates, not the number of increments.
alpha (95% = 0.05)	0.05	0.05	0.05	0.05	standard choice is alpha = 0.05
t(alpha, df=r-1)	6.31				from Student's t distribution
Student's t UCL	664.05				Note that the UCL for these relatively small sample sizes will typically exceed the maximum.
Chebychev UCL	536.01				The calculated UCL should be used (do not use the maximum).

Attachment D-5 TABLE 1-D
Manganese

ISM Calculator for 1-sided Upper Confidence Limit (UCL) for the Mean

Note on Selecting a UCL Method. This worksheet can be used to calculate a 95UCL from ISM data using both the Chebyshev and Student's-t methods. If you have discrete data or other knowledge that indicates the variability in contaminant concentrations within the DU is low, use the Student's t method. If discrete data or other knowledge suggests that the variability may be high or the variability is unknown, use the Chebyshev method. Because the Chebyshev method tends to yield higher UCL values for the same data set, it's statistical performance is desirable - it achieves the desired 95% coverage of the mean under conditions when the variability of concentrations throughout the DU are moderate or high (See Table 4-4). One drawback of this performance is that the Chebyshev will tend to more severely overestimate the true mean than Student's t. Nevertheless, if no discrete data are available to estimate this variability, then Chebyshev is generally preferred over Student's t. Do not mistake the standard deviation (SD) of replicates as a measure of this variability. The SD of replicates is a measure of consistency in estimates of the mean - this is considered a reliable indicator of the laboratory processing steps, but not an indicator of the degree of variability in the distribution of concentrations throughout the DU.

	Replicate Results		Summary Statistics		
Replicate Number	Data A	Data B	Stats A	Stats B	Notes
Rep 1	19.3		--	--	If you have replicate ISM results, enter data in the first section "Replicate Results"
Rep 2	54.6		--	--	If you have summary statistics, enter data in the second section "Summary Statistics"
Rep 3			--	--	
Rep 4			--	--	
Rep 5			--	--	
arithmetic mean	36.950				sample mean of replicate results
standard deviation	24.961				sample standard deviation of replicate results
CV = SD / mean	0.676				CV gives a measure of spread of the replicates, which is different from CV of underlying distribution
count (r)	2	0			For ISM, the sample size in the UCL calculation is the number of replicates, not the number of increments.
alpha (95% = 0.05)	0.05	0.05	0.05	0.05	standard choice is alpha = 0.05
t(alpha, df=r-1)	6.31				from Student's t distribution
Student's t UCL	148.39				Note that the UCL for these relatively small sample sizes will typically exceed the maximum.
Chebychev UCL	113.88				The calculated UCL should be used (do not use the maximum).

Table 2

EXPOSURE POINT CONCENTRATION COMPARISON BETWEEN INCREMENTAL AND DISCRETE SAMPLES

Cayo La Chiva UXO-18

Former Vieques Naval Training Range, Vieques, Puerto Rico

			EPCs Used in the HHRA				Additional Evaluation of EPCs											
							Discrete Samples			MIS Samples						Maximum EPC Between Discrete & MIS Samples		
Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL	Maximum Detected Concentration (and Qualifier)		Minimum Concentration	Maximum Concentration	FOD	Minimum Concentration	Maximum Concentration	FOD	Student's t UCL (3)	Chebychev UCL (3)	Higher UCL	Value	Statistic	Rationale
Surface Soil (0 - 1 feet)	Aluminum	mg/kg	3.74E+03	NA	9.7E+03		3.6E+03	9.7E+03	3 / 3	2.6E+02	6.0E+02	2 / 2	1.5E+03	1.2E+03	1.5E+03	9.7E+03	MaxDet	(2)
	Arsenic	mg/kg	1.90E+00	NA	4.8E+00		2.2E+00	4.8E+00	3 / 3			0 / 2				4.8E+00	MaxDet	(2)
	Cobalt	mg/kg	1.53E+00	NA	2.5E+00		2.4E+00	2.5E+00	3 / 3	9.8E-02	2.4E-01	2 / 2	6.2E-01	4.8E-01	6.2E-01	2.5E+00	MaxDet	(2)
	Iron	mg/kg	2.93E+03	NA	7.7E+03		2.7E+03	7.7E+03	3 / 3	1.9E+02	3.2E+02	2 / 2	6.6E+02	5.4E+02	6.6E+02	7.7E+03	MaxDet	(2)
	Manganese	mg/kg	1.37E+02	NA	3.2E+02		1.1E+02	3.2E+02	3 / 3	1.9E+01	5.5E+01	2 / 2	1.5E+02	1.1E+02	1.5E+02	3.2E+02	MaxDet	(2)
	Thallium	mg/kg	1.79E-01	NA	5.5E-01	J+	5.5E-01	5.5E-01	1 / 3			0 / 2				5.5E-01	MaxDet	(2)

(1) The maximum detected concentration was used for this chemical because there were less than 8 total samples.

(2) The higher of the maximum detected concentration of discrete samples and the higher UCL of MIS samples was selected as the EPC.

(3) UCL was calculated using ITRC's online Incremental Sampling Methodology (ISM) Calculator.

EPC = exposure point concentration

FOD = frequency of detection

mg/kg = milligrams/kilogram

J+ - Estimated result; potential positive bias

NA = Not applicable

UCL = upper confidence limit

Attachment D-6
Comparison of Maximum Detection Limit and LOQ to Adjusted RSLs

Attachment D-6

Comparison of Maximum Detection Limit and LOQ to Adjusted RSLs

Former Vieques Naval Training Range

Vieques, Puerto Rico

		Detection Limit (DL)		LOQ		Numbers					
CAS Number	**Analyte Name**	**Minimum**	**Maximum**	**Minimum**	**Maximum**	**Detection**	**Analyses**	**Adjusted Residential Soil RSL**	**RSL Basis**	**Maximum DL exceeds RSL?**	**Maximum RL exceeds RSL?**
99-35-4	1,3,5-Trinitrobenzene	0.079	0.079	0.5	0.5	0	4	220	n	No	No
99-65-0	1,3-Dinitrobenzene	0.063	0.063	0.45	0.45	0	4	0.61	n	No	No
118-96-7	2,4,6-Trinitrotoluene	0.083	0.083	0.5	0.5	0	4	3.6	n	No	No
121-14-2	2,4-Dinitrotoluene	0.083	0.083	0.5	0.5	0	4	1.6	c	No	No
606-20-2	2,6-Dinitrotoluene	0.083	0.083	0.5	0.5	0	4	0.33	c	No	Yes
35572-78-2	2-Amino-4,6-dinitrotoluene	0.075	0.075	0.5	0.5	0	4	15	n	No	No
88-72-2	2-Nitrotoluene	0.066	0.066	0.5	0.5	0	4	2.9	c	No	No
99-08-1	3-Nitrotoluene	0.071	0.071	0.5	0.5	0	4	0.61	n	No	No
19406-51-0	4-Amino-2,6-dinitrotoluene	0.075	0.075	0.5	0.5	0	4	15	n	No	No
99-99-0	4-Nitrotoluene	0.08	0.08	0.5	0.5	0	4	24	n	No	No
2691-41-0	HMX	0.08	0.08	0.5	0.5	0	4	380	n	No	No
98-95-3	Nitrobenzene	0.075	0.075	0.5	0.5	0	4	4.8	c	No	No
55-63-0	Nitroglycerin	0.085	0.085	0.5	0.5	0	4	0.61	n	No	No
78-11-5	PETN	0.579	0.579	2.5	2.5	0	4	12	n	No	No
88-89-1	Picric Acid	0.06	0.06	0.2	0.2	0	4	NA	--	--	--
121-82-4	RDX	0.08	0.08	0.5	0.5	0	4	5.6	c	No	No
479-45-8	Tetryl	0.091	0.091	0.5	0.5	0	4	12	n	No	No
7440-36-0	Antimony	0.1	0.63	0.2	1.3	0	5	3.1	n	No	No
18540-29-9	Chromium (hexavalent)	2.3	7	4	12	0	5	0.29	c	Yes	Yes
7440-22-4	Silver	0.02	0.13	0.05	0.31	0	5	39	n	No	No

Note:

Chemicals that were 100% non-detected are presented.

Units are presented in mg/kg.

Regional Screening Levels (RSL) for Residential Soil (November 2013). RSL based on non-carcinogenic health effects are adjusted using an Hazard Quotient (HQ) = 0.1.

NA - not available.

RSL Basis: n=non-carcinogenic; c=carcinogenic health effects.

Appendix E
Ecological Risk Assessment

APPENDIX E

Ecological Risk Assessment

1.1 Introduction

This appendix contains a screening ecological risk assessment (SERA), constituting Steps 1 and 2 of the ecological risk assessment (ERA) process, and the first step (Step 3A) of a baseline ecological risk assessment (BERA) for UXO 18 (Cayo La Chiva). UXO 18 is a small (12-acre) island south of the Eastern Maneuver Area (EMA) on Vieques Island, is surrounded by the Caribbean Sea, and is within swimming distance from a public beach Playa La Chiva (a.k.a., Blue Beach).

The approach, methods, and assumptions used for this ERA were based upon the final ERA protocol presented in the *Master Standard Operating Procedures, Protocols, and Plans* (CH2M HILL, 2010a), and the *Master Ecological Risk Assessment Protocol for Vieques Environmental Restoration Program – Update 1 (Addendum)* (CH2M HILL, 2010b).

1.1.1 Ecological Risk Assessment Process

This ERA was conducted in accordance with the *Navy Policy for Conducting Ecological Risk Assessments* (CNO, 1999) and the Navy guidance for implementing this ERA policy (NAVFAC, 2003). The Navy ERA policy and guidance, which describe a process consisting of eight steps organized into three tiers, are conceptually similar to the eight-step ERA process outlined in U.S. Environmental Protection Agency (USEPA) ERA guidance for the Superfund program (USEPA, 1997). For both sets of guidance, Steps 1 and 2 involve conducting a SERA using very conservative assumptions. The BERA represents Steps 3 through 7. The BERA uses more realistic assumptions and site-specific data to refine the risk estimates from the SERA for components that fail the initial screen. Step 8 addresses risk management issues. The major differences between the Navy ERA policy/guidance and the USEPA ERA guidance are:

1. The Navy policy/guidance provides clearly defined criteria for exiting the ERA process at specific points.
2. The Navy policy/guidance divides Step 3 (the first step of the BERA) into two distinct sub-steps (Steps 3A and 3B), with a potential exit point after Step 3A.
3. The Navy policy/guidance incorporates risk management considerations throughout all tiers of the ERA process.

ERAs are conducted using a tiered, step-wise approach and are punctuated with Scientific Management Decision Points (SMDPs). SMDPs represent points in the ERA process where agreement on conclusions, actions, or methodologies is needed so that the ERA process can continue (or terminate) in a technically defensible manner. The results of the ERA at a particular SMDP are used to determine how the ERA process should proceed, for example, to the next step in the process or directly to a later step. The process continues until a final decision has been reached (i.e., remedial action or controls if unacceptable risks are identified, or no further action if risks are acceptable). The process can also be iterative if data needs are identified at any step; the needed data are collected and the process starts again at the point appropriate to the type of data collected.

The screening (preliminary) problem formulation is the first step of an ERA and establishes the goals, scope, and focus of the SERA. As part of problem formulation, the environmental setting of the site is characterized in terms of the habitats and biota known or likely to be present. The types and concentrations of chemicals that are present in ecologically relevant media (such as surface soil) are also described. A preliminary conceptual model is developed that describes potential source areas, potential transport pathways (the mechanisms whereby chemicals may be transported from a source of contamination to ecologically relevant media), potential exposure pathways (an exposure pathway links a potential source of contamination with one or more receptors through exposure via one or more media and exposure routes), potential exposure

routes (e.g., ingestion), and potential receptors. Assessment endpoints, measurement endpoints, and risk hypotheses are then selected to evaluate those receptors for which complete and potentially significant exposure pathways are likely to exist[1]. The fate, transport, and toxicological properties of the chemicals present at the site, particularly the potential for bioaccumulation, are also considered during the problem formulation process.

Step 1 of the ERA process is intended to answer two main questions:

1. Do complete exposure pathways exist?
2. Are sufficient data available to conduct the SERA?

If no complete exposure pathways exist, the ERA process terminates at Step 1 with a conclusion of negligible (acceptable) risk because exposure, and thus potential risk, can only occur if complete exposure pathways exist. If one or more complete exposure pathways are known to exist, or are likely to exist, the ERA process continues to Step 2 but only evaluates those pathways that have been determined to be "critical" (ecologically important), that is, represent exposures to sensitive receptors that are associated with the predominant fate and transport mechanisms at the site (USEPA, 1997). An evaluation of the available data is then conducted to determine if they are adequate to support the SERA. If not, additional data are collected before the ERA process continues. The second step of the ERA process involves conducting a screening exposure assessment, a screening effects assessment, and a screening risk calculation (risk characterization) based upon very conservative assumptions.

The results of the SERA are used to evaluate the potential for unacceptable ecological risks based upon very conservative assumptions. If the results of the SERA suggest that further ecological risk evaluation is warranted, the ERA process proceeds to the BERA (Steps 3 through 7), which is a more detailed phase of the ERA process, for the pathways, chemicals, receptors, and areas identified in the SERA. As indicated above, the first step of the BERA (Step 3) is divided into two distinct sub-steps (3A and 3B) in Navy ERA guidance.

Step 3 of the USEPA ERA guidance consists of the following activities (USEPA, 1997):

1. Refinement of the Chemicals of Potential Concern (COPCs) from the SERA.
2. Further characterizing the potential ecological effects of contaminants.
3. Refining information on contaminant fate and transport, complete exposure pathways, and receptors potentially at risk.
4. Selecting assessment endpoints.
5. Refining the conceptual model and risk hypotheses from the SERA.

Step 3A of the Navy policy/guidance (refinement of conservative exposure assumptions) corresponds to the first activity listed above for the USEPA ERA guidance. In Step 3A, a refined evaluation of exposure estimates is conducted using more realistic assumptions and additional methodologies relative to those used in the SERA, which is intended to be a very conservative assessment. Examples of more realistic exposure assumptions include using central tendency (e.g., mean) estimates (rather than maximums) for media concentrations, bioaccumulation factors, and exposure parameters. Examples of additional methodologies include consideration of background and upgradient concentrations, bioavailability, and detection frequency (CNO, 1999; NAVFAC, 2003).

[1] An assessment endpoint is an explicit expression of the environmental component or value that is to be protected. A measurement endpoint is a measurable ecological characteristic that is related to the component or value chosen as the assessment endpoint. Risk hypotheses are testable hypotheses about the relationship among the assessment endpoints and their predicted responses when exposed to contaminants or other stressors.

If risk estimates (and their associated uncertainty) are acceptable following Step 3A, the site will meet the conditions of the exit criterion specified in the Navy guidance. If the Step 3A evaluation does not support a determination of acceptable risk within acceptable uncertainty, the site continues to Step 3B.

Step 3B of the Navy policy/guidance (problem formulation) corresponds conceptually to the last four activities of Step 3 listed above for the USEPA ERA guidance. In Step 3B, the preliminary conceptual model from the SERA is refined based upon the results of the Step 3A evaluation to develop a revised list of key receptors, critical exposure pathways, key COPCs, assessment endpoints, measurement endpoints, and risk hypotheses. Based upon the refined conceptual model, the lines of evidence to be used in characterizing risk are determined. Agreement on the refined conceptual model, COPCs, exposure pathways, endpoints, and risk hypotheses constitutes the SMDP at the end of Step 3 in both Navy and USEPA ERA guidance.

Following the completion of Step 3, a decision point is reached with two potential outcomes. If the refined risk estimates are acceptable for each selected assessment endpoint, the investigation proceeds to risk characterization (Step 7) to document this conclusion and the ERA process terminates. If the uncertainties associated with the refined risk estimates are unacceptable and/or the risk estimates indicate that unacceptable risks may exist, site-specific studies might be required and the ERA process continues (Steps 4 through 6). Step 4 is a work planning step where additional site-specific studies are scoped and designed. Step 5 consists of the verification of the field sampling design developed in Step 4 while Step 6 constitutes the site investigation and data analysis phase of the process. The scope (e.g., spatial extent of sampling) and components (e.g., collection of biological data, such as tissue samples, toxicity testing, etc.) of any site-specific studies are determined by the conclusions of Step 3 and the pathways/endpoints associated with the potential unacceptable risks.

Step 7 consists of the documentation and synthesis of the information and data identified in Steps 1 through 3 (no additional study) or Steps 1 through 6 (additional study). In this step, risk is evaluated and characterized using both quantitative and qualitative methods. Conclusions are made as to whether there is a reasonable potential for unacceptable ecological risk and, if there is a potential for unacceptable ecological risk, the magnitude of that risk. The results of the completed BERA (Step 7) are used to make necessary risk management decisions (Step 8) related to current or future risks. Possible decisions include:

- Adequate information exists to conclude that no unacceptable ecological risks exist. The assessment should stop at Step 7.
- Adequate information exists to conclude that unacceptable ecological risks exist for which remedial actions or controls are warranted. Whether remedial actions or controls are taken, and the specific actions or controls taken, will depend upon a number of risk management factors such as the results of human health risk assessments (if applicable) and the potential impact of the remedial action or control itself on the habitats and biota present. This analysis would occur as part of Step 8.
- Adequate information does not exist to estimate risk or the risk estimate is believed to be too conservative or uncertain to recommend remediation. The assessment should be refined.

1.2 Problem Formulation

Problem formulation establishes the goals, scope, and focus of the ERA. As part of problem formulation, the ecological setting of UXO 18 is characterized in terms of the habitats and biota known or likely to be present. The types and concentrations of chemicals that are present in ecologically relevant media (surface soil) are also described based upon available analytical data. A conceptual site model is developed that describes source areas, transport pathways and exposure media, exposure pathways and routes, and receptors. Assessment endpoints, measurement endpoints, and risk hypotheses are developed to evaluate those receptors for which critical exposure pathways exist. The fate, transport, and toxicological properties of the chemicals present at UXO 18, particularly the potential for bioaccumulation, are also considered during this process.

1.2.1 Ecological Setting

Cayo Chiva is a rocky island, isolated from the coastline at a distance of 0.16 miles due south of Blue Beach (Playa La Chiva). The majority of the western and southern portions of the island consist of steep, vertical limestone rock slopes rising 30 to 50 feet above the bay (Bahía de La Chiva). The eastern and northern portions of the island consist of a narrow strand of sandy beach which extends to a very shallow seagrass bed within the bay. A qualitative biological survey of Cayo La Chiva was conducted by CH2M HILL from June 14 through 21, 2011, the results of which are summarized below.

Habitats and Biota

Three habitat types were identified on Cayo La Chiva, including dry scrub forest, secondary growth forest, and mangrove forest. These habitats and observed terrestrial wildlife species are described below.

Flora

Dominant habitat types are described in the following sections. Approximately 1.6 acres of unvegetated rocky shoreline and sandy beach occur along the island shoreline.

Dry Scrub Forest

The dry scrub forest covers the majority of the island and is dominated by small diameter trees and shrubs. Dominant species observed include catclaw blackbead (*Pithecellobium unguis-cati*), torchwood (*Amyris elemifera*), gumbo limbo (*Bursera simaruba*), Jamaican caper (*Capparis cynophallophora*), seagrape (*Coccoloba uvifera*), white cedar (*Tabebuia heterophylla*), blacktorch (*Erithalis fruticosa*), buttonsage (*Lantana involucrata*), and rougeplant (*Rivina humilis*). The canopy consists mostly of small trees and shrubs 7 to 12 feet in height with 100 percent cover classified as shrubs. The groundcover is very sparse due to the dense shrub canopy, ranging from 5 to 25 percent. Dense tangles of vines are present in scattered locations throughout the island. The dry scrub habitat covers approximately 7.2 acres. The substrate in this habitat type is mostly limestone bedrock, fractured limestone, or a thin veneer of soil.

Secondary Growth Forest

The secondary growth forest occurs as isolated stands of mature trees on Cayo La Chiva. The dominant species include many large tree species such as water mampoo (*Pisonia subcordata*), gumbo limbo, Spanish lime (*Melicoccus bijugatus*), red manjack (*Cordia collococca*), seagrape, white cedar, white stopper (*Eugenia axillaris*) and wild banyantree (*Ficus citrifolia*). The trees in the secondary growth forest are approximately 30 feet in height with a minimum diameter at breast height (DBH) of approximately 7 inches and larger. The secondary growth forest habitat covers approximately 2.4 acres. The canopy density is 100 percent and the substrate is mostly soil with scattered limestone at the surface.

Mangrove Forest

The mangrove forest is a narrow fringe along the eastern and northern coast of Cayo La Chiva. This fringe is dominated by black mangrove (*Avicennia germinans*), white mangrove (*Laguncularia racemosa*), button mangrove (*Conocarpus erectus*), and Portia tree (*Thespesia populnea*). Mangrove forest habitat is approximately 0.8 acre. The canopy density is approximately 100 percent at the north end of the island but becomes less dense further south as the habitat becomes a narrow fringe along the beach. Substrate within the mangrove habitat is 100 percent sand.

Fauna

Other biological resources observed during the site survey include hermit crab (*Coenobita clypeatus*), common anole (*Anolis cristatellus*), white-winged dove (*Zenaida asiatica*), white-crowned pigeon (*Patagioenas leucocephala*), zenaida dove (*Zenaida aurita*), yellow warbler (*Dendroica petechia*), bananaquit (*Coereba flaveola*), pearly-eyed thrasher (*Margarops fuscatus*), grey kingbird (*Tyrannus dominicensis*), yellow-crowned night heron (*Nyctanassa violacea*), American kestrel (*Falco sparverius*), red-tailed hawk (*Buteo jamaicensis*), Puerto Rican flycatcher (*Myiarchus antillarum*), and magnificent frigatebird (*Fregata magnificens*). Hermit crabs were present in large numbers throughout the island. Many of dove species

appeared to be nesting and using the island for roosting. Three yellow-crowned night heron nests were found. Most passerine birds were noted roosting or flying over. The red-tailed hawk was noted flying over and did not appear to be hunting for food on Cayo La Chiva.

Rare, Threatened, and Endangered Species

Thirteen federally listed species are known to occur, or have the potential to occur, on or near NASD Vieques (Table L-1). No listed plant or animal species were observed during the ground survey.

1.2.2 Summary of Available Analytical Data

Samples evaluated in the UXO 18 ERA are listed in **Table E-2**, and their locations are shown on **Figure E-1**. The analytical data sets for these samples are included in **Appendix C** of the RI/FS Report**.**

One multi-incremental sample (SMI) of surface soil (0 to approximately 2 inches) was collected within each of two sampling units where munitions and explosives of concern (MEC) items were previously identified. Discrete surface soil samples were collected from 0 to 1 ft below ground surface (bgs) at each of three smoke canister locations. Each soil sample was analyzed for explosives, inorganic constituents, pH, and total organic carbon (TOC). In addition, hexachloroethane was analyzed only in the three discrete surface soil samples. Physical parameter measurements are presented in **Table E-3**.

1.2.3 Conceptual Site Model

The conceptual site model relates potentially exposed receptor populations with potential source areas based upon physical site characteristics and complete exposure pathways. Important components of the conceptual site model are the identification of potential source areas, transport pathways, exposure media, exposure pathways and routes, and receptors. Actual or potential exposures of ecological receptors associated with a site are determined by identifying the most likely, and most important, mechanisms and pathways of contaminant release and transport. A complete exposure pathway has three components: (1) a source of chemicals that results in a release to the environment; (2) a pathway of chemical transport through an environmental medium; and (3) an exposure or contact point for an ecological receptor. **Figure E-2** illustrates a diagrammatic conceptual site model for UXO 18. Key components of this conceptual site model are discussed in the following subsections.

Potential Source Areas

Inspections conducted across UXO 18 in January 2011 identified five MEC items (5-inch rockets) along the western portion of the island. The items were destroyed through open detonation in March 2011. In addition, smoke canisters (HC 30 lbs ABC-M5) were observed on the ground surface. The smoke canisters were expended, but at the time of operation the HC smoke mixture would have contained 47% hexachloroethane (a semivolatile organic compound [SVOC]), 47% zinc oxide, and 6% grained aluminum. The MEC, expended smoke canisters, and the MEC detonation had the potential to release chemical contaminants to nearby environmental media.

Potential source areas in the UXO 18 include:

- Deterioration of MEC and smoke canisters (i.e., point source releases).
- Release of contaminants from past operation of smoke canisters
- Open detonation of MEC items [i.e., non-point source release).

Transport Pathways and Exposure Media

A transport pathway describes the mechanisms whereby site-related chemicals, once released, may be transported from a source to ecologically relevant media (such as surface soil) where exposures may occur. UXO 18 is comprised primarily of limestone and dolomite exposed at the ground surface, but with some areas of accumulated soil. These transport pathways are shown on **Figure E-2** and include:

- Overland flow (runoff) that redistributes surface soil contaminants within terrestrial habitats.

- Storm surges, tides, and waves may distribute contaminants associated with soils in low lying shoreline areas.

Exposure media for ecological receptors at UXO 18 include:

- Surface soil: 0 – 2 inches across the terrestrial habitats of UXO 18 (Decision Unit 1, composite multi-incremental soil samples).
- Discrete surface soil: 0 - 12 inches at the three smoke canisters locations.

Air is not addressed in this ERA since this medium is not likely to result in significant contributions to total exposures.

Exposure Pathways and Routes

An exposure pathway links a source of contamination with one or more receptors through exposure via one or more media and exposure routes. Exposure, and thus potential risk, can only occur if complete exposure pathways exist. Figure L-2 shows the potentially complete exposure pathways to ecological receptors at UXO 18.

Potentially complete exposure pathways exist for terrestrial receptors exposed to surface soil across UXO 18. Receptor groups evaluated in this ERA include terrestrial plants, soil invertebrates, reptiles, birds, and mammals.

An exposure route describes the specific mechanism(s) by which a receptor is exposed to a chemical present in an environmental medium. The most common exposure routes are dermal contact, direct uptake, ingestion, and inhalation. Terrestrial plants may be exposed to chemicals present in surface soils through their root surfaces during water and nutrient uptake. Terrestrial invertebrates may be exposed to chemicals in surface soil through dermal contact and ingestion.

Animals may be exposed to chemicals through the: (1) inhalation of gaseous chemicals or of chemicals adhered to airborne particulate matter; (2) incidental ingestion of contaminated abiotic media (soil) during feeding or preening activities; (3) ingestion of contaminated water; (4) ingestion of contaminated plant and/or animal tissues for chemicals that have entered food webs; and/or (5) dermal contact with contaminated abiotic media. These routes, where applicable, are depicted on **Figure E-2**.

Direct contact is the primary exposure route for lower trophic level receptors (e.g., plants; soil invertebrates) at the site. Incidental ingestion of soil and exposure via terrestrial food webs are the primary exposure routes for upper trophic level receptors (e.g., omnivorous birds) in the terrestrial habitats of UXO 18. The following pathways are not evaluated for wildlife receptors in the ERA:

- The contribution to the total dose from the inhalation route is generally insignificant for upper trophic level ecological receptors relative to ingestion pathways. Thus, the air (inhalation) pathway was not evaluated for ecological receptors.
- There is no drinking water source on UXO 18, therefore exposure via direct ingestion of drinking water was not included in the ERA.
- Exposure to chemicals present in surface soil via dermal contact may occur but is unlikely to represent a major exposure pathway for most upper trophic level receptors because fur or feathers minimize transfer of chemicals across dermal tissue. Thus, dermal contact was not evaluated for upper trophic level receptors in the ERA. Incidental ingestion of surface soil during feeding, preening, or grooming activities was, however, considered in the risk estimates. Direct contact was considered for lower trophic level receptors (soil invertebrates).

Receptors

Because of the complexity of natural systems, it is generally not possible to directly assess the potential impacts to all ecological receptors present at a site. Therefore, specific receptor species (e.g., red-tailed

hawk) or species groups (e.g., invertebrates) are often selected as surrogates to evaluate potential risks to larger components of the ecological community (guilds; such as carnivorous birds) used to represent the assessment endpoints (e.g., survival and reproduction of carnivorous birds). Selection criteria typically include those species that:

- Are known to occur, or are likely to occur, at the site.
- Have a particular ecological, economic, or aesthetic value.
- Are representative of taxonomic groups, life history traits, and/or trophic levels in the habitats present for which complete exposure pathways are likely to exist.
- Can, because of toxicological sensitivity or potential exposure magnitude, be expected to represent potentially sensitive populations.

Upper trophic level receptors quantitatively evaluated in the ERA were limited to birds and mammals, the taxonomic groups with the most available information regarding exposure and toxicological effects. The following upper trophic level receptors were selected for exposure modeling in terrestrial habitats based upon the criteria listed above and the habitats present on the site:

- Norway rat (*Rattus norvegicus*) – terrestrial mammalian omnivore (modeled as an herbivore in the SERA portion of the ERA).
- Indian mongoose (*Herpestes auropunctatus*) – terrestrial mammalian omnivore (modeled as an invertivore in the SERA portion of the ERA).
- Velvet free-tailed bat (*Molossus molossus*) – aerial mammalian insectivore.
- Fruit bat (*Artibeus jamaicensis*) – terrestrial mammalian herbivore.
- Pearly-eyed thrasher (*Margarops fuscatus*) – terrestrial avian omnivore (modeled as an invertivore in the SERA portion of the ERA).
- Red-tailed hawk (*Buteo jamaicensis*) – terrestrial avian carnivore.
- Cave swallow (*Petrochelidon fulva*) – aerial avian insectivore.
- Common ground dove (*Columbina passerine*) – terrestrial avian herbivore.

There is a high degree of uncertainty regarding the estimation of bioaccumulated chemicals in aerial insects that are consumed by insectivorous bats (free-tailed bat) and birds (cave swallow) using standard invertebrate uptake models, which typically do not consider the emergent forms of invertebrates. This is also true for estimating chemical concentrations in non-vegetative parts of plants, such as fruit or nectar, consumed by some receptors (fruit bat). These uncertainties are discussed in the uncertainty section (Section 1.6).

The rat and mongoose were included as receptors to represent specific receptor guilds, recognizing that should unacceptable risks be found for these receptors, risk managers will consider their status as invasive species. Although direct impacts to these invasive species themselves may not be considered significant from a risk management perspective, the reduction of their populations may have indirect adverse impacts to native species, such as the red-tailed hawk, that may prey upon these species.

Lower trophic level receptor species were evaluated based upon those taxonomic groupings for which medium-specific ecological screening values (ESVs) have been developed. As such, specific species of terrestrial biota (plants and soil invertebrates) were not chosen as receptors because of the limited information available for specific species and because these receptors are evaluated on a community level via a comparison to soil ESVs developed for these groups.

Reptiles are also an applicable receptor group. However, individual species of reptiles were not selected for evaluation because of the very limited amount of available toxicological information for this taxonomic group for direct effects and effects from exposures via food webs. Potential risks to reptiles from food web exposures were evaluated using other terrestrial fauna (birds and mammals) as surrogates. Similarly, potential risks to reptiles (e.g., lizards) from direct exposures to surface soil were evaluated using soil ESVs developed for other taxonomic groups (described above).

Endpoints and Risk Hypotheses

The conclusion of the problem formulation includes the selection of ecological endpoints and risk hypotheses, which are based upon the conceptual model. Two types of endpoints, assessment endpoints and measurement endpoints, are defined as part of the ERA process (USEPA, 1997). An assessment endpoint is an explicit expression of the environmental component or value that is to be protected. A measurement endpoint is a measurable ecological characteristic that is related to the component or value chosen as the assessment endpoint. The considerations for selecting assessment and measurement endpoints are summarized in USEPA (1997) and discussed in detail in Suter (1989, 1990, 1993). Risk hypotheses are testable hypotheses about the relationship among the assessment endpoints and their predicted responses when exposed to contaminants.

Endpoints define ecological attributes that are to be protected (assessment endpoints) and measurable characteristics of those attributes (measurement endpoints) that can be used to gauge the degree of impact that has or may occur. Assessment endpoints most often relate to attributes of biological populations or communities, and are intended to focus the risk assessment on particular components of the ecosystem that could be adversely affected by chemicals attributable to a site (USEPA, 1997). Assessment endpoints contain an entity (e.g., dove population) and an attribute of that entity (e.g., survival rate). Individual assessment endpoints usually encompass a group of species or populations (the receptor) with some common characteristic, such as specific exposure route or contaminant sensitivity, with the receptor then used to represent the assessment endpoint in the risk evaluation.

Assessment and measurement endpoints may involve ecological components from any level of biological organization, from individual organisms to the ecosystem itself. Effects on individual organisms are important for some receptors, such as rare and endangered species; population- and community-level effects are typically more relevant to ecosystems. Population- and community-level effects are usually difficult to evaluate directly without long-term and extensive study. However, measurement endpoint evaluations at the individual level, such as an evaluation of the effects of chemical exposure on reproduction, can be used to predict effects on an assessment endpoint at the population or community level. In addition, use of criteria values designed to protect the majority of the components of a community can be useful in evaluating potential community- and/or population-level effects.

Table E-4 shows the assessment endpoints, risk hypotheses, and measurement endpoints used in the ERA. **Table E-4** also shows the receptors associated with each endpoint.

1.3 Exposure Assessment

The principal activity associated with the exposure assessment is the estimation of chemical concentrations in applicable media, termed exposure point concentrations (EPCs), to which the receptors may be exposed. This is accomplished through the selection of appropriate sets of the available analytical data using a set of criteria (e.g., validation status, sampling date). Once the analytical data sets are selected, EPCs are calculated as a particular point on the distribution of concentrations. At the screening level (Step 2), the EPC is the maximum detected concentration. At the baseline level (Step 3A), EPCs are central tendency estimates (e.g., arithmetic mean). EPCs are then used in bioaccumulation and food web models to estimate exposures to upper trophic level receptors.

For conservatism, the maximum (SERA) and mean (BERA) reporting limits for chemicals analyzed for but not detected were also compared to medium-specific ESVs and (where applicable) used for food web exposure

modeling. This was done to determine if reporting limits were less than chemical concentrations at which potential adverse effects to ecological receptors may occur.

1.3.1 Selection Criteria for Analytical Data

Available analytical data (described in Section 1.2.2) were selected for use in the ERA based upon the following:

- Data must have been validated by a qualified data validator using acceptable data validation methods. Rejected (R) values were not used in the ERA. Unqualified data and data qualified as J (estimated) were treated as detected. Data qualified as U (undetected) were treated as non-detected.
- For samples with duplicate analyses, the higher of the two concentrations was used when both values were detects or when both values were non-detects. In cases where one result was a detect and the other a non-detect, the detected value was used in the assessment.
- For non-detected results, the limit of detection (LOD) was used to represent the concentration. When calculating statistics (e.g., arithmetic mean), one-half of the LOD was used for non-detected results.

1.3.2 Data Groupings

Surface soil data were partitioned into the following spatial groups:

- **Site Surface Soil (SMI)** – soil samples collected from 0 – 2 inches across the terrestrial habitats of UXO 18 (Decision Unit 1, composite multi-incremental soil samples).
- **Discrete Surface Soil** – Discrete surface soil samples from 0 - 12 inches at the three smoke canisters locations.

For the evaluation of direct exposure of chemicals detected in soil to plants and invertebrates, the surface soil data groupings listed above were evaluated separately considering that they represent slightly different exposure areas (i.e., composite of soil (SMI) from across approximately 1 acre, versus discrete samples at isolated smoke canisters). For food web exposure, samples from both data groupings were combined considering that wide ranging birds and mammals may forage throughout UXO 18.

In addition, background upper tolerance limits (UTLs) from the East Vieques background study (CH2M HILL, 2007) were used for comparison to surface soil samples.

1.3.3 Exposure Point Concentrations

At the screening level (SERA; Step 2) for direct exposures, the EPC was the maximum detected concentration. At the baseline level (BERA; Step 3A) for direct exposures, the EPC was a central tendency estimate (arithmetic mean and the 95 percent upper confidence limit [UCL] of the arithmetic mean), which provides a more representative estimate of potential exposures and risks to receptor populations (which are the focus of the selected assessment endpoints). These three EPCs were also used in bioaccumulation and food web models to estimate exposures to upper trophic level receptors. Dietary items for which tissue concentrations were modeled included terrestrial plants and soil invertebrates.

Incidental ingestion of surface soil, but not ingestion of drinking water, was included when calculating the total exposure. The models and parameter values used for calculating these tissue concentrations are outlined in the following subsections.

Not all chemicals were evaluated for food web exposures. Only those chemicals with the potential to bioaccumulate to a significant extent, as defined in Table 4-2 of USEPA (2000), were evaluated. This list of bioaccumulating chemicals is provided in **Table E-5** for chemicals relevant to UXO 18, and is based upon the list and selection process outlined in the final ERA Protocol (CH2M HILL, 2010a). The list of relevant chemicals for UXO 18 includes: (1) all sampled chemicals on the USEPA (2000) list; (2) all explosive compounds detected in UXO 18 surface soil (since no explosives were detected in the SMI or discrete

samples, none are evaluated in the food web exposures); and (3) chemicals not on the list of important bioaccumulative chemicals (USEPA, 2000) for which bird and/or mammal Eco-SSLs have been developed.

For the screening (SERA) exposure estimates, the uptake of chemicals from the abiotic media into food items was based upon conservative (e.g., 90th percentile) bioconcentration factors (BCFs) or bioaccumulation factors (BAFs) from the literature, where available. The 90th percentile is generally recommended to provide for a conservative screening assessment (Sample et al., 1998a; 1998b; Bechtel Jacobs, 1998b). If 90th percentile values were not available in the cited reference, the maximum value was used, if available. If only central tendency (e.g., median) values were reported, they were used for both the SERA and BERA. Where an individual study (as opposed to a compilation of multiple studies) was cited, the best available value was sometimes a single value or the derivation was not specified. Default (assumed) factors of 1.0 were used only when data were not readily available for a chemical in the literature.

BCFs and BAFs used for baseline (BERA) exposure estimates were based upon, or modeled from, central tendency estimates (e.g., median or mean). Baseline values considered both the distribution of the data (e.g., normal or log normal) and the recommendations in the cited reference. Geometric means were preferred for log normal distributions and arithmetic means for normal distributions. In some cases, neither distribution was applicable or the distribution was biased by an outlying value. In these cases, point estimates like the median were then considered. Where an individual study (as opposed to a compilation of multiple studies) was cited, the best available value was sometimes a single value or the derivation was not specified. Default (assumed) factors of 1.0 were used only when data were not readily available for a chemical in the literature.

In the baseline assessment, using central tendency estimates (rather than high-end values or maximums) for exposure parameters such as BAFs provides a more representative estimate of potential exposures and risks to receptor populations (which are the focus of the selected assessment endpoints) of upper trophic level receptors. Since these upper trophic level species are highly mobile, they would be expected to effectively average their exposure over time as they forage within the area defining their home range. Average prey concentrations are most appropriately estimated using central tendency estimates of media concentrations and accumulation factors. For example, the wildlife dietary exposure models contained in the *Wildlife Exposure Factors Handbook* (USEPA, 1993) specify the calculation of an average daily dose. Increasing the representativeness of the exposure estimates relative to population-level effects is consistent with the intent of the BERA. In cases where adequate spatial sampling coverage exists, mean concentrations are also appropriate for evaluating potential risks to populations of lower trophic level receptors because the members of the population are expected to be found throughout a site (where suitable habitat is present), rather than concentrated in one particular area. While effects on individual organisms might be important for some receptors, such as rare and endangered species, population- and community-level effects are typically more relevant to ecosystems.

Terrestrial Plants

Tissue concentrations in the above-ground vegetative portion of terrestrial plants were estimated by multiplying the maximum (SERA) or mean (BERA) surface soil concentration for each bioaccumulative chemical by chemical-specific soil-to-plant BAFs obtained from the literature. These BAFs, for both the SERA and BERA, are listed in **Table E-6**. For the SERA (Step 2), the point estimate BAFs in **Table E-6** (screening set) were the preferred values. For the BERA (Step 3A), the algorithms listed in **Table E-7**, if available for a chemical, were the preferred method for deriving BAFs, followed by the point-estimate BAFs in **Table E-6** (baseline set).

The BAF values used were based upon root uptake from soil and upon the ratio between dry-weight soil and dry-weight plant tissue. Literature values based upon the ratio between dry-weight soil and wet-weight plant tissue were converted to a dry-weight basis by dividing the wet-weight BAF by an estimated solids content for terrestrial plants (15 percent [0.15]; Sample et al., 1997).

For inorganic chemicals lacking literature-based, chemical-specific BAFs or applicable algorithms, a soil-to-plant BAF of 1.0 was used. For non-ionic organic chemicals (with a log K_{ow} of between 3 and 8) without literature-based BAFs, soil-to-plant BAFs were estimated using the rinsed foliage algorithm provided in Figure 5B of USEPA (2007f):

$$\log BAF = (-0.4057)(\log K_{ow}) + 1.781$$

where: BAF = Soil-to-plant BAF (unitless; dry-weight basis)
K_{ow} = Octanol-water partitioning coefficient (unitless)

The log K_{ow} values used in this equation are listed in Table L-5.

Soil Invertebrates (Earthworms)

Tissue concentrations in soil invertebrates (earthworms) were estimated by multiplying the maximum (SERA) or mean (BERA) surface soil concentration for each bioaccumulative chemical by chemical-specific soil-to-invertebrate BCFs or BAFs obtained from the literature. These BCF/BAF values, for both the SERA and BERA, are listed in **Table E-8**. For the SERA, the point estimate BAFs in **Table E-8** (screening set) were the preferred values. For the BERA, the algorithms listed in **Table E-7**, if available for a chemical, were the preferred method for deriving BAFs, followed by the point-estimate BAFs in **Table E-8** (baseline set).

BCFs are calculated by dividing the concentration of a chemical in earthworm tissue by the concentration of that same chemical in the surrounding environmental medium (in this case, soil) without accounting for uptake via the diet. BAFs consider both direct exposure to soil and exposure via the diet. Because earthworms consume soil, BAFs are more appropriate values and were used when available. BAFs based upon depurated analyses (soil was purged from the gut of the earthworm prior to analysis) were given preference over undepurated analyses when selecting BAF values because direct ingestion of soil is accounted for separately in the food web model.

The BCF/BAF values selected were based upon the ratio between dry-weight soil and dry-weight earthworm tissue. Literature values based upon the ratio between dry-weight soil and wet-weight earthworm tissue were converted to a dry-weight basis by dividing the wet-weight BCF/BAF by the estimated solids content for earthworms (16 percent [0.16]; USEPA, 1993). For chemicals without available measured BAFs/BCFs, an earthworm BAF was estimated using available regression equations from the literature, was estimated using data for similar chemicals, or a BAF of 1.0 was assumed.

Small Mammals

Whole-body tissue concentrations in small mammals (omnivores) were estimated using one of two methodologies. For chemicals with literature-based soil-to-small mammal BAFs, the small mammal tissue concentration was calculated by multiplying the maximum (SERA) or mean (BERA) surface soil concentration for each bioaccumulative chemical by a chemical-specific soil-to-small mammal BAF obtained from the literature. These BAF values, for both the SERA and BERA, are listed in **Table E-9**. For the SERA, the point estimate BAFs in **Table E-9** (screening set) were the preferred values. For the BERA, the algorithms listed in **Table E-7**, if available for a chemical, were the preferred method for deriving BAFs, followed by the point-estimate BAFs in **Table E-9** (baseline set).

The BAF values selected were based upon the ratio between dry-weight soil and whole-body dry-weight tissue. Literature values based upon the ratio between dry-weight soil and wet-weight tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content for small mammals (32 percent [0.32]; USEPA, 1993).

For chemicals without soil-to-small mammal BAF values or algorithms, an alternate approach was used to estimate whole-body tissue concentrations. Because most chemical exposure for these small mammals is via the diet, it was assumed that the concentration of each bioaccumulative chemical in the small mammal's tissues was equal to the chemical concentration in its diet multiplied by a diet to whole-body BAF derived from the literature. The small mammal tissue concentration was calculated as follows:

$$TC_x = [[\sum_i (FC_{xi})(PDF_i)] + [(SC_x)(PDS)]] (BAF_{diet\text{-}whole\ body})$$

where:	TC_x	=	Small mammal tissue concentration for chemical x (mg/kg, dry weight)
	FC_{xi}	=	Concentration of chemical x in food item i (mg/kg, dry weight)
	PDF_i	=	Proportion of diet composed of food item i (dry weight basis)
	SC_x	=	Concentration of chemical x in soil (mg/kg, dry weight)
	PDS	=	Proportion of diet composed of soil (dry weight basis)
	BAF	=	Diet to whole-body BAF (unitless)

This equation is basically a weighted average of the chemical concentration in the various dietary components (including soil ingestion) for the small mammal (rat), multiplied by a diet-to-whole body BAF, and thus excludes water ingestion.

For chemicals lacking diet to whole-body BAF values (not to be confused with the soil-to-small mammal BAFs listed in **Table E-9**), a diet to whole-body BAF of one was assumed. The use of a diet to whole-body BAF of one is likely to result in a conservative estimate of chemical concentrations for chemicals that are not known to biomagnify in terrestrial food webs and a reasonable estimate of chemical concentrations for chemicals that are known to bioaccumulate or biomagnify, based upon reported literature values. For example, a maximum diet to whole-body BAF value of 1.0 was reported by Simmons and McKee (1992) for PCBs based upon laboratory studies with white-footed mice. Menzie et al. (1992) reported diet to whole-body BAF values for DDT of 0.3 for voles and 0.2 for short-tailed shrews. Reported diet to whole-body BAF values for dioxin were only slightly above one (1.4) for the deer mouse (USEPA, 1990).

1.3.4 Dietary Intakes

Upper trophic level receptor exposures via food webs to chemicals present in surface soil were determined using estimated chemical concentrations in each relevant dietary component for each upper trophic level receptor, as described in the previous section. Incidental ingestion of surface soil was also included when calculating the total exposure. Drinking water exposures were excluded due to a lack of a drinking water source on UXO 18.

Dietary intakes for each upper trophic level receptor were calculated using the following formula (modified from USEPA [1993]):

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

where:	DI_x	=	Dietary intake for chemical x (mg chemical/kg body weight/day)
	FIR	=	Food ingestion rate (kg/day, dry-weight)
	FC_{xi}	=	Concentration of chemical x in food item i (mg/kg, dry-weight)
	PDF_i	=	Proportion of diet composed of food item i (dry-weight basis)
	SC_x	=	Concentration of chemical x in soil or sediment (mg/kg, dry-weight)
	PDS	=	Proportion of diet composed of soil or sediment (dry-weight basis)
	BW	=	Body weight (kg, wet-weight)

Incidental ingestion of soil was modeled as a dietary component rather than using a separate soil ingestion rate. Parameter values for the selected receptors are listed in **Tables E-10** (screening) **and E-11** (baseline). When measured food ingestion rates were not available for a receptor from the literature, the rates were estimated using allometric equations from Nagy (2001).

The exposure parameter values were selected to provide for a conservative evaluation at the screening level (Step 2). Examples of these conservative assumptions include:

- All of the dietary items consumed by the receptor are obtained from the site (i.e., an Area Use Factor [AUF] of one was assumed) at the point of maximum concentration.
- Chemicals are 100 percent bioavailable.
- Maximum food ingestion rates were used (calculated maximum ingestion rates using allometric equations were based upon the maximum adult body weight).
- Minimum adult body weights were used. The selection focused on the most geographically appropriate values available from standard literature sources (e.g., USEPA, 1993).
- Exclusive diets (composed of one primary prey item) were used.

For the baseline (Step 3A) estimates:

- Central tendency estimates (e.g., mean, median, or midpoint) for adult body weight and ingestion rates were used, as were more realistic dietary compositions. Central tendency estimates for these exposure parameters are more relevant for a BERA because they better represent the characteristics of a greater proportion of the individuals in the population. Populations or communities (rather than individual organisms) were emphasized when developing the assessment endpoints for the ERA.
- An AUF of 1.0 was retained in Step 3A.

1.4 Effects Assessment

The purpose of the effects assessment is to establish chemical exposure levels (screening values) that represent conservative thresholds for adverse ecological effects. One set of screening values is developed for each selected assessment endpoint. Based upon the conceptual model, direct exposure to surface soil, and exposure via terrestrial food webs, are the complete pathways at the site.

The effects assessment defines the methods and data used to define an adverse ecological effect. For this ERA, effects data are available from multiple lines of evidence, as follows:

- **Ecological Screening Values (ESVs) for Surface Soil** - Analytical data are compared to the medium-specific ESVs developed in Section 1.4.1.
- **Toxicity Reference Values (TRVs) for Ingestion Exposures** - Food web exposure estimates are compared to ingestion-based TRVs developed in Section 1.4.2 for upper trophic level receptors.
- **Bioavailability Measures** - Additional data were collected to help evaluate chemical-specific bioavailability in surface soil.

In addition, comparison of site surface soil concentrations to Vieques-wide background concentrations was conducted as an additional line of evidence (see Section 1.5).

1.4.1 Medium-Specific ESVs

Medium-specific ESVs were established for each ecologically relevant medium. Based upon the conceptual site model (**Figure E-2**), direct exposure to surface soil is a potentially complete pathway. The ESVs used in the ERA are summarized in **Table E-12**.

Measures of chemical bioavailability are also included in this assessment.

1.4.2 Ingestion TRVs

Ingestion TRVs for dietary exposures were derived for each bioaccumulative chemical evaluated in the ERA. TRVs were derived for both mammalian and avian upper trophic level receptors, the only two taxonomic groups for which sufficient toxicological information was generally available for the range of bioaccumulative chemicals evaluated. Toxicological information from the literature for wildlife species most closely related to the receptor species were used, where available, but were supplemented by laboratory

studies of non-wildlife species (e.g., laboratory mice) where necessary. The ingestion TRVs are expressed as milligrams of the chemical per kilogram body weight of the receptor per day (mg/kg-BW/day).

Survival, growth, and reproduction were emphasized as toxicological endpoints because they are the most relevant, ecologically, to maintaining viable populations and because they are generally the most studied toxicological endpoints for ecological receptors. Endpoints based upon reproduction were generally preferred to those based upon growth which were preferred to those based upon survival. If several chronic toxicological studies were available from the literature, the most appropriate study was selected for each receptor species based upon study design, study methodology, study duration, study endpoint, and test species.

Ingestion TRVs were derived for both chronic No Observed Adverse Effect Level (NOAEL) and chronic Lowest Observed Effect Level (LOAEL) endpoints. The applicable uncertainty factors from **Table E-13** were used to derive these TRVs where appropriate (uncertainty factors were not generally applied to TRVs obtained from Eco-SSL documents because these TRVs often encompassed multiple studies). Because assessment endpoints were based upon population- or community-level effects, no intraspecies uncertainty factors were applied. Taxonomic class-type uncertainty factors were also not applied because the TRVs selected were typically derived based upon data from a broad range of taxonomic groups. Maximum Acceptable Toxicant Concentrations (MATCs), defined as the geometric mean of the NOAEL and LOAEL, were also calculated.

In terrestrial habitats, Step 2 food web COPCs were selected by first comparing maximum soil concentrations with the lower of the available bird and mammal Eco-SSLs (**Table E-14**). Chemicals that exceeded the Eco-SSLs based upon the maximum soil concentration were retained for site-specific food web modeling. Those that did not were not evaluated further for terrestrial food web exposures. The final Step 2 food web COPCs were selected based upon a comparison of maximum exposure doses from site-specific food web modeling with the NOAEL-based ingestion TRV. Those chemicals with an exposure dose exceeding the NOAEL-based ingestion TRV were identified as Step 2 COPCs. For Step 3A, ingestion-based (food web) COPCs were based upon a comparison of mean exposure doses with ingestion TRVs based upon the NOAEL, MATC, and LOAEL. An exceedance of the MATC was considered an unacceptable effect at Step 3A, although chemicals that exceed the MATC, but not the LOAEL, were discussed for possible risk management considerations.

Ingestion TRVs for mammals and birds are provided in **Tables E-**15 and **E-16**, respectively. Where more than one value is shown for a chemical in these tables, the value used for each receptor is specified in **Attachment E-1**.

1.4.3 Bioavailability Measures

Data collected to evaluate the potential chemical-specific bioavailability in abiotic media included:

- Surface Soil – pH.

1.5 Risk Characterization

The risk characterization portion of the ERA uses the information generated during the three previous parts of the ERA (problem formulation, exposure assessment, and effects assessment) to estimate potential risks to ecological receptors at the level of conservatism applied (screening or baseline).

1.5.1 Methodology

The methodology used for the risk characterization, per the final ERA protocol, is described in the following two subsections for the SERA (Step 2) and BERA (Step 3A).

SERA Approach

The main objective of risk characterization at the screening level (termed risk calculation) is to derive a list of COPCs. As part of this risk calculation, the maximum exposure concentrations (abiotic media) or maximum

exposure doses (upper trophic level receptors) are compared with the corresponding ESVs or TRVs to derive risk estimates using the hazard quotient (HQ) method. HQs are calculated by dividing the chemical concentration in the medium being evaluated by the corresponding medium-specific ESV, or by dividing the exposure dose by the corresponding ingestion-based TRV. HQs equaling or exceeding one indicate the potential for unacceptable risk since the chemical concentration or dose (exposure) equals or exceeds the ESV or TRV (effect); these chemicals are identified as COPCs at Step 2. However, ESVs/TRVs and exposure estimates are derived using intentionally conservative assumptions at the screening level such that HQs greater than or equal to one do not necessarily indicate that unacceptable risks are present. Rather, it identifies chemical-pathway-receptor combinations requiring further evaluation using more realistic exposure scenarios and assumptions. Following the same reasoning, HQs less than one indicate that unacceptable risks are unlikely, enabling a conclusion of negligible (acceptable) risk to be reached with high confidence.

In addition to chemicals that exceeded medium-specific ESVs based upon maximum detected concentrations, or that exceeded TRVs based upon maximum ingestion doses, the following also applied to COPC selection at Step 2:

- Non-detected chemicals were retained as COPCs if the maximum detection limit exceeded the ESV for that medium or if the ingestion dose calculated using the maximum detection limit exceeded the TRV.
- All detected chemicals lacking a TRV and/or ESV were retained as COPCs.
- The essential nutrients calcium, magnesium, potassium, and sodium were excluded as potential COPCs since they are essential macronutrients that are needed in relatively high concentrations for normal metabolism, growth, and reproduction.

BERA Approach

COPCs from the SERA are reevaluated in the first step of the BERA (Step 3A). As discussed previously, this reevaluation involves using more realistic assumptions about exposures and a comparison of these revised exposure estimates (based upon central tendency estimates of media concentrations, BAFs, and exposure parameters) with ESVs and TRVs.

In addition to chemicals that exceeded medium-specific ESVs based upon mean detected concentrations, or that exceeded TRVs based upon mean ingestion doses, the following also applied to COPC selection at Step 3A:

- All detected chemicals lacking a TRV and/or ESV were retained as COPCs for risk evaluation.
- Ingestion-based (food web) COPCs were based upon a comparison of mean and 95% UCL exposure doses with ingestion TRVs based upon the NOAEL, MATC, and LOAEL. An exceedance of the MATC was generally considered an unacceptable effect at Step 3A, although chemicals that exceed the MATC, but not the LOAEL, were discussed for possible risk management considerations.

For Step 3A, the following additional factors were also considered, as appropriate:

- **Frequency of Detection.** Chemicals that were detected in less than five percent of the samples in a medium were generally eliminated as COPCs in that medium if at least 20 samples are available (USEPA, 1989). It is unlikely that infrequently detected chemicals represent an unacceptable risk to receptors at the population level, due to limited spatial exposure. However, a qualitative evaluation was conducted to insure that “hot spot” areas were not eliminated from consideration based upon this screening criterion before a chemical was eliminated from further consideration.
- **Vieques-Wide Background Concentrations.** Vieques-wide background concentrations from the East Vieques background study (CH2M HILL, 2007) were also considered in the reevaluation for surface soil. The background evaluation consisted of a direct comparison of site surface soil concentrations to the upper tolerance limits (UTLs) developed for inorganics in the background study (**Table E-17**), in a manner

analogous to the comparison to ESVs. UXO 18 falls within soil type Tl (tertiary limestone), so UTLs based upon this soil type were used in the ERA.

1.5.2 UXO 18 SMI Surface Soil

SMI surface soil samples and discrete surface soil samples are compared separately with soil ESVs. Food web exposures evaluate exposure to the combined data sets for these two soil groupings.

Comparison with Soil ESVs

Maximum, mean, and 95% UCL SMI surface soil concentrations are compared to soil ESVs for plants and soil invertebrates in **Table E-18**; identical comparisons for discrete samples are provided in **Table E-19**. These tables also contain a comparison against background UTLs for metals that exceeded soil ESVs in at least one sample.

SERA (Step 2)

Maximum SMI surface soil concentrations are compared to ESVs in **Table E-18**. Based upon this comparison, no chemical had a HQ that exceeded one based upon maximum detected concentrations. One metal (hexavalent chromium) was not detected but the maximum detection limit exceeded the ESV. Hexavalent chromium was identified as a Step 2 COPC for SMI samples.

Maximum discrete surface soil concentrations are compared to ESVs in **Table E-19**. Based upon this comparison, two metals (manganese and selenium) had HQs exceeding one based upon maximum detected concentrations and were identified as Step 2 COPCs. One metal (hexavalent chromium) was not detected but the maximum detection limit exceeded the ESV. Hexavalent chromium was also identified as a Step 2 COPC for discrete samples.

BERA (Step 3A)

Mean concentrations in SMI surface soil are compared to ESVs in **Table E-18**. **Table E-18** also contains a comparison to background UTLs. Hexavalent chromium was not detected but the mean detection limit exceeded the ESV. This chemical was not identified as a COPC for further risk evaluation but is discussed in the uncertainty section (Section 1.6). Thus, no chemicals were identified as COPCs for further risk evaluation in SMI surface soil samples.

Mean concentrations in discrete surface soil are compared to ESVs in **Table E-19**. **Table E-19** also contains a comparison to background UTLs for the Step 2 metal COPCs. Manganese and selenium did not exceed background UTLs. Hexavalent chromium was not detected but the mean detection limit exceeded the ESV. This chemical was not identified as a COPC for further risk evaluation but is discussed in the uncertainty section (Section 1.6). Thus, no chemicals were identified as COPCs for further risk evaluation in discrete surface soil samples.

Food Web Exposures

Chemicals with available bird and/or mammal Eco-SSLs were first screened against these Eco-SSLs (**Table E-20**). Those chemicals exceeding the Eco-SSLs based upon the maximum surface soil concentration (antimony, selenium, and vanadium) were retained for site-specific food web modeling. Chemicals with concentrations below the bird and mammal Eco-SSLs were not evaluated further for terrestrial food web exposures. The evaluation of antimony was based upon detection limits as this chemical was not detected in surface soil samples.

Hexachloroethane was analyzed in discrete surface soil samples only, but was not detected. This chemical was retained for food web modeling because it is considered to be bioaccumulative, but its concentration was based upon detection limits.

SERA (Step 2)

HQs based upon maximum exposure doses for each upper trophic level terrestrial receptor are listed in **Table E-21** (calculations are shown in **Attachment E-1**). Based upon a comparison to NOAELs, three metals (antimony, selenium, and vanadium) had HQs exceeding one for one or more receptors. The exceedance for antimony was based upon reporting limits.

BERA (Step 3A)

HQs based upon 95 percent UCL exposure doses for each upper trophic level terrestrial receptor are listed in **Table E-22** (calculations are shown in **Attachment E-1**). Based upon a comparison to NOAELs, only antimony had a HQ exceeding one for one receptor (velvet free-tailed bat). This NOAEL exceedance for antimony was based upon reporting limits; HQs did not exceeded one based upon the MATC or LOAEL.

HQs based upon mean exposure doses for each upper trophic level terrestrial receptor are listed in **Table E-23** (calculations are shown in **Attachment E-1**). None of the metals had a HQ that exceeded one based upon the MATC, the defined threshold for a potential adverse effect in the final ERA protocol. Thus, no chemicals were retained as COPCs for further risk evaluation for terrestrial food web exposures.

1.5.3 Risk Evaluation

In this section, the various lines of evidence discussed in the previous section are integrated in order to evaluate the potential for unacceptable risks.

Eleven assessment endpoints were developed for terrestrial habitats at UXO 18 (**Table E-4**). Lines of evidence for terrestrial habitats included: (1) comparison of surface soil concentrations with ESVs; (2) comparison of modeled dietary doses with ingestion TRVs; and (3) comparison of site surface soil concentrations with background concentrations.

No chemicals were identified as Step 3A COPCs for surface soil SMI samples or discrete samples. In addition, no chemicals were retained as COPCs for terrestrial food web exposures.

In conclusion, no unacceptable risks were identified for terrestrial receptors associated with UXO 18.

1.5.4 Risk Summary and Conclusions

No COCs were identified for surface soil SMI samples and discrete samples at UXO 18. Similarly, no COCs were identified for food web exposures. Thus, risks to ecological receptors are considered acceptable under current site conditions.

1.6 Uncertainties

Uncertainties are present in all risk assessments because of the limitations of the available data and the need to make certain assumptions and extrapolations based on incomplete information. In addition, the use of various models (e.g., uptake and food web exposures) carries with it some associated uncertainty as to how well the model reflects actual conditions. Since conservative assumptions were generally used in the exposure and effects assessments, these uncertainties are more likely to result in an overestimation rather than an underestimation of the likelihood and magnitude of risks to ecological receptors. The uncertainties in this ERA are mainly attributable to the following factors:

- Reporting Limits - Reporting limits for one undetected analyte (hexavalent chromium) exceeded the applicable ESV in surface soil SMI and discrete samples. **Table E-24** reports both the ratio of the minimum and maximum reporting limits to the ESV as well as the ratio of the mean value (calculated using one-half of the reporting limit for each sample) to the ESV. Because hexavalent chromium was not detected, it is not known to be present on the site but the potential for unacceptable risks cannot be totally discounted because the reporting limits are higher than the ESVs. The magnitude of the ratios can be used to qualitatively evaluate the magnitude of the associated uncertainty (e.g., there is more uncertainty in terms of the potential for risk for a ratio of 100 relative to a ratio of 10). In surface soil,

the hexavalent chromium mean ratio exceeded one (for SMI and discrete samples) and this ratio was less than 10.

The laboratory analysis of hexavalent chromium required sample dilution of up to 10 times due to matrix issues, resulting in limits of detection ranging from 4.0 to 12.0 mg/kg. Since none of the mean ratios exceeded 10, it suggests that the associated uncertainties are relatively low and are unlikely to impact the conclusions of the ERA.

- Duplicate Analyses - When evaluating samples with field duplicates, the value used in the ERA was always the detect when one result was a detect and the duplicate was a non-detect, regardless of whether or not the non-detected value was higher. In these cases, the use of the detect has less uncertainty since it represents an actual measured value (versus an upper limit bound) and the two samples will have identical or similar reporting limits.

- Ingestion TRVs - Data on the toxicity of many chemicals to the receptor species were sparse or lacking, requiring the extrapolation of data from other wildlife species or from laboratory studies with non-wildlife species. This is a typical limitation and extrapolation for ERAs because so few wildlife species have been tested directly for most chemicals. The uncertainties associated with toxicity extrapolation were minimized through the selection of the most appropriate test species for which suitable toxicity data were available. The factors considered in selecting a test species to represent a receptor species included taxonomic relatedness, trophic level, foraging method, and similarity of diet. It is difficult to predict if these extrapolations would result in overestimating or underestimating potential risks.

  A second uncertainty related to the derivation of ingestion TRVs applies to metals. Most of the toxicological studies on which the ingestion TRVs for metals were based used forms of the metal (such as salts) that have high water solubility and high bioavailability to receptors. Because the analytical samples on which site-specific exposure estimates were based measured total metal, regardless of form, and these highly bioavailable forms are expected to compose only a fraction of the total metal concentration, this is likely to result in an overestimation of potential risks for these chemicals but not to the extent that it would unduly impact the conclusions of the ERA.

  A third source of uncertainty related to the derivation of ingestion-based TRVs applies to selenium. The ingestion-based TRV used for this metal was based on the organometallic (methylated) form. TRVs for inorganic forms tend to be substantially higher. Given that inorganic forms likely contribute significantly to the total selenium, use of a TRV based on the organometallic form tends to make the TRV for this metal extremely conservative and likely overestimates potential risk.

- Chemical Mixtures - Information on the toxicological effects of chemical interactions is generally lacking for ecological receptors, which required (as is standard for ERAs) that the chemicals be evaluated on a compound-by-compound basis during the comparison to ESVs. This could result in an underestimation of risk (if there are additive or synergistic effects among chemicals) or an overestimation of risks (if there are antagonistic effects among chemicals).

- Receptor Species Selection - Reptiles were selected as receptors in the ERA, but were not evaluated quantitatively even when exposure pathways were likely to be complete. For food web exposures, this taxon was evaluated using other fauna (birds and mammals) as surrogates due to the general lack of taxon-specific toxicological data. This represents an uncertainty in the ERA.

- Food Web Exposure Modeling - Chemical concentrations in terrestrial food items (plants, earthworms, and small mammals) were modeled from measured surface soil concentrations and were not directly measured. The use of generic, literature-derived exposure models and bioaccumulation factors introduces some uncertainty into the resulting estimates. The values selected and methodology employed were intended to provide a conservative (SERA) or reasonable (Step 3A) estimate of potential food web exposure concentrations.

Surface soil concentrations used for the evaluation of food web exposures were based on the combination of chemical data collected by two different methods, multi-incremental soil (SMI) sampling and discrete sampling. Each SMI analytical result represents a composite of 100 subsamples collected from the 0-2 inch soil profile across approximately 1 acre in areas where MEC was previously identified; two SMI samples were collected at UXO 18. Discrete soil samples were collected from 0-12 inches at three former smoke canister locations. Samples from both data groupings were combined considering that wide ranging birds and mammals may forage throughout UXO 18. However, the results of the SMI sampling effort represent an average across each of the two sampled areas whereas the discrete sampling method yields results which pertain only to the three specific sampling locations. Therefore when a maximum value is used in the food web exposure evaluation, the maximum of the two SMI samples is really the maximum of an "averaged" value represented by 100 subsamples. As a result there is uncertainty associated with combining data that represents both discrete locations and area-wide averages. However, considering there are only five total surface soil samples at UXO 18, it was determined that a better representation would be to evaluate all surface soil data for exposure of wide ranging wildlife as opposed to separate evaluations of the three discrete samples separately and the two SMI samples and is the approach concurred upon by the Vieques Technical Subcommittee. Another source of uncertainty is the use of default assumptions for exposure parameters such as BCFs and BAFs. Although BCFs or BAFs for many bioaccumulative chemicals were readily available from the literature and were used in the ERA, the use of a default factor of 1.0 to estimate the concentration of some chemicals in receptor prey items is a source of uncertainty.

There is a high degree of uncertainty in estimating chemical concentrations in the tissues of aerial insects that are consumed by insectivorous bats (free-tailed bat) and birds (cave swallow) using standard invertebrate uptake models, which typically do not consider the emergent forms of invertebrates. However, it is expected that the emergent (aerial) forms of insects, which typically have higher proportions of soft tissues, would typically have lower concentrations of non-lipophilic chemicals (such as metals) than the soil/benthic forms since exoskeletons are not typically retained at emergence. Thus, modeled tissue concentrations are likely to be conservative for the chemicals groups evaluated for this exposure pathway in this ERA.

There is also some uncertainty in estimating chemical concentrations in non-vegetative parts of plants, such as fruit or nectar, consumed by some receptors (fruit bat) since the uptake models estimate uptake into the above-ground vegetative portions of plants. However, available data suggest that bioaccumulation into the non-vegetated portions of plants is lower than for the vegetative portion of plants for the metals modeled (Baes et al., 1984). Thus, the approach used was conservative in that the tissue concentrations are likely to have been overestimated.

Area use factors were assumed to equal one. This is a conservative assumption since a significant percentage of each upper trophic level receptor species' time could be spent foraging off-site in unimpacted areas or in areas where chemical concentrations are expected to be significantly lower.

- Mean Versus Maximum Media Concentrations - As is typical in an ERA, a finite number of samples of environmental media are used to develop the exposure estimates. The maximum measured concentration provides a conservative estimate for immobile biota or those with a limited home range. The most realistic exposure estimates for mobile species with relatively large home ranges and for species populations (even those that are immobile or have limited home ranges) are those based upon the mean chemical concentrations in each medium to which these receptors are exposed. This is reflected in the wildlife dietary exposure models contained in the *Wildlife Exposure Factors Handbook* (USEPA, 1993), which specify the use of average media concentrations. Given the mobility of the upper trophic level receptor species used in the ERA, the use of maximum chemical concentrations (rather than mean concentrations) in the SERA to estimate the exposure via food webs is very conservative. This conservatism was reduced to more realistic levels in the values selected for use in the Step 3A evaluation.

- Comparisons to Background Concentrations - Background concentrations were used to judge the site-relatedness of individual chemicals in surface soil. If site concentrations were consistent with background levels, it was assumed that the concentrations were not related to known site-related source areas. There exists the possibility that concentrations below background were indeed site-related, rendering the assumption false. However the potential impact of this possibility is minimal since chemicals at concentrations consistent with background should exhibit no different ecological effects than commonly occurring in areas not affected by releases, regardless of their source.

1.7 References

Agency for Toxic Substances and Disease Registry (ATSDR). 1997. *Toxicological profile for hexachloroethane*. September.

Baes, C.F. III, R.D. Sharp, A.L. Sjoreen, and R.W. Shor. 1984. *A review and analysis of parameters for assessing transport of environmentally released radionuclides through agriculture.* Oak Ridge National Laboratory. ORNL-5786. 148 pp.

Bechtel Jacobs. 1998a. *Empirical models for the uptake of inorganic chemicals from soil by plants.* Prepared for U.S. Department of Energy. BJC/OR-133. September 1998.

Bechtel Jacobs. 1998b. *Biota sediment accumulation factors for invertebrates: review and recommendations for Oak Ridge Reservation.* Prepared for U.S. Department of Energy. BJC/OR-112. August 1998.

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. *Journal of Wildlife Management.* 58:375-382.

Canadian Council of Ministers of the Environment (CCME). 2007. *Canadian soil quality guidelines for the protection of environmental and human health.* Summary Tables. Update 7.0. September.

CH2M HILL, Inc. 2010a. *Master Standard Operating Procedures, Protocols, and Plans. Environmental Restoration Program. Vieques, Puerto Rico*. Final. April.

CH2M HILL, Inc. 2010b. *Master Ecological Risk Assessment Protocol for Vieques Environmental Restoration Program – Update 1 (Addendum)*. Draft. August.

CH2M HILL, Inc. 2007. *Final East Vieques background soil inorganics investigation report, Former Vieques Naval Training Range, Vieques, Puerto Rico.* Prepared for Department of the Navy, NAVFAC Atlantic. October.

Chief of Naval Operations (CNO). 1999. *Navy policy for conducting ecological risk assessments.* Memorandum from Chief of Naval Operations to Commander, Naval Facilities Engineering Command. Ser N453E/9U595355.

Dunning, J.B., Jr. (editor). 2008. *CRC handbook of avian body masses, second edition.* CRC Press, Boca Raton, FL.

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997a. *Toxicological benchmarks for screening contaminants of potential concern for effects on terrestrial plants: 1997 revision.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-85/R3.

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997b. *Toxicological benchmarks for screening contaminants of potential concern for effects on soil and litter invertebrates and heterotrophic process: 1997 revision.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-126/R2.

Ehrlich, P.R., D.S. Dobkin, and D. Wheye. 1988. *The birder's handbook. A field guide to the natural history of North American birds.* Simon and Schuster/Fireside. New York, NY.

Geo-Marine. 2003. Integrated Natural Resources Management Plan (INRMP). Navy Lands on Vieques, Vieques Island, Puerto Rico. Plan Years 2003-2012. Final Draft.

Linzey, D.W. 1998. The mammals of Virginia. Blacksburg, Virginia: The McDonald & Woodward Publishing Company, Inc.

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. *American wildlife and plants: a guide to wildlife food habits.* Dover Publications, Inc. New York, NY. 500 pp.

Menzie, C.A., D.E. Burmaster, J.S. Freshman, and C.A. Callahan. 1992. Assessment of methods for estimating ecological risk in the terrestrial component: a case study at the Baird & McGuire Superfund Site in Holbrook, Massachusetts*. Environmental Toxicology and Chemistry.* 11:245-260.

Nagy, K. A. 2001. Food requirements of wild animals: predictive equations for free-living mammals, reptiles, and birds. *Nutrition Abstracts and Reviews. Series B.* 71:21R-31R.

National Research Council Canada (NRCC). 2006. *Development of ecological and human health preliminary soil quality guidelines for energetic materials to ensure training sustainability of Canadian forces.* Final Report (Revised), NRC #45936. 30 June.

Naval Facilities Engineering Command (NAVFAC). 2003. *Navy guidance for conducting ecological risk assessments.* http://web.ead.anl.gov/ecorisk/. February.

Nellis, D.W. 1989. *Herpestes auropunctatus*. Mammalian species. Number 342. American Society of Mammalogists, New York, New York, USA.

Oberle, M.W. 2000. *Puerto Rico's birds in photographs*. Editorial Humanitas, Mr. Mark Oberle, 23rd Avenue E. Seattle, Washington, 98112-2936. 129 pp.

Ortega, J. and I. Castro-Arellano. 2001. *Artibeus jamaicensis*. Mammalian Species No. 662. American Society of Mammalogists.

Reid, F.A. 2009. *A field guide to the mammals of Central America and Southeast Mexico. Second edition.* Oxford University Press.

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, G.W. Suter II, and T.L. Ashwood. 1998a. *Development and validation of bioaccumulation models for earthworms.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-220.

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, and G.W. Suter II. 1998b. *Development and validation of bioaccumulation models for small mammals.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-219.

Sample, B.E., M.S. Aplin, R.A. Efroymson, G.W. Suter II, and C.J.E. Welsh. 1997. *Methods and tools for estimation of the exposure of terrestrial wildlife to contaminants.* Environmental Sciences Division, Oak Ridge National Laboratory. ORNL/TM-13391.

Sample, B.E. and G.W. Suter II. 1994. *Estimating exposure of terrestrial wildlife to contaminants.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-125.

Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. *Toxicological benchmarks for wildlife: 1996 revision.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-86/R3.

Silva, M. and J.A. Downing. 1995. *CRC handbook of mammalian body masses*. CRC Press, Boca Raton, FL. 359 pp.

Simmons, G.J. and M.J. McKee. 1992. Alkoxyresorufin metabolism in white-footed mice at relevant environmental concentrations of Aroclor 1254*. Fundamental and Applied Toxicology.* 19:446-452.

Stroud, D.C. 1982. Population dynamics of *Rattus* and *R. norvegicus* in a riparian habitat. *Journal of Mammalogy.* 63:151-154.

Suter, G.W. II. 1993. *Ecological risk assessment*. Chelsea, Mich.: Lewis Publishers.

Suter, G.W. II. 1990. Endpoints for regional ecological risk assessment. *Environmental Management* 14:9-23.

Suter, G.W. II. 1989. Ecological endpoints. In *Ecological assessment of hazardous waste sites: a field and laboratory reference.* Ed. W. Warren-Hicks, B.R. Parkhurst, and S.S. Baker Jr., Chapter 2. EPA/600/3-89/013.

Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F.M. Cretella, P.H. Reno, and F.B. Daniel. 1999. Nitroaromatic Munition Compounds: Environmental Effects and Screening Values. *Reviews of Environmental Contamination and Toxicology.* 161:1-156.

U.S. Environmental Protection Agency (USEPA). 2008. *Ecological soil screening levels for chromium.* OSWER Directive 9285.7-66. April.

U.S. Environmental Protection Agency (USEPA). 2007a. *Ecological soil screening levels for copper*. OSWER Directive 9285.7-68. February.

U.S. Environmental Protection Agency (USEPA). 2007b. *Ecological soil screening levels for manganese*. OSWER Directive 9285.7-71. April.

U.S. Environmental Protection Agency (USEPA). 2007c. *Ecological soil screening levels for nickel.* OSWER Directive 9285.7-76. March.

U.S. Environmental Protection Agency (USEPA). 2007d. *Ecological soil screening levels for selenium.* OSWER Directive 9285.7-72. July.

U.S. Environmental Protection Agency (USEPA). 2007e. *Ecological soil screening levels for zinc.* OSWER Directive 9285.7-73. June.

U.S. Environmental Protection Agency (USEPA). 2007f. *Guidance for developing ecological soil screening levels. Attachment 4-1.* OSWER Directive 9285.7-55. April.

U.S. Environmental Protection Agency (USEPA). 2006. *Ecological soil screening levels for silver*. OSWER Directive 9285.7-77. September.

U.S. Environmental Protection Agency (USEPA). 2005a. *Ecological soil screening levels for antimony.* OSWER Directive 9285.7-61. February.

U.S. Environmental Protection Agency (USEPA). 2005b. *Ecological soil screening levels for arsenic.* OSWER Directive 9285.7-62. March.

U.S. Environmental Protection Agency (USEPA). 2005c. *Ecological soil screening levels for barium*. OSWER Directive 9285.7-63. February.

U.S. Environmental Protection Agency (USEPA). 2005d. *Ecological soil screening levels for beryllium.* OSWER Directive 9285.7-64. February.

U.S. Environmental Protection Agency (USEPA). 2005e. *Ecological soil screening levels for cadmium.* OSWER Directive 9285.7-65. March.

U.S. Environmental Protection Agency (USEPA). 2005f. *Ecological soil screening levels for cobalt.* OSWER Directive 9285.7-67. March.

U.S. Environmental Protection Agency (USEPA). 2005g. *Ecological soil screening levels for lead.* OSWER Directive 9285.7-70. March.

U.S. Environmental Protection Agency (USEPA). 2005h. *Ecological soil screening levels for vanadium.* OSWER Directive 9285.7-75. April.

U.S. Environmental Protection Agency (USEPA). 2003a. *Ecological soil screening level for aluminum*. OSWER Directive 9285.7-60. November.

U.S. Environmental Protection Agency (USEPA). 2003b. *Ecological soil screening level for iron*. OSWER Directive 9285.7-69. November.

U.S. Environmental Protection Agency (USEPA). 2002. *Perchlorate environmental contamination: toxicological review and risk characterization.* External Review Draft. 16 January. NCEA-1-0503.

U.S. Environmental Protection Agency (USEPA). 2001. *Supplemental guidance to RAGS: Region 4 ecological risk assessment bulletins.* Web version – 30 November.

U.S. Environmental Protection Agency (USEPA). 1999. *Screening level ecological risk assessment protocol for hazardous waste combustion facilities.* EPA/530/D-99/001A. Peer Review Draft. August.

U.S. Environmental Protection Agency (USEPA). 1997a. *Ecological risk assessment guidance for Superfund: process for designing and conducting ecological risk assessments.* Interim Final. EPA/540/R-97/006.

U.S. Environmental Protection Agency (USEPA). 1993. *Wildlife exposure factors handbook. Volume I of II.* EPA/600/R-93/187a.

U.S. Environmental Protection Agency (USEPA). 1990. *Assessment of risks from exposure of humans, terrestrial and avian wildlife, and aquatic life to dioxins and furans from disposal and use of sludge from bleached kraft and sulfite pulp and paper mills.* EPA/560/5-90/013.

Wentsel, R.S., T.W. LaPoint, M. Simini, R.T. Checkai, D. Ludwig, and L.W. Brewer. 1996. *Tri-service procedural guidelines for ecological risk assessments.* U.S. Department of the Navy, U.S. Department of the Air Force, and U.S. Department of the Army. June.

Tables

TABLE E-1

Federally Listed Species Occurring or Potentially Occurring at NASD Vieques

UXO 18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Scientific Name (Common Name)	Federal Status
Plants	
Chaemacrista glandulosa var. mirabilis (Herb)	Endangered
Stahlia monosperma (Cobana negra)	Threatened
Calyptranthes thomasiana (Thomas' lidflower)	Endangered
Eugenia woodburyana (Evergreen tree)	Endangered
Goetzea elegans	Endangered
Reptiles and Amphibians	
Chelonia mydas (Green sea turtle)	Threatened
Dermochelys coriacea (Leatherback sea turtle)	Endangered
Eretmochelys imbricata (Hawksbill sea turtle)	Endangered
Caretta caretta (Loggerhead sea turtle)	Threatened
Birds	
Sterna dougalli dougalli (Roseate tern)	Threatened
Mammals	
Physeter macrocephalus (Sperm whale)	Endangered
Megaptera novaeangliae (Humpback whale)	Endangered
Trichechus manatus (West Indian manatee)	Endangered

Source: Vieques Integrated Natural Resource Plan, Plan Years 2003 - 2012 (Geo-Marine 2003)

TABLE E-2

Samples Used in the Ecological Risk Assessment

UXO 18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Station ID	Sample ID	Date	Sampled Depth Range (feet)
SMI Samples - Upland Area			
Upland Decision Unit			
VE-UXO18-1DU01	VE-UXO18-01SMI01-0613/-1113	6/12/2013 and 11/15/13	0 - 0.17
VE-UXO18-1DU01	VE-UXO18-01SMI01T-0613/-1113	6/12/2013 and 11/15/13	0 - 0.17
VE-UXO18-1DU01	VE-UXO18-01SMI01TT-0613/-1113	6/12/2013 and 11/15/13	0 - 0.17
VE-UXO18-1DU02	VE-UXO18-01SMI02-0613/-1113	6/12/2013 and 11/15/13	0 - 0.17
Discrete Surface Soil Samples - Upland Area			
Upland Decision Unit			
VE-UXO18-1SO01	VE-UXO18-01SS01-0001	6/12/2013	0 - 12
VE-UXO18-1SO01P	VE-UXO18-01SS01-0001P	6/12/2013	0 - 12
VE-UXO18-1SO02	VE-UXO18-01SS02-0001	6/12/2013	0 - 12
VE-UXO18-1SO03	VE-UXO18-01SS03-0001	6/12/2013	0 - 12

Shaded cells indicate field duplicates

TABLE E-3
Physical Parameter Measurements - Surface Soil
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Area	Decision Unit	Sample ID	Date	Total Organic Carbon		Redox (Mv)	pH (units)
				mg/kg	percent		
SMI - Upland	1	VE-UXO18-01SMI01-0613	6/12/2013	19,900	1.99	164	7.6
SMI - Upland	1	VE-UXO18-01SMI02-0613	6/12/2013	86,700	8.67	147	7.5
Discrete - Upland	1	VE-UXO18-01SS01-0001	6/12/2013	48,000	4.80	199	7.8
Discrete - Upland	1	VE-UXO18-01SS02-0001	6/12/2013	64,000	6.40	209	7.9
Discrete - Upland	1	VE-UXO18-01SS03-0001	6/12/2013	68,000	6.80	224	7.6

TABLE E-4
Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Terrestrial Habitats			
Survival, growth, and reproduction of terrestrial soil invertebrate communities	Are site-related chemical concentrations in surface soil sufficient to adversely effect soil invertebrate communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface soil with soil screening values; SMI samples and discrete samples evaluated separately.	Soil invertebrates
Survival, growth, and reproduction of terrestrial plant communities	Are site-related chemical concentrations in surface soil sufficient to adversely effect terrestrial plant communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface soil with soil screening values; SMI samples and discrete samples evaluated separately.	Terrestrial plants
Survival, growth, and reproduction of terrestrial reptile populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to terrestrial reptile populations?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface soil with soil screening values. Evidence of potential risk to other upper trophic level terrestrial receptors evaluated in the ERA (birds and mammals used as surrogates)	Reptiles
Survival, growth, and reproduction of avian terrestrial invertivore (SERA)/ omnivore (BERA) populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume soil invertebrates (SERA) or terrestrial plants and soil invertebrates (BERA) from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; maximum HQs >1 based upon the NOAEL (SERA) and mean HQs >1 based upon the MATC (BERA) indicate an effect	Pearly-eyed thrasher
Survival, growth, and reproduction of avian terrestrial herbivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume terrestrial plants from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; maximum HQs >1 based upon the NOAEL (SERA) and mean HQs >1 based upon the MATC (BERA) indicate an effect	Common ground dove
Survival, growth, and reproduction of avian aerial insectivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume soil invertebrates from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; maximum HQs >1 based upon the NOAEL (SERA) and mean HQs >1 based upon the MATC (BERA) indicate an effect	Cave swallow

TABLE E-4
Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Survival, growth, and reproduction of avian terrestrial carnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume small mammals from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; maximum HQs >1 based upon the NOAEL (SERA) and mean HQs >1 based upon the MATC (BERA) indicate an effect	Red-tailed hawk
Survival, growth, and reproduction of mammalian terrestrial herbivore (SERA)/ omnivore (BERA) populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume terrestrial plants (SERA) or terrestrial plants and soil invertebrates (BERA) from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; maximum HQs >1 based upon the NOAEL (SERA) and mean HQs >1 based upon the MATC (BERA) indicate an effect	Norway rat
Survival, growth, and reproduction of mammalian terrestrial invertivore (SERA)/ omnivore (BERA) populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume soil invertebrates (SERA) or small mammals, soil invertebrates, and terrestrial plants (BERA) from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; maximum HQs >1 based upon the NOAEL (SERA) and mean HQs >1 based upon the MATC (BERA) indicate an effect	Indian mongoose
Survival, growth, and reproduction of mammalian herbivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume plants from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; maximum HQs >1 based upon the NOAEL (SERA) and mean HQs >1 based upon the MATC (BERA) indicate an effect	Fruit bat
Survival, growth, and reproduction of mammalian aerial insectivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume soil invertebrates from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; maximum HQs >1 based upon the NOAEL (SERA) and mean HQs >1 based upon the MATC (BERA) indicate an effect	Velvet free-tailed Bat

TABLE E-5
Bioaccumulative Chemicals List and Log K_{ow} Values
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical	Log K_{ow} Range	Selected log K_{ow}	Reference
Metals			
Antimony[1]	-- - --	--	--
Arsenic	-- - --	--	--
Barium[1]	-- - --	--	--
Beryllium[1]	-- - --	--	--
Cadmium	-- - --	--	--
Chromium[2]	-- - --	--	--
Cobalt[1]	-- - --	--	--
Copper	-- - --	--	--
Lead	-- - --	--	--
Manganese[1]	-- - --	--	--
Mercury[3]	-- - --	--	--
Nickel	-- - --	--	--
Selenium	-- - --	--	--
Silver	-- - --	--	--
Vanadium[1]	-- - --	--	--
Zinc	-- - --	--	--
Polychlorinated Biphenyls[4]			
Aroclor-1016	Not reported	5.60	Sample et al. 1996
Aroclor-1221	Not reported	4.70	Jones et al. 1997
Aroclor-1232	Not reported	5.10	Jones et al. 1997
Aroclor-1242	Not reported	5.60	Jones et al. 1997
Aroclor-1248	Not reported	6.20	Jones et al. 1997
Aroclor-1254	Not reported	6.50	Jones et al. 1997
Aroclor-1260	Not reported	6.80	Jones et al. 1997
Pesticides			
4,4'-DDD	5.90 - 6.65	6.10	USEPA 1995a
4,4'-DDE	5.63 - 6.96	6.76	USEPA 1995a
4,4'-DDT	5.56 - 7.01	6.53	USEPA 1995a
Aldrin	5.11 - 7.50	6.50	USEPA 1995a
alpha-BHC	3.75 - 3.81	3.80	USEPA 1995a
alpha-Chlordane[5]	5.80 - 6.41	6.32	USEPA 1995a
beta-BHC	3.75 - 3.84	3.81	USEPA 1995a
delta-BHC	Not reported	4.10	USEPA 1996b
Dieldrin	3.63 - 6.20	5.37	USEPA 1995a
Endosulfan I	3.55 - 3.85	3.83	USEPA 1995a
Endosulfan II	3.62 - 4.52	4.52	USEPA 1995a
Endrin	2.92 - 5.20	5.06	USEPA 1995a
gamma-BHC (Lindane)	3.61 - 3.90	3.73	USEPA 1995a
gamma-Chlordane[5]	5.80 - 6.41	6.32	USEPA 1995a
Heptachlor	4.93 - 6.26	6.26	USEPA 1995a
Heptachlor epoxide	3.50 - 5.40	5.00	USEPA 1995a
Methoxychlor	4.20 - 5.60	5.08	USEPA 1995a
Toxaphene	4.33 - 5.56	5.50	USEPA 1995a

TABLE E-5
Bioaccumulative Chemicals List and Log K_{ow} Values
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical	Log K_{ow} Range	Selected log K_{ow}	Reference
Volatile and Semivolatile Organic Compounds			
1,1,2,2-Tetrachloroethane[6]	2.31 - 2.64	2.39	USEPA 1995a
1,2,4,5-Tetrachlorobenzene	4.51 - 4.83	4.64	USEPA 1995a
1,2,4-Trichlorobenzene	3.89 - 4.23	4.01	USEPA 1995a
1,2-Dichlorobenzene	3.20 - 3.61	3.43	USEPA 1995a
1,3-Dichlorobenzene	Not reported	3.50	USEPA 1996b
1,4-Dichlorobenzene	3.26 - 3.62	3.42	USEPA 1995a
4-Bromophenyl-phenylether	4.89 - 5.24	5.00	USEPA 1995a
4-Chlorophenyl-phenylether	4.08 - 5.09	4.95	USEPA 1995a
Acenaphthene	3.77 - 4.49	3.92	USEPA 1995a
Acenaphthylene	Not reported	4.10	USEPA 1996b
Anthracene	4.44 - 4.80	4.55	USEPA 1995a
Benzo(a)anthracene	5.61 - 5.79	5.70	USEPA 1995a
Benzo(a)pyrene	5.98 - 6.34	6.11	USEPA 1995a
Benzo(b)fluoranthene	5.79 - 6.40	6.20	USEPA 1995a
Benzo(g,h,i)perylene	6.58 - 7.05	6.70	USEPA 1995a
Benzo(k)fluoranthene	6.12 - 6.27	6.20	USEPA 1995a
Chrysene	5.41 - 5.79	5.70	USEPA 1995a
Dibenz(a,h)anthracene	6.50 - 6.88	6.69	USEPA 1995a
Fluoranthene	4.84 - 5.39	5.12	USEPA 1995a
Fluorene	4.04 - 4.40	4.21	USEPA 1995a
Hexachlorobenzene	5.23 - 6.92	5.89	USEPA 1995a
Hexachlorobutadiene	4.74 - 5.16	4.81	USEPA 1995a
Hexachlorocyclopentadiene	5.05 - 5.51	5.39	USEPA 1995a
Hexachloroethane	3.82 - 4.14	4.00	USEPA 1995a
Indeno(1,2,3-cd)pyrene	6.58 - 6.72	6.65	USEPA 1995a
Pentachlorophenol	5.01 - 5.24	5.09	USEPA 1995a
Phenanthrene	4.37 - 4.57	4.55	USEPA 1995a
Pyrene	4.76 - 5.52	5.11	USEPA 1995a

[1] Terrestrial habitats (soils) only (see text)

[2] Listed as chromium VI but applied to total chromium

[3] Listed as methylmercury but applied to total mercury

[4] PCB congeners 8, 18, 28, 44, 52, 66, 77, 81, 101, 105, 118, 126, 128, 138, 153, 156, 169, 170, 180, 187, 195, 206, and 209 are also listed in USEPA (2000)

[5] Listed as "chlordane"

[6] Listed as "tetrachloroethane"

TABLE E-6

Soil Bioconcentration Factors For Plants (Dry Weight)

UXO 18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Metals						
Antimony	0.011	90th percentile	Bechtel Jacobs 1998a	--	see Table L-7	--
Arsenic	1.103	90th percentile	Bechtel Jacobs 1998a	--	see Table L-7	--
Barium	0.477	90th percentile	Bechtel Jacobs 1998a	0.154	Geometric mean	Bechtel Jacobs 1998a
Beryllium	0.010	Geometric mean	Baes et al. 1984	--	see Table L-7	--
Cadmium	3.250	90th percentile	Bechtel Jacobs 1998a	--	see Table L-7	--
Chromium	0.084	90th percentile	Bechtel Jacobs 1998a	0.041	Median	Bechtel Jacobs 1998a; USEPA 2007f
Cobalt	0.025	90th percentile	Bechtel Jacobs 1998a	0.008	Geometric mean	Bechtel Jacobs 1998a
Copper	0.625	90th percentile	Bechtel Jacobs 1998a	--	see Table L-7	--
Lead	0.468	90th percentile	Bechtel Jacobs 1998a	--	see Table L-7	--
Manganese	0.234	90th percentile	Bechtel Jacobs 1998a	0.081	Geometric mean	Bechtel Jacobs 1998a
Mercury	5.000	90th percentile	Bechtel Jacobs 1998a	--	see Table L-7	--
Nickel	1.411	90th percentile	Bechtel Jacobs 1998a	--	see Table L-7	--
Selenium	3.012	90th percentile	Bechtel Jacobs 1998a	--	see Table L-7	--
Silver	0.037	90th percentile	Bechtel Jacobs 1998a	0.014	Median	Bechtel Jacobs 1998a; USEPA 2007f
Vanadium	0.010	90th percentile	Bechtel Jacobs 1998a	0.005	Geometric mean	Bechtel Jacobs 1998a
Zinc	1.820	90th percentile	Bechtel Jacobs 1998a	--	see Table L-7	--
Semivolatile Organic Compounds						
Hexachloroethane	1.439	Calculated	USEPA 2007f (Figure 5B)	1.439	Calculated	USEPA 2007f (Figure 5B)

TABLE E-7
Bioconcentration/Bioaccumulation Factor Models (Dry Weight)
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical	Plants[1]	Reference	Soil Invertebrates[2]	Reference	Small Mammal Omnivores[3]	Reference
Metals						
Antimony	$C_p = e^{(-3.233 + 0.938(\ln Cs))}$	USEPA 2007f	--	--	--	--
Arsenic	$C_p = e^{(-1.992 + 0.564(\ln Cs))}$	Bechtel Jacobs 1998a	$C_w = e^{(-1.421 + 0.706(\ln Cs))}$	Sample et al. 1998a; USEPA 2007f	$C_m = e^{(-4.5796 + 0.7354(\ln Cs))}$	Sample et al. 1998b
Beryllium	$C_p = e^{(-0.5361 + 0.7345(\ln Cs))}$	USEPA 2007f	--	--	--	--
Cadmium	$C_p = e^{(-0.476 + 0.546(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007f	$C_w = e^{(2.114 + 0.795(\ln Cs))}$	Sample et al. 1998a; USEPA 2007f	$C_m = e^{(-1.5383 + 0.5660(\ln Cs))}$	Sample et al. 1998b
Chromium	--	--	--	--	$C_m = e^{(-1.4945 + 0.7326(\ln Cs))}$	Sample et al. 1998b
Cobalt	--	--	--	--	$C_m = e^{(-4.4669 + 1.3070(\ln Cs))}$	Sample et al. 1998b; USEPA 2007f
Copper	$C_p = e^{(0.669 + 0.394(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007f	$C_w = e^{(1.675 + 0.264(\ln Cs))}$	Sample et al. 1998a	$C_m = e^{(1.4592 + 0.2681(\ln Cs))}$	Sample et al. 1998b
Lead	$C_p = e^{(-1.328 + 0.561(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007f	$C_w = e^{(-0.218 + 0.807(\ln Cs))}$	Sample et al. 1998a; USEPA 2007f	$C_m = e^{(0.0761 + 0.4422(\ln Cs))}$	Sample et al. 1998b; USEPA 2007f
Manganese	--	--	$C_w = e^{(-0.809 + 0.682(\ln Cs))}$	Sample et al. 1998a; USEPA 2007f	--	--
Mercury	$C_p = e^{(-0.996 + 0.544(\ln Cs))}$	Bechtel Jacobs 1998a	--	--	--	--
Nickel	$C_p = e^{(-2.224 + 0.748(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007f	--	--	$C_m = e^{(-0.2462 + 0.4658(\ln Cs))}$	Sample et al. 1998b; USEPA 2007f
Selenium	$C_p = e^{(-0.678 + 1.104(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007f	$C_w = e^{(-0.075 + 0.733(\ln Cs))}$	Sample et al. 1998a; USEPA 2007f	$C_m = e^{(-0.4158 + 0.3764(\ln Cs))}$	Sample et al. 1998b; USEPA 2007f
Zinc	$C_p = e^{(1.575 + 0.555(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007f	$C_w = e^{(4.449 + 0.328(\ln Cs))}$	Sample et al. 1998a; USEPA 2007f	$C_m = e^{(4.4713 + 0.0738(\ln Cs))}$	Sample et al. 1998b

[1] Where C_p = Concentration in aboveground portion of plant (mg/kg dry wt) and C_s = Concentration in soil (mg/kg dry wt)
[2] Where C_w = Concentration in earthworm (mg/kg dry wt) and C_s = Concentration in soil (mg/kg dry wt)
[3] Where C_m = Concentration in whole-body small mammal (mg/kg dry wt) and C_s = Concentration in soil (mg/kg dry wt)

TABLE E-8

Soil Bioaccumulation Factors For Soil Invertebrates (Dry Weight)

UXO 18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Metals						
Antimony	1.000	Assumed	--	1.000	Assumed	--
Arsenic	0.523	90th percentile	Sample et al. 1998a	--	see Table L-7	--
Barium	0.160	90th percentile	Sample et al. 1998a	0.060	Geometric mean	Sample et al. 1998a
Beryllium	1.182	90th percentile	Sample et al. 1998a	0.070	Geometric mean	Sample et al. 1998a
Cadmium	40.69	90th percentile	Sample et al. 1998a	--	see Table L-7	--
Chromium	3.162	90th percentile	Sample et al. 1998a	0.320	Geometric mean	Sample et al. 1998a
Cobalt	0.291	90th percentile	Sample et al. 1998a	0.113	Geometric mean	Sample et al. 1998a
Copper	1.531	90th percentile	Sample et al. 1998a	--	see Table L-7	--
Lead	1.522	90th percentile	Sample et al. 1998a	--	see Table L-7	--
Manganese	0.124	90th percentile	Sample et al. 1998a	--	see Table L-7	--
Mercury	20.63	90th percentile	Sample et al. 1998a	1.186	Geometric mean	Sample et al. 1998a
Nickel	4.730	90th percentile	Sample et al. 1998a	1.656	Arithmetic mean	Sample et al. 1998a
Selenium	1.340	90th percentile	Sample et al. 1998a	--	see Table L-7	--
Silver	15.34	90th percentile	Sample et al. 1998a	2.045	Median	Sample et al. 1998a; USEPA 2007f
Vanadium	0.088	90th percentile	Sample et al. 1998a	0.039	Arithmetic mean	Sample et al. 1998a
Zinc	12.89	90th percentile	Sample et al. 1998a	--	see Table L-7	--
Semivolatile Organic Compounds						
Hexachloroethane	1.000	Assumed	--	1.000	Assumed	--

TABLE E-9

Soil Bioaccumulation Factors For Small Mammals (Dry Weight) - Omnivores

UXO 18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Metals						
Antimony	NA	--	See Section 1.3.3.3 (Small Mammals)	NA	--	See Section 1.3.3.3 (Small Mammals)
Arsenic	0.014	90th percentile	Sample et al. 1998b	--	see Table L-7	--
Barium	0.069	90th percentile	Sample et al. 1998b	0.046	Median	Sample et al. 1998b
Beryllium	NA	--	See Section 1.3.3.3 (Small Mammals)	NA	--	See Section 1.3.3.3 (Small Mammals)
Cadmium	0.462	90th percentile	Sample et al. 1998b	--	see Table L-7	--
Chromium	0.349	90th percentile	Sample et al. 1998b	--	see Table L-7	--
Cobalt	0.025	90th percentile	Sample et al. 1998b	--	see Table L-7	--
Copper	0.554	90th percentile	Sample et al. 1998b	--	see Table L-7	--
Lead	0.286	90th percentile	Sample et al. 1998b	--	see Table L-7	--
Manganese	0.037	90th percentile	Sample et al. 1998b	0.031	Median	Sample et al. 1998b
Mercury	0.130	90th percentile	Sample et al. 1998b	0.054	Median	Sample et al. 1998b
Nickel	0.589	90th percentile	Sample et al. 1998b	--	see Table L-7	--
Selenium	1.263	90th percentile	Sample et al. 1998b	--	see Table L-7	--
Silver	0.810	90th percentile	Sample et al. 1998b	0.151	Median	Sample et al. 1998b
Vanadium	0.013	90th percentile	Sample et al. 1998b	0.010	Median	Sample et al. 1998b
Zinc	2.782	90th percentile	Sample et al. 1998b	--	see Table L-7	--
Volatile and Semivolatile Organic Compounds						
Hexachloroethane	NA	--	See Section 1.3.3.3 (Small Mammals)	NA	--	See Section 1.3.3.3 (Small Mammals)

NA - Not Available

TABLE E-10

Exposure Parameters for Upper Trophic Level Ecological Receptors - Screening

UXO 18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Receptor	Body Weight (kg)		Water Ingestion Rate (L/day)		Food Ingestion Rate (kg/day - dry)	
	Value	Reference	Value	Reference	Value	Reference
Birds						
Cave swallow (terrestrial)	0.0144	Dunning 2008 (minimum for male/female - Puerto Rico)	0.0042	allometric equation (USEPA 1993)[1]	0.0044	allometric equation (Nagy 2001)[3]
Common ground dove	0.0224	Dunning 2008 (minimum - Puerto Rico [gender not reported])	0.0070	allometric equation (USEPA 1993)[1]	0.0081	allometric equation (Nagy 2001)[4]
Pearly-eyed thrasher	0.080	Dunning 2008 (minimum for male/female - Puerto Rico)	0.0157	allometric equation (USEPA 1993)[1]	0.0174	allometric equation (Nagy 2001)[3]
Red-tailed hawk	0.957	USEPA 1993 (lowest of 6 adult values [3 male/3 female])	0.0680	allometric equation (USEPA 1993)[1]	0.0395	Sample and Suter 1994
Mammals						
Fruit bat	0.0341	Silva and Downing 1995 (minimum for male/female - Virgin Islands)	0.0080	allometric equation (USEPA 1993)[2]	0.0058	allometric equation (Nagy 2001)[7]
Indian mongoose	0.312	Silva and Downing 1995 (minimum for male/female - Puerto Rico)	0.0933	allometric equation (USEPA 1993)[2]	0.0460	allometric equation (Nagy 2001)[6]
Norway rat	0.168	Silva and Downing 1995 (minimum for male/female - Arkansas)	0.0516	allometric equation (USEPA 1993)[2]	0.0398	allometric equation (Nagy 2001)[5]
Velvet free-tailed bat (terrestrial)	0.0080	Silva and Downing 1995 (minimum for male/female - Virgin Islands)	0.0018	allometric equation (USEPA 1993)[2]	0.0019	allometric equation (Nagy 2001)[7]

1 - All birds equation: $0.059\ (BW)^{0.67}$ (maximum body weight used: thrasher - 0.138 kg; heron - 0.220 kg; hawk - 1.235 kg; sandpiper - 0.0598 kg; dove - 0.0412 kg; swallow - 0.0195 kg; pintail - 0.633 kg)

2 - All mammals equation: $0.099\ (BW)^{0.90}$ (maximum body weight used: rat - 0.485 kg; mongoose - 0.936 kg; fruit bat - 0.0615 kg; free-tailed bat - 0.0117 kg; fishing bat - 0.0813 kg)

3 - Insectivorous birds equation: $(0.54*((BW*1000)^{0.705}))/1000$ (maximum body weight used: 0.138 kg)

4 - All birds equation: $(0.638*((BW*1000)^{0.685})/1000$ (maximum body weight used: heron - 0.220 kg; sandpiper - 0.0598 kg)

5 - Rodent equation used: $(0.332*((BW*1000)^{0.774}))/1000$ (maximum body weight used - 0.485 kg)

6 - Carnivore equation used: $(0.153*((BW*1000)^{0.834})/1000$ (maximum body weight used - 0.936 kg)

7 - Bat equation used: $(0.365*((BW*1000)^{0.671}))/1000$

TABLE E-10
Exposure Parameters for Upper Trophic Level Ecological Receptors - Screening
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Receptor	Dietary Composition (percent)							Soil/ Sediment Ingestion (percent)	
	Terrestrial Plants	Soil Invertebrates	Small Mammals	Fish	Aquatic Plants	Aquatic Invertebrates	Reference	Value	Reference
Birds									
Cave swallow (terrestrial)	0	100	0	0	0	0	Sample et al. 1997; Ehrlich et al. 1988	0	Sample et al. 1997
Common ground dove	95.0	0	0	0	0	0	Martin et al. 1951	5.0	Assumed based upon diet
Pearly-eyed thrasher	0	95.4	0	0	0	0	Exclusive diet	4.6	Sample and Suter 1994 (value is for American robin)
Red-tailed hawk	0	0	100	0	0	0	USEPA 1993; Sample and Suter 1994	0	Sample and Suter 1994
Mammals									
Fruit bat	100	0	0	0	0	0	Ortega and Castro-Arellano 2001	0	Assumed based upon diet
Indian Mongoose	0	97.2	0	0	0	0	Exclusive diet	2.8	Beyer et al. 1994 (value is for red fox)
Norway rat	98.0	0	0	0	0	0	Exclusive diet	2.0	Beyer et al. 1994 (value is for deer mouse)
Velvet free-tailed bat (terrestrial)	0	100	0	0	0	0	Reid 2009	0	Assumed based upon diet

TABLE E-11

Exposure Parameters for Upper Trophic Level Ecological Receptors - Baseline

UXO 18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Receptor	Body Weight (kg)		Water Ingestion Rate (L/day)		Food Ingestion Rate (kg/day - dry)		Home Range (ha)	
	Value	Reference	Value	Reference	Value	Reference	Value	Reference
Birds								
Cave swallow (terrestrial)	0.0158	Dunning 2008 (mean for male/female - Puerto Rico)	0.0037	allometric equation (USEPA 1993)[1]	0.0038	allometric equation (Nagy 2001)[5]	No data	--
Common ground dove	0.0320	Dunning 2008 (mean - Puerto Rico [gender not reported])	0.0059	allometric equation (USEPA 1993)[1]	0.0069	allometric equation (Nagy 2001)[4]	No data	--
Pearly-eyed thrasher	0.104	Dunning 2008 (mean for male/female - Puerto Rico)	0.0129	allometric equation (USEPA 1993)[1]	0.0123	allometric equation (Nagy 2001)[3]	No data	--
Red-tailed hawk	1.134	USEPA 1993 (mean of 6 adult values [3 male/3 female])	0.0642	allometric equation (USEPA 1993)[1]	0.0363	Sample and Suter 1994	859	USEPA 1993 (mean for male/female adults)
Mammals								
Fruit bat	0.0408	Silva and Downing 1995 (mean for male/female - Virgin Islands)	0.0056	allometric equation (USEPA 1993)[2]	0.0044	allometric equation (Nagy 2001)[8]	0.6 to 8 km radius	Ortega and Castro-Arellano 2001
Indian mongoose	0.528	Silva and Downing 1995 (mean for male/female - Puerto Rico)	0.0557	allometric equation (USEPA 1993)[2]	0.0285	allometric equation (Nagy 2001)[7]	3.20	Nellis 1989
Norway rat	0.209	Silva and Downing 1995 (mean for male/female - Arkansas)	0.0242	allometric equation (USEPA 1993)[2]	0.0207	allometric equation (Nagy 2001)[6]	0.24	Stroud 1982
Velvet free-tailed bat (terrestrial)	0.0101	Silva and Downing 1995 (mean for male/female - Virgin Islands)	0.0016	allometric equation (USEPA 1993)[2]	0.0017	allometric equation (Nagy 2001)[8]	No data	--

1 - All birds equation: $0.059\ (BW)^{0.67}$

2 - All mammals equation: $0.099\ (BW)^{0.90}$

3 - Omnivorous birds equation: $(0.67*((BW*1000)^{0.627}))/1000$

4 - All birds equation: $(0.638*((BW*1000)^{0.685)})/1000$

5 - Insectivorous birds equation: $(0.54*((BW*1000)^{0.705}))/1000$

6 - Rodent equation used: $(0.332*((BW*1000)^{0.774}))/1000$

7 - Carnivore equation used: $(0.153*((BW*1000)^{0.834)})/1000$

8 - Bat equation used: (0.365*((BW*1000)0.671))/1000

Note: an area use factor of 1 was assumed for the baseline risk assessment

TABLE E-11
Exposure Parameters for Upper Trophic Level Ecological Receptors - Baseline
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Receptor	Dietary Composition (percent)							Soil/ Sediment Ingestion (percent)	
	Terrestrial Plants	Soil Invertebrates	Small Mammals	Fish	Aquatic Plants	Aquatic Invertebrates	Reference	Value	Reference
Birds									
Cave swallow (terrestrial)	0	100	0	0	0	0	Sample et al. 1997; Ehrlich et al. 1988	0	Sample et al. 1997
Common ground dove	95.0	0	0	0	0	0	Martin et al. 1951	5.0	Assumed based upon diet
Pearly-eyed thrasher	20.0	75.4	0	0	0	0	Oberle 2000 (estimated based on description of diet)	4.6	Sample and Suter 1994 (value is for American robin)
Red-tailed hawk	0	0	100	0	0	0	USEPA 1993; Sample and Suter 1994	0	Sample and Suter 1994
Mammals									
Fruit bat	100	0	0	0	0	0	Ortega and Castro-Arellano 2001	0	Assumed based upon diet
Indian mongoose	11.1	56.4	29.7	0	0	0	Nellis 1989	2.8	Beyer et al. 1994 (value is for red fox)
Norway rat	49.0	49.0	0	0	0	0	Linzey 1998 (estimated based on description of diet)	2.0	Beyer et al. 1994 (value is for deer mouse)
Velvet free-tailed bat (terrestrial)	0	100	0	0	0	0	Reid 2009	0	Assumed based upon diet

TABLE E-12
Soil Ecological Screening Values (ESVs) for Plants and Soil Invertebrates
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical	ESV	Units	Type/Receptor	Reference	Comments
Inorganics					
Aluminum	pH < 5.5	--	Eco-SSL	USEPA 2003a	
Antimony	78.0	mg/kg	Eco-SSL - Invertebrate	USEPA 2005a	
Arsenic	18.0	mg/kg	Eco-SSL - Plant	USEPA 2005b	
Barium	330	mg/kg	Eco-SSL - Invertebrate	USEPA 2005c	
Beryllium	40.0	mg/kg	Eco-SSL - Invertebrate	USEPA 2005d	
Cadmium	32.0	mg/kg	Eco-SSL - Plant	USEPA 2005e	
Chromium (total)	64.0	mg/kg	Soil Quality Guideline	CCME 2007	
Chromium (hexavalent)	0.40	mg/kg	Soil Quality Guideline	CCME 2007	
Cobalt	13.0	mg/kg	Eco-SSL - Plant	USEPA 2005f	
Copper	70.0	mg/kg	Eco-SSL - Plant	USEPA 2007a	
Iron	5 < pH > 8	--	Eco-SSL	USEPA 2003b	
Lead	120	mg/kg	Eco-SSL - Plant	USEPA 2005g	
Manganese	220	mg/kg	Eco-SSL - Plant	USEPA 2007b	
Mercury	0.10	mg/kg	Invertebrate	Efroymson et al. 1997b	
Nickel	38.0	mg/kg	Eco-SSL - Plant	USEPA 2007c	
Selenium	0.52	mg/kg	Eco-SSL - Plant	USEPA 2007d	
Silver	560	mg/kg	Eco-SSL - Plant	USEPA 2006	
Thallium	1.00	mg/kg	Plant	Efroymson et al. 1997a	
Vanadium	130	mg/kg	Soil Quality Guideline	CCME 2007	
Zinc	120	mg/kg	Eco-SSL - Invertebrate	USEPA 2007e	
Explosives					
1,3,5-Trinitrobenzene	--	--	--	--	
1,3-Dinitrobenzene	--	--	--	--	
2,4,6-Trinitrotoluene	10,000	ug/kg	Plant	Talmage et al. 1999	
2,4-Dinitrotoluene	11,000	ug/kg	Plant/Invertebrate	NRCC 2006	
2,6-Dinitrotoluene	8,500	ug/kg	Plant/Invertebrate	NRCC 2006	
2-Amino-4,6-dinitrotoluene	80,000	ug/kg	Plant	Talmage et al. 1999	
2-Nitrotoluene	--	--	--	--	
3,5-Dinitroaniline	--	--	--	--	
3-Nitrotoluene	--	--	--	--	
4-Amino-2,6-dinitrotoluene	--	--	--	--	
4-Nitrotoluene	--	--	--	--	
HMX	10,000	ug/kg	Invertebrate	Talmage et al. 1999	
Nitrobenzene	2,260	ug/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 226,000; UF of 100
Nitroglycerine	--	--	--	--	
Nitroguanidine	--	--	--	--	
Perchlorate	1,000	ug/kg	Invertebrate	USEPA 2002	
PETN	--	--	--	--	
RDX	10,000	ug/kg	Invertebrate	Talmage et al. 1999	
Tetryl	10,000	ug/kg	Plant	Talmage et al. 1999	
Semivolatile Organic Compounds					
Hexachloroethane	--	--	--	--	

TABLE E-13
Uncertainty Factors
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Convert From	Convert To	Uncertainty Factor
Chronic NOAEL or NOEC	Chronic NOAEL or NOEC	1
Chronic LOAEL or LOEC	Chronic NOAEL or NOEC	5
Chronic NOAEL or NOEC	Chronic LOAEL or LOEC	5
Subchronic NOAEL or NOEC	Chronic NOAEL or NOEC	10
Subchronic LOAEL or LOEC	Chronic NOAEL or NOEC	20
Acute NOAEL or NOEC	Chronic NOAEL or NOEC	30
Acute LOAEL or LOEC	Chronic NOAEL or NOEC	50
LD50 or LC50	Chronic NOAEL or NOEC	100

Uncertainty factors from Wentsel et al. (1996)
Durations are defined as follows (USEPA 1999; Sample et al. 1996):
- Acute: <3 days (plants, invertebrates) and <14 days (fish, birds, mammals)
- Subchronic: 3 - 6 days (plants, invertebrates) and 14 - 90 days (fish, birds, mammals)
- Chronic: >7 days (plants, invertebrates) and >90 days or during critical life stage (fish, birds, mammals)

TABLE E-14
Eco-SSL Values for Birds and Mammals
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical	Bird	Mammal	Units	Reference
Metals				
Antimony	--	0.27	mg/kg	USEPA 2005a
Arsenic	43.0	46.0	mg/kg	USEPA 2005b
Barium	--	2,000	mg/kg	USEPA 2005c
Beryllium	--	21.0	mg/kg	USEPA 2005d
Cadmium	0.77	0.36	mg/kg	USEPA 2005e
Chromium	26.0	34.0	mg/kg	USEPA 2008
Cobalt	120	230	mg/kg	USEPA 2005f
Copper	28.0	49.0	mg/kg	USEPA 2007a
Lead	11.0	56.0	mg/kg	USEPA 2005g
Manganese	4,300	4,000	mg/kg	USEPA 2007b
Nickel	210	130	mg/kg	USEPA 2007c
Selenium	1.20	0.63	mg/kg	USEPA 2007d
Silver	4.20	14.0	mg/kg	USEPA 2006a
Vanadium	7.80	280	mg/kg	USEPA 2005h
Zinc	46.0	79.0	mg/kg	USEPA 2007e

TABLE E-15
Ingestion-Based Toxicity Reference Values (TRVs) for Mammals
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical	Chemical Form	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	Reference	NOAEL (mg/kg/d)	Reference	MATC (mg/kg/d)
Metals											
Antimony	--	rat	--	31 days	oral in water	survival, growth, reproduction	0.590	USEPA 2005a	0.059	USEPA 2005a	0.187
Arsenic	Arsenite (As+3)	mouse	0.03	3 generations	oral in water/food	reproduction	1.26	Sample et al. 1996	0.25 a	--	0.56
Arsenic	--	dog	--	8 weeks	oral in diet	survival, growth, reproduction	1.66	USEPA 2005b	1.04	USEPA 2005b	1.31
Barium	--	multiple	--	--	oral	survival, growth, reproduction	259 b	--	51.8	USEPA 2005c	116
Beryllium	--	rat	--	4 years	oral in water	survival, growth, reproduction	2.66 b	--	0.53	USEPA 2005d	1.19
Cadmium	--	rat	--	2 weeks	oral in water	survival, growth, reproduction	7.70	USEPA 2005e	0.77	USEPA 2005e	2.43
Chromium	Cr+3	multiple	--	--	oral	survival, growth, reproduction	12.0 b	--	2.40	USEPA 2008	5.37
Chromium	Cr+6	multiple	--	--	oral	survival, growth, reproduction	46.2 b	--	9.24	USEPA 2008	20.7
Cobalt	--	multiple	--	--	oral	survival, growth, reproduction	36.7 b	--	7.33	USEPA 2005f	16.4
Copper	--	pig	--	4 weeks	oral in diet	survival, growth, reproduction	9.34	USEPA 2007a	5.60	USEPA 2007a	7.23
Copper	Copper sulfate	mink	1.00	357 days	oral in diet	reproduction	15.1	Sample et al. 1996	11.7	Sample et al. 1996	13.3
Lead	--	rat	--	7 weeks	oral in water	survival, growth, reproduction	8.90	USEPA 2005g	4.70	USEPA 2005g	6.47
Manganese	--	multiple	--	--	oral	survival, growth, reproduction	258 b	--	51.5	USEPA 2007b	115
Mercury	Methyl mercury chloride	rat	0.35	3 generations	oral in diet	reproduction	0.160	Sample et al. 1996	0.032	Sample et al. 1996	0.072
Mercury	Methyl mercury chloride	mink	1.00	93 days	oral in diet	survival/weight loss	0.25 c	Sample et al. 1996	0.15 c	Sample et al. 1996	0.19
Nickel	--	mouse	--	35 days	oral	survival, growth, reproduction	3.40	USEPA 2007c	1.70	USEPA 2007c	2.40
Selenium	Potassium selenate	rat	0.35	1 year	oral in water	reproduction	0.33	Sample et al. 1996	0.20	Sample et al. 1996	0.26
Silver	--	pig	--	40 days	oral in diet	survival, growth, reproduction	60.2	USEPA 2006a	12.0 a	--	26.9
Vanadium	--	mouse	--	12 days	oral (gavage)	survival, growth, reproduction	8.31	USEPA 2005h	4.16	USEPA 2005h	5.88
Zinc	--	multiple	--	--	oral	survival, growth, reproduction	377 b	--	75.4	USEPA 2007e	169
Semivolatile Organic Compounds											
Hexachloroethane	--	rat	0.35	GD 6-16	oral (gavage)	reproduction	500	ATSDR 1997	100	ATSDR 1997	224

NA - Not Available
[a] Uncertainty factor of 5 applied to LOAEL
[b] Uncertainty factor of 5 applied to NOAEL
[c] Does not include subchronic uncertainty factor of 10 applied by Sample et al (1996) since the study duration meets the criteria for a chronic study in Table L-20

TABLE E-16
Ingestion-Based Toxicity Reference Values (TRVs) for Birds
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical	Chemical Form	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	Reference	NOAEL (mg/kg/d)	Reference	MATC (mg/kg/d)
Metals											
Antimony	--	--	--	--	--	--	NA	--	NA	--	NA
Arsenic	--	chicken	--	19 days	oral in diet	survival, growth,reproduction	11.2 b	--	2.24	USEPA 2005b	5.01
Arsenic	Sodium arsenite	mallard	1.00	128 days	oral in diet	survival	12.8	Sample et al. 1996	5.14	Sample et al. 1996	8.12
Barium	Barium hydroxide	chicken (chicks)	0.121	4 weeks	oral in diet	survival	41.7 c	Sample et al. 1996	20.8 c	Sample et al. 1996	29.5
Beryllium	--	--	--	--	--	--	NA	--	NA	--	NA
Cadmium	--	multiple	--	--	oral in diet	survival, growth,reproduction	7.35 b	--	1.47	USEPA 2005e	3.29
Chromium	Cr+3	multiple	--	--	oral in diet	survival, growth,reproduction	13.3 b	--	2.66	USEPA 2008	5.95
Cobalt	--	multiple	--	--	oral in diet	survival, growth,reproduction	38.1 b	--	7.61	USEPA 2005f	17.0
Copper	--	chicken	--	84 days	oral in diet	survival, growth,reproduction	12.1	USEPA 2007a	4.05	USEPA 2007a	7.00
Lead	--	chicken	--	4 weeks	oral in diet	survival, growth,reproduction	3.26	USEPA 2005g	1.63	USEPA 2005g	2.31
Lead	Metallic	American kestrel	0.13	7 months	oral in diet	reproduction	19.3 b	--	3.85	Sample et al. 1996	8.61
Manganese	--	multiple	--	--	oral	survival, growth,reproduction	895 b	--	179	USEPA 2007b	400
Mercury	Mercury chloride	Japanese quail	0.15	1 year	oral in diet	reproduction	0.90	Sample et al. 1996	0.45	Sample et al. 1996	0.64
Mercury	--	red-tailed hawk	1.10	12 weeks	oral in diet	survival/neurological	1.20	USEPA 1995b	0.49	USEPA 1995b	0.77
Mercury	Methyl mercury	mallard	1.00	3 generations	oral in diet	reproduction	0.078	USEPA 1997b	0.026	USEPA 1997b	0.045
Nickel	--	multiple	--	--	oral in diet	survival, growth,reproduction	33.6 b	--	6.71	USEPA 2007c	15.0
Selenium	Selanomethionine	mallard	1.00	100 days	oral in diet	reproduction	0.80	Sample et al. 1996	0.40	Sample et al. 1996	0.57
Selenium	Selanomethionine	black-crowned night-heron	0.88	94 days	oral in diet	reproduction	9.00 b	--	1.80	Sample et al. 1996	4.02
Selenium	Selanomethionine	screech owl	0.20	13.7 weeks	oral in diet	reproduction	1.50	Sample et al. 1996	0.44	Sample et al. 1996	0.81
Selenium	--	chicken	--	2 weeks	oral in diet	survival, growth,reproduction	0.58	USEPA 2007d	0.29	USEPA 2007d	0.41
Silver	--	turkey	--	5 weeks	oral in diet	survival, growth	20.2	USEPA 2006a	4.04 a	--	9.03
Vanadium	Vanadyl sulfate	mallard	1.17	12 weeks	oral in diet	growth/survival	57.0 b	--	11.4	Sample et al. 1996	25.5
Vanadium	--	chicken	--	5 weeks	oral in diet	survival, growth,reproduction	0.688	USEPA 2005h	0.344	USEPA 2005h	0.486
Zinc	--	multiple	--	--	oral in diet	survival, growth,reproduction	331 b	--	66.1	USEPA 2007e	148
Semivolatile Organic Compounds											
Hexachloroethane	--	--	--	--	--	--	NA	--	NA	--	NA

NA - Not Available
[a] Uncertainty factor of 5 applied to LOAEL
[b] Uncertainty factor of 5 applied to NOAEL
[c] Subchronic to chronic uncertainty factor of 10 applied

TABLE E-17
Background Data and Upper Tolerance Limits (UTLs) - Surface Soil
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical	Tl		
	Maximum	Mean	UTL
Inorganics (mg/kg)			
Aluminum	NR	NR	35,000
Antimony[1]	5.80	--	5.80
Arsenic	9.60	4.10	9.20
Barium	NR	NR	212
Beryllium	0.95	0.449	0.95
Cadmium	2.10	1.40	2.40
Calcium	362,000	162,000	417,000
Chromium	58.8	27.3	70.0
Cobalt	NR	NR	16.0
Copper	NR	NR	94.0
Iron	NR	NR	38,100
Lead	10.6	6.18	16.0
Magnesium	NR	NR	22,200
Manganese	NR	NR	1,630
Mercury	0.31	0.133	0.31
Nickel	NR	NR	41.0
Potassium	9,050	4,000	10,800
Selenium	1.30	1.51	1.30
Silver	NR	NR	0.22
Sodium	NR	NR	1,590
Thallium	NR	NR	0.13
Vanadium	50.3	24.8	56.0
Zinc	NR	NR	32.0

NR - Not Reported
Tl - Tertiary limestone (soil type)
UTL - upper tolerance limit
1 - Maximum value from USEPA split samples

TABLE E-18
Ecological Screening Statistics - UXO-18 Surface Soil (SMI samples)
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL (Norm)	Geometric Mean	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Explosives (UG/KG)																			
1,3,5-Trinitrobenzene	200 - 200	0 / 2	--	--	--	100	0.0	100	100	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,3-Dinitrobenzene	200 - 200	0 / 2	--	--	--	100	0.0	100	100	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2,4,6-Trinitrotoluene	200 - 200	0 / 2	--	--	--	100	0.0	100	100	10,000	-- / --	0.02	NO	--	-- / --	--	--	--	NO
2,4-Dinitrotoluene	200 - 200	0 / 2	--	--	--	100	0.0	100	100	11,000	-- / --	0.02	NO	--	-- / --	--	--	--	NO
2,6-Dinitrotoluene	200 - 200	0 / 2	--	--	--	100	0.0	100	100	8,500	-- / --	0.02	NO	--	-- / --	--	--	--	NO
2-Amino-4,6-dinitrotoluene	200 - 200	0 / 2	--	--	--	100	0.0	100	100	80,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
2-Nitrotoluene	200 - 200	0 / 2	--	--	--	100	0.0	100	100	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
3-Nitrotoluene	200 - 200	0 / 2	--	--	--	100	0.0	100	100	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Amino-2,6-dinitrotoluene	200 - 200	0 / 2	--	--	--	100	0.0	100	100	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Nitrotoluene	200 - 200	0 / 2	--	--	--	100	0.0	100	100	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
HMX	200 - 200	0 / 2	--	--	--	100	0.0	100	100	10,000	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Nitrobenzene	200 - 200	0 / 2	--	--	--	100	0.0	100	100	2,260	-- / --	0.1	NO	--	-- / --	--	--	--	NO
Nitroglycerin	200 - 200	0 / 2	--	--	--	100	0.0	100	100	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Perchlorate	4.00 - 4.00	0 / 2	--	--	--	2.00	0.0	2.00	2.00	1,000	-- / --	0.004	NO	--	-- / --	--	--	--	NO
PETN	1,000 - 1,000	0 / 2	--	--	--	500	0.0	500	500	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Picric Acid	120 - 120	0 / 2	--	--	--	60.0	0.0	60.0	60.0	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
RDX	200 - 200	0 / 2	--	--	--	100	0.0	100	100	10,000	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Tetryl	200 - 200	0 / 2	--	--	--	100	0.0	100	100	10,000	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Inorganics (MG/KG)																			
Aluminum	-- - --	2 / 2	262	598	VE-UXO18-01SMI02-0613	430	238	1,491	396	pH <5.5	0 / 2	--	NO	--	-- / --	--	--	--	NO
Antimony	0.20 - 0.20	0 / 2	--	--	--	0.10	0.0	0.10	0.10	78.0	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Arsenic	0.30 - 0.30	0 / 2	--	--	--	0.15	0.0	0.15	0.15	18.0	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Barium	-- - --	2 / 2	2.40	4.50	VE-UXO18-01SMI02-0613	3.45	1.48	10.1	3.29	330	0 / 2	0.01	NO	--	-- / --	--	--	--	NO
Beryllium	0.20 - 0.20	0 / 2	--	--	--	0.10	0.0	0.10	0.10	40.0	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Cadmium	0.080 - 0.080	0 / 2	--	--	--	0.040	0.0	0.040	0.040	32.0	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Calcium [3]	-- - --	2 / 2	27,100	41,300	VE-UXO18-01SMI01-0613	34,200	10,041	79,028	33,455	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Chromium (hexavalent)	4.00 - 10.0	0 / 2	--	--	--	3.50	2.12	13.0	3.16	0.40	-- / --	25.0	YES	--	-- / --	--	32	8.75	YES
Chromium	-- - --	2 / 2	0.69	0.85	VE-UXO18-01SMI02-0613	0.77	0.11	1.28	0.77	64.0	0 / 2	0.01	NO	--	-- / --	--	--	--	NO
Cobalt	-- - --	2 / 2	0.098	0.24	VE-UXO18-01SMI02-0613	0.17	0.10	0.62	0.15	13.0	0 / 2	0.02	NO	--	-- / --	--	--	--	NO
Copper	-- - --	2 / 2	0.46	0.68	VE-UXO18-01SMI02-0613	0.57	0.16	1.26	0.56	70.0	0 / 2	0.01	NO	--	-- / --	--	--	--	NO
Iron	-- - --	2 / 2	185	316	VE-UXO18-01SMI02-0613	251	92.6	664	242	5< pH >8	0 / 2	--	NO	--	-- / --	--	--	--	NO
Lead	0.40 - 0.40	1 / 2	0.20	0.20	VE-UXO18-01SMI01-0613	0.20	0.0	0.20	0.20	120	0 / 2	0.002	NO	--	-- / --	--	--	--	NO
Magnesium [3]	-- - --	2 / 2	620	1,430	VE-UXO18-01SMI01-0613	1,025	573	3,582	942	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Manganese	-- - --	2 / 2	19.3	54.6	VE-UXO18-01SMI02-0613	37.0	25.0	148	32.5	220	0 / 2	0.25	NO	--	-- / --	--	--	--	NO
Nickel	-- - --	2 / 2	0.17	0.36	VE-UXO18-01SMI02-0613	0.27	0.13	0.86	0.25	38.0	0 / 2	0.01	NO	--	-- / --	--	--	--	NO
Potassium [3]	-- - --	2 / 2	70.9	184	VE-UXO18-01SMI02-0613	127	80.0	484	114	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Selenium	0.10 - 0.10	1 / 2	0.12	0.12	VE-UXO18-01SMI02-0613	0.085	0.049	0.31	0.077	0.52	0 / 2	0.23	NO	--	-- / --	--	--	--	NO
Silver	0.050 - 0.050	0 / 2	--	--	--	0.025	0.0	0.025	0.025	560	-- / --	0.0001	NO	--	-- / --	--	--	--	NO
Sodium [3]	-- - --	2 / 2	61.7	294	VE-UXO18-01SMI01-0613	178	164	911	135	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Thallium	0.050 - 0.050	0 / 2	--	--	--	0.025	0.0	0.025	0.025	1.00	-- / --	0.05	NO	--	-- / --	--	--	--	NO
Vanadium	-- - --	2 / 2	0.50	0.54	VE-UXO18-01SMI02-0613	0.52	0.028	0.65	0.52	130	0 / 2	0.004	NO	--	-- / --	--	--	--	NO
Zinc	-- - --	2 / 2	2.90	3.60	VE-UXO18-01SMI01-0613	3.25	0.49	5.46	3.23	120	0 / 2	0.03	NO	--	-- / --	--	--	--	NO
Other Parameters																			
pH	-- - --	2 / 2	7.50	7.60	VE-UXO18-01SMI01-0613	7.55	0.071	7.87	7.55	--	-- / --	--	--	--	-- / --	--	--	--	--
Redox (MV)	-- - --	2 / 2	147	164	VE-UXO18-01SMI01-0613	156	12.0	209	155	--	-- / --	--	--	--	-- / --	--	--	--	--
Total organic carbon (MG/KG)	-- - --	2 / 2	19,900	86,700	VE-UXO18-01SMI02-0613	53,300	47,235	264,179	41,537	--	-- / --	--	--	--	-- / --	--	--	--	--

NSV - No Screening Value
1 - Count of detected samples exceeding or equaling Screening Value
2 - Shaded cells indicate hazard quotient based on reporting limits
3 - Macronutrient - Not considered to be a COPC

TABLE E-19

Ecological Screening Statistics - UXO-18 Surface Soil (discrete samples)

UXO 18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL (Norm)	Geometric Mean	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Semivolatile Organic Compounds (UG/KG)																			
Hexachloroethane	1.90 - 2.10	0 / 3	--	--	--	1.00	0.050	1.08	1.00	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Explosives (UG/KG)																			
1,3,5-Trinitrobenzene	200 - 200	0 / 3	--	--	--	100	0.0	100	100	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,3-Dinitrobenzene	200 - 200	0 / 3	--	--	--	100	0.0	100	100	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2,4,6-Trinitrotoluene	200 - 200	0 / 3	--	--	--	100	0.0	100	100	10,000	-- / --	0.02	NO	--	-- / --	--	--	--	NO
2,4-Dinitrotoluene	200 - 200	0 / 3	--	--	--	100	0.0	100	100	11,000	-- / --	0.02	NO	--	-- / --	--	--	--	NO
2,6-Dinitrotoluene	200 - 200	0 / 3	--	--	--	100	0.0	100	100	8,500	-- / --	0.02	NO	--	-- / --	--	--	--	NO
2-Amino-4,6-dinitrotoluene	200 - 200	0 / 3	--	--	--	100	0.0	100	100	80,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
2-Nitrotoluene	200 - 200	0 / 3	--	--	--	100	0.0	100	100	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
3-Nitrotoluene	200 - 200	0 / 3	--	--	--	100	0.0	100	100	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Amino-2,6-dinitrotoluene	200 - 200	0 / 3	--	--	--	100	0.0	100	100	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Nitrotoluene	200 - 200	0 / 3	--	--	--	100	0.0	100	100	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
HMX	200 - 200	0 / 3	--	--	--	100	0.0	100	100	10,000	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Nitrobenzene	200 - 200	0 / 3	--	--	--	100	0.0	100	100	2,260	-- / --	0.09	NO	--	-- / --	--	--	--	NO
Nitroglycerin	200 - 200	0 / 3	--	--	--	100	0.0	100	100	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Perchlorate	4.00 - 4.00	0 / 3	--	--	--	2.00	0.0	2.00	2.00	1,000	-- / --	0.004	NO	--	-- / --	--	--	--	NO
PETN	1,000 - 1,000	0 / 3	--	--	--	500	0.0	500	500	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Picric Acid	120 - 120	0 / 3	--	--	--	60.0	0.0	60.0	60.0	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
RDX	200 - 200	0 / 3	--	--	--	100	0.0	100	100	10,000	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Tetryl	200 - 200	0 / 3	--	--	--	100	0.0	100	100	10,000	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Inorganics (MG/KG)																			
Aluminum	-- - --	3 / 3	3,630	9,720	VE-UXO18-01SS03-0001	5,940	3,300	11,504	5,403	pH <5.5	0 / 3	--	NO	--	-- / --	--	--	--	NO
Antimony	1.10 - 1.30	0 / 3	--	--	--	0.60	0.050	0.68	0.60	78.0	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Arsenic	-- - --	3 / 3	2.20	4.80	VE-UXO18-01SS03-0001	3.07	1.50	5.60	2.85	18.0	0 / 3	0.27	NO	--	-- / --	--	--	--	NO
Barium	-- - --	3 / 3	34.5	49.0	VE-UXO18-01SS02-0001	42.3	7.31	54.6	41.8	330	0 / 3	0.15	NO	--	-- / --	--	--	--	NO
Beryllium	0.23 - 0.25	1 / 3	0.090	0.090	VE-UXO18-01SS03-0001	0.11	0.018	0.14	0.11	40.0	0 / 3	0.002	NO	--	-- / --	--	--	--	NO
Cadmium	-- - --	3 / 3	0.18	0.32	VE-UXO18-01SS02-0001	0.25	0.070	0.37	0.24	32.0	0 / 3	0.01	NO	--	-- / --	--	--	--	NO
Calcium [3]	-- - --	3 / 3	229,000	265,000	VE-UXO18-01SS01-0001	244,000	18,735	275,584	243,530	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Chromium (hexavalent)	4.60 - 12.0	0 / 3	--	--	--	3.60	2.08	7.11	3.26	0.40	-- / --	30.0	YES	--	-- / --	--	17.8	9.0	YES
Chromium	-- - --	3 / 3	6.30	11.4	VE-UXO18-01SS03-0001	8.97	2.56	13.3	8.71	64.0	0 / 3	0.18	NO	--	-- / --	--	--	--	NO
Cobalt	-- - --	3 / 3	2.40	2.50	VE-UXO18-01SS02-0001	2.43	0.058	2.53	2.43	13.0	0 / 3	0.19	NO	--	-- / --	--	--	--	NO
Copper	-- - --	3 / 3	8.10	13.6	VE-UXO18-01SS03-0001	11.6	3.02	16.7	11.3	70.0	0 / 3	0.19	NO	--	-- / --	--	--	--	NO
Iron	-- - --	3 / 3	2,680	7,710	VE-UXO18-01SS03-0001	4,710	2,652	9,180	4,259	5< pH >8	0 / 3	--	NO	--	-- / --	--	--	--	NO
Lead	0.46 - 0.49	1 / 3	2.00	2.00	VE-UXO18-01SS03-0001	0.83	1.02	2.54	0.48	120	0 / 3	0.02	NO	--	-- / --	--	--	--	NO
Magnesium [3]	-- - --	3 / 3	3,630	12,300	VE-UXO18-01SS03-0001	6,903	4,709	14,842	5,976	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Manganese	-- - --	3 / 3	110	315	VE-UXO18-01SS03-0001	203	104	378	185	220	1 / 3	1.43	YES	1,630	0 / 3	0.19	--	--	NO
Nickel	-- - --	3 / 3	1.90	3.80	VE-UXO18-01SS03-0001	2.73	0.97	4.37	2.62	38.0	0 / 3	0.10	NO	--	-- / --	--	--	--	NO
Potassium [3]	-- - --	3 / 3	827	2,350	VE-UXO18-01SS03-0001	1,412	820	2,795	1,272	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Selenium	0.57 - 0.57	2 / 3	0.75	0.98	VE-UXO18-01SS03-0001	0.67	0.35	1.27	0.59	0.52	2 / 3	1.88	YES	1.3	0 / 3	0.75	--	--	NO
Silver	0.28 - 0.31	0 / 3	--	--	--	0.15	0.0087	0.16	0.15	560	-- / --	0.001	NO	--	-- / --	--	--	--	NO
Sodium [3]	-- - --	3 / 3	452	627	VE-UXO18-01SS02-0001	524	91.4	678	519	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Thallium	0.28 - 0.31	1 / 3	0.55	0.55	VE-UXO18-01SS03-0001	0.28	0.23	0.67	0.23	1.00	0 / 3	0.55	NO	--	-- / --	--	--	--	NO
Vanadium	-- - --	3 / 3	5.10	14.6	VE-UXO18-01SS03-0001	8.90	5.03	17.4	8.05	130	0 / 3	0.11	NO	--	-- / --	--	--	--	NO
Zinc	-- - --	3 / 3	10.1	23.7	VE-UXO18-01SS03-0001	18.4	7.26	30.6	17.2	120	0 / 3	0.20	NO	--	-- / --	--	--	--	NO
Other Parameters																			
pH	-- - --	3 / 3	7.60	7.90	VE-UXO18-01SS02-0001	7.77	0.15	8.02	7.77	--	-- / --	--	--	--	-- / --	--	--	--	--
Redox (MV)	-- - --	3 / 3	199	224	VE-UXO18-01SS03-0001	211	12.6	232	210	--	-- / --	--	--	--	-- / --	--	--	--	--
Total organic carbon (MG/KG)	-- - --	3 / 3	48,000	68,000	VE-UXO18-01SS03-0001	60,000	10,583	77,841	59,335	--	-- / --	--	--	--	-- / --	--	--	--	--

NSV - No Screening Value

1 - Count of detected samples exceeding or equaling Screening Value

2 - Shaded cells indicate hazard quotient based on reporting limits

3 - Macronutrient - Not considered to be a COPC

TABLE E-20
Screening Statistics - UXO 18 Surface Soil (SMI [0 - 2 inches] and discrete [0 - 12 inches]) - Mammal/Bird Eco-SSLs
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	95% UCL (Norm)	Arithmetic Mean	Mammal Eco-SSL	Frequency of Exceedance	Maximum Hazard Quotient	95% UCL Hazard Quotient	Mean Hazard Quotient	Bird Eco-SSL	Frequency of Exceedance	Maximum Hazard Quotient	95% UCL Hazard Quotient	Mean Hazard Quotient
Inorganics (MG/KG)															
Antimony	0.20 - 1.30	0 / 5	--	0.66	0.40	0.27	5 / 5	4.8	2.5	1.5	--	-- / --	--	--	--
Arsenic	0.30 - 0.30	3 / 5	4.8	3.7	1.90	46.0	0 / 5	0.10	0.08	0.04	43.0	0 / 5	0.11	0.09	0.04
Barium	-- - --	5 / 5	49.0	47.6	26.7	2,000	0 / 5	0.02	0.02	0.01	--	-- / --	--	--	--
Beryllium	0.20 - 0.25	1 / 5	0.09	0.12	0.11	21.0	0 / 5	0.004	0.01	0.01	--	-- / --	--	--	--
Cadmium	0.08 - 0.08	3 / 5	0.32	0.29	0.17	0.36	0 / 5	0.89	0.79	0.46	0.77	0 / 5	0.42	0.37	0.22
Chromium	-- - --	5 / 5	11.4	10.3	5.7	34.0	0 / 5	0.34	0.30	0.17	26.0	0 / 5	0.44	0.40	0.22
Cobalt	-- - --	5 / 5	2.5	2.71	1.53	230	0 / 5	0.01	0.01	0.01	120	0 / 5	0.02	0.02	0.01
Copper	-- - --	5 / 5	13.6	13.3	7.2	49.0	0 / 5	0.28	0.27	0.15	28.0	0 / 5	0.49	0.47	0.26
Lead	0.40 - 0.49	2 / 5	2.0	1.33	0.58	56.0	0 / 5	0.04	0.02	0.01	11.0	0 / 5	0.18	0.12	0.05
Manganese	-- - --	5 / 5	315	249	137	4,000	0 / 5	0.08	0.06	0.03	4,300	0 / 5	0.07	0.06	0.03
Nickel	-- - --	5 / 5	3.8	3.2	1.75	130	0 / 5	0.03	0.02	0.01	210	0 / 5	0.02	0.02	0.01
Selenium	0.10 - 0.57	3 / 5	0.98	0.83	0.44	0.63	2 / 5	1.56	1.31	0.69	1.20	0 / 5	0.82	0.69	0.36
Silver	0.05 - 0.31	0 / 5	--	0.17	0.10	14.0	0 / 5	0.02	0.01	0.01	4.20	0 / 5	0.07	0.04	0.02
Vanadium	-- - --	5 / 5	14.6	11.1	5.5	280	0 / 5	0.05	0.04	0.02	7.80	1 / 5	1.87	1.42	0.71
Zinc	-- - --	5 / 5	23.7	21.6	12.3	79.0	0 / 5	0.30	0.27	0.16	46.0	0 / 5	0.52	0.47	0.27

Shaded cells indicate HQ > 1

TABLE E-21
Hazard Quotients for Terrestrial Food Web Exposures - Step 2 (Screening) - Maximum
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical	Norway Rat			Indian Mongoose			Fruit Bat			Velvet Free-Tailed Bat			Pearly-eyed Thrasher			Red-tailed Hawk			Common Ground Dove			Cave Swallow		
	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ
Metals																								
Antimony**	0.16	0.05	0.02	**3.2**	**1.03**	0.32	0.04	0.01	<0.01	**5.2**	**1.7**	0.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	**3.45**	**2.69**	**2.09**	0.96	0.75	0.58	**2.51**	**1.95**	**1.52**	**1.56**	**1.21**	0.95	0.64	0.35	0.19	0.12	0.06	0.03	**3.58**	**2.53**	**1.79**	0.91	0.49	0.27
Vanadium	0.02	0.02	0.01	0.06	0.04	0.03	0.01	<0.01	<0.01	0.07	0.05	0.04	**1.20**	0.85	0.60	0.02	0.02	0.01	0.91	0.65	0.46	**1.14**	0.80	0.57
Semivolatile Organics																								
Hexachloroethane**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

** - Concentration based on detection limits; chemical not detected
NA - TRV Not Available
Shaded cells indicate HQ > 1

TABLE E-22

Hazard Quotients for Terrestrial Food Web Exposures - Step 3A (Baseline) - 95% UCL

UXO 18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Chemical	Norway Rat			Indian Mongoose			Fruit Bat			Velvet Free-Tailed Bat			Pearly-eyed Thrasher			Common Ground Dove			Cave Swallow		
	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ
Metals																					
Antimony**	0.59	0.19	0.06	0.5	0.14	0.05	0.05	0.02	0.00	1.9	0.6	0.19	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	0.31	0.24	0.19	0.19	0.15	0.12	0.22	0.17	0.13	0.69	0.54	0.42	0.20	0.11	0.06	0.32	0.23	0.16	0.44	0.24	0.13
Vanadium	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	0.01	0.29	0.21	0.15	0.38	0.27	0.19	0.30	0.21	0.15

** - Concentration based on detection limits; chemical not detected

NA - TRV Not Available

Shaded cells indicate HQ > 1

TABLE E-23

Hazard Quotients for Terrestrial Food Web Exposures - Step 3A (Baseline) - Mean

UXO 18

Former Vieques Naval Training Range

Vieques, Puerto Rico

Chemical	Norway Rat			Indian Mongoose			Fruit Bat			Velvet Free-Tailed Bat			Pearly-eyed Thrasher			Common Ground Dove			Cave Swallow		
	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ
Metals																					
Antimony**	0.36	0.11	0.04	0.3	0.09	0.03	0.03	0.01	<0.01	**1.2**	0.4	0.12	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	0.18	0.14	0.11	0.13	0.10	0.08	0.11	0.09	0.07	0.43	0.34	0.26	0.12	0.06	0.04	0.16	0.11	0.08	0.28	0.15	0.08
Vanadium	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	0.15	0.10	0.07	0.19	0.13	0.09	0.15	0.11	0.08

** - Concentration based on detection limits; chemical not detected

NA - TRV Not Available

Shaded cells indicate HQ > 1

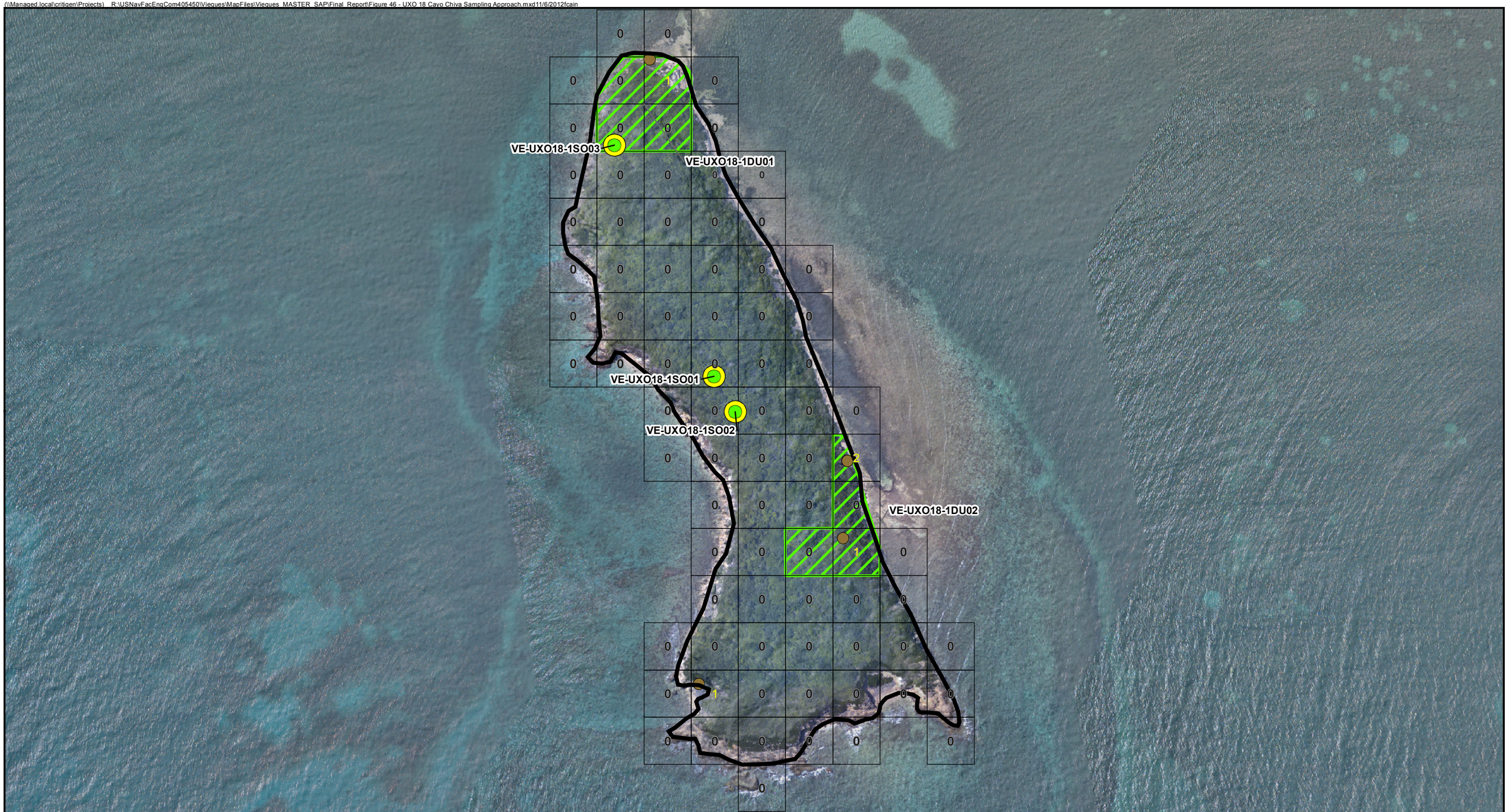
TABLE E-24
Reporting Limit to Screening Value Comparison
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Chemical	Units	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Mean Concentration	Screening Value	Minimum Ratio	Maximum Ratio	Mean Ratio
Surface Soil - SMI									
Chromium (hexavalent)	MG/KG	0 / 2	4.00	10.0	3.50	0.4	10.00	25.00	8.75
Surface Soil - Discrete									
Chromium (hexavalent)	MG/KG	0 / 3	4.60	12.0	3.60	0.4	11.50	30.0	9.00

Shaded cells indicate ratio > 1

Figures

(\\Managed.local\critigen\Projects) R:\USNavFacEngCom405450\Vieques\MapFiles\Vieques_MASTER_SAP\Final_Report\Figure 46 - UXO 18 Cayo Chiva Sampling Approach.mxd11/6/2012fcain



Surface Soil Sample
Smoke Canister Location
Decision Unit
Rockets / Guided Missiles
Grid (30 Meter)
Sample Unit

2005 Aerial Imagery
2005 Hillshade

Denisity of MEC and Munitions Scrap by 30 Meter Grid (Jenks Method Classification)

1 - 139
140 - 455
456 - 929
930 - 1579
1580 - 2360
2361 - 3463
3464 - 4920
4921 - 6808
6809 - 10113
10114 - 16918

N
W E
S

0 100 200
Feet

Figure E-1
UXO 18 Cayo Chiva Sampling Stations
Remedial Investigation Feasibility Study
Former Vieques Naval Training Range
Vieques, Puerto Rico

CH2MHILL®

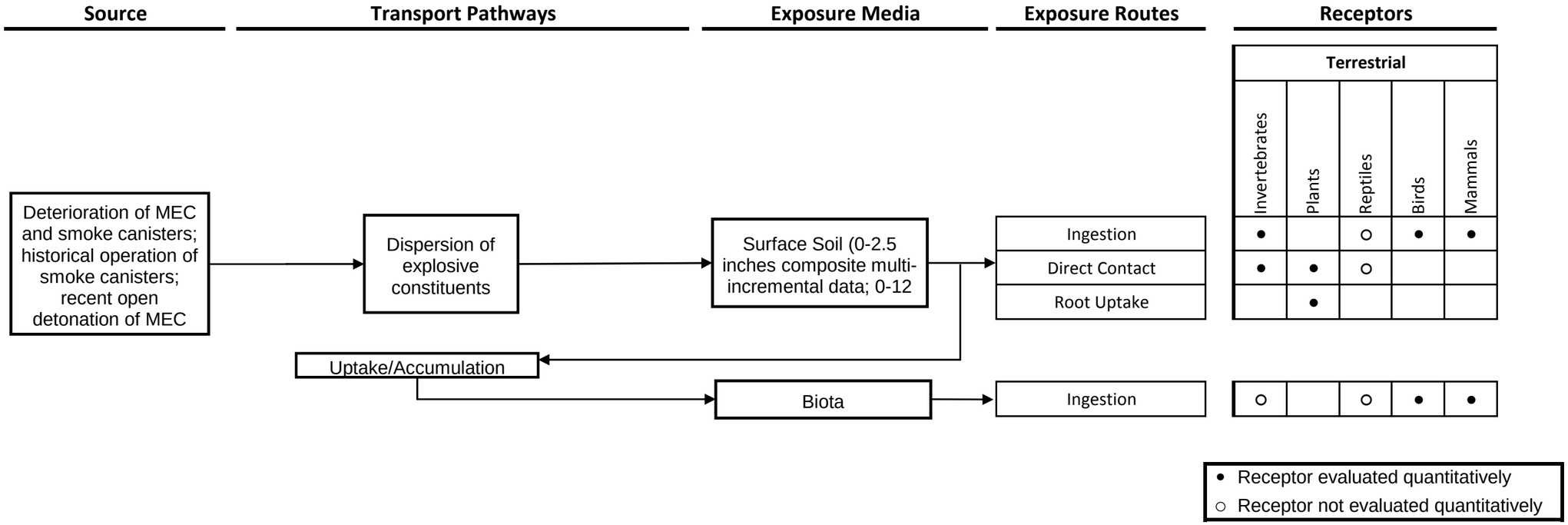


Figure E-2
Ecological Conceptual Site Model
UXO 18
Former Vieques Naval Training Range
Vieques, Puerto Rico

Attachment E-1
Terrestrial Food Web Calculations

ATTACHMENT TABLE E-1-1
Summary of Norway Rat Exposure Doses - Screening (Step 2)
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	1.3	1.000	1.30E+00	0.011	1.48E-02	9.60E-03	0.059	0.19	0.59	1.63E-01	5.15E-02	1.63E-02
Selenium	0.98	1.340	1.31E+00	3.012	2.95E+00	6.90E-01	0.20	0.26	0.33	**3.45E+00**	**2.69E+00**	**2.09E+00**
Vanadium	14.6	0.088	1.28E+00	0.010	1.42E-01	1.02E-01	4.16	5.88	8.31	2.45E-02	1.74E-02	1.23E-02
Semivolatile Organics												
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	7.12E-04	100	224	500	7.12E-06	3.18E-06	1.42E-06

Orange shaded cell - Concentration based on detection limits; chemical not detected

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0398	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.980	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.020	= Proportion of diet composed of soil
BW =	0.168	= Body weight (kg)

ATTACHMENT TABLE E-1-2
Summary of Indian Mongoose Exposure Doses - Screening (Step 2)
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Soil-Mammal BAF	Small Mammal Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals														
Antimony	1.3	1.000	1.30E+00	0.011	1.48E-02	See footnote	4.05E-02	1.92E-01	0.059	0.19	0.59	**3.25E+00**	**1.03E+00**	3.25E-01
Selenium	0.98	1.340	1.31E+00	3.012	2.95E+00	1.263	1.24E+00	1.92E-01	0.20	0.26	0.33	9.61E-01	7.48E-01	5.83E-01
Vanadium	14.6	0.088	1.28E+00	0.010	1.42E-01	0.013	1.91E-01	2.44E-01	4.16	5.88	8.31	5.87E-02	4.16E-02	2.94E-02
Semivolatile Organics														
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	See footnote	3.00E-03	3.10E-04	100	224	500	3.10E-06	1.38E-06	6.19E-07

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF of 1.0 was assumed
Orange shaded cell - Concentration based on detection limits; chemical not detected

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0460	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.972	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (terrestrial plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (small mammals, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (small mammals)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.028	= Proportion of diet composed of soil
BW =	0.312	= Body weight (kg)

ATTACHMENT TABLE E-1-3
Summary of Fruit Bat Exposure Doses - Screening (Step 2)
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	1.3	1.000	1.30E+00	0.011	1.48E-02	2.52E-03	0.059	0.19	0.59	4.26E-02	1.35E-02	4.26E-03
Selenium	0.98	1.340	1.31E+00	3.012	2.95E+00	5.01E-01	0.20	0.26	0.33	**2.51E+00**	**1.95E+00**	**1.52E+00**
Vanadium	14.6	0.088	1.28E+00	0.010	1.42E-01	2.40E-02	4.16	5.88	8.31	5.78E-03	4.09E-03	2.89E-03
Semivolatile Organics												
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	5.13E-04	100	224	500	5.13E-06	2.30E-06	1.03E-06

Orange shaded cell - Concentration based on detection limits; chemical not detected

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0058 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 1.000 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.000 = Proportion of diet composed of soil
BW = 0.0341 = Body weight (kg)

ATTACHMENT TABLE E-1-4
Summary of Velvet Free-Tailed Bat Exposure Doses - Screening (Step 2)
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	1.3	1.000	1.30E+00	0.011	1.48E-02	3.09E-01	0.059	0.19	0.59	**5.24E+00**	**1.66E+00**	5.24E-01
Selenium	0.98	1.340	1.31E+00	3.012	2.95E+00	3.12E-01	0.20	0.26	0.33	**1.56E+00**	**1.21E+00**	9.46E-01
Vanadium	14.6	0.088	1.28E+00	0.010	1.42E-01	3.05E-01	4.16	5.88	8.31	7.34E-02	5.19E-02	3.67E-02
Semivolatile Organics												
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	4.99E-04	100	224	500	4.99E-06	2.23E-06	9.98E-07

Orange shaded cell - Concentration based on detection limits; chemical not detected

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0019	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	1.000	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of soil
BW =	0.0080	= Body weight (kg)

ATTACHMENT TABLE E-1-5
Summary of Pearly-eyed Thrasher Exposure Doses - Screening (Step 2)
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	1.3	1.000	1.30E+00	0.011	1.48E-02	2.83E-01	NA	NA	NA	NA	NA	NA
Selenium	0.98	1.340	1.31E+00	3.012	2.95E+00	2.83E-01	0.44	0.81	1.50	6.42E-01	3.48E-01	1.88E-01
Vanadium	14.6	0.088	1.28E+00	0.010	1.42E-01	4.13E-01	0.344	0.486	0.688	**1.20E+00**	8.49E-01	6.00E-01
Semivolatile Organics												
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	4.57E-04	NA	NA	NA	NA	NA	NA

Orange shaded cell - Concentration based on detection limits; chemical not detected

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0174 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.954 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.046 = Proportion of diet composed of soil
BW = 0.080 = Body weight (kg)

ATTACHMENT TABLE E-1-6
Summary of Red-tailed Hawk Exposure Doses - Screening (Step 2)
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Soil-Mammal BAF	Small Mammal Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals														
Antimony	1.3	1.000	1.30E+00	0.011	1.48E-02	See footnote	4.05E-02	1.67E-03	NA	NA	NA	NA	NA	NA
Selenium	0.98	1.340	1.31E+00	3.012	2.95E+00	1.263	1.24E+00	5.11E-02	0.44	0.81	1.50	1.16E-01	6.29E-02	3.41E-02
Vanadium	14.6	0.088	1.28E+00	0.010	1.42E-01	0.013	1.91E-01	7.90E-03	0.344	0.486	0.688	2.30E-02	1.62E-02	1.15E-02
Semivolatile Organics														
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	See footnote	3.00E-03	1.24E-04	NA	NA	NA	NA	NA	NA

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF of 1.0 was assumed
Orange shaded cell - Concentration based on detection limits; chemical not detected

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0395	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (terrestrial plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (small mammals, dry weight basis)
PDFi =	1.000	= Proportion of diet composed of food item (small mammals)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of soil
BW =	0.957	= Body weight (kg)

ATTACHMENT TABLE E-1-7
Summary of Common Ground Dove Exposure Doses - Screening (Step 2)
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	1.3	1.000	1.30E+00	0.011	1.48E-02	2.88E-02	NA	NA	NA	NA	NA	NA
Selenium	0.98	1.340	1.31E+00	3.012	2.95E+00	1.04E+00	0.29	0.41	0.58	**3.58E+00**	**2.53E+00**	**1.79E+00**
Vanadium	14.6	0.088	1.28E+00	0.010	1.42E-01	3.14E-01	0.344	0.486	0.688	9.14E-01	6.46E-01	4.57E-01
Semivolatile Organics												
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	1.08E-03	NA	NA	NA	NA	NA	NA

Orange shaded cell - Concentration based on detection limits; chemical not detected

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0081	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.950	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.050	= Proportion of diet composed of soil
BW =	0.0224	= Body weight (kg)

ATTACHMENT TABLE E-1-8
Summary of Cave Swallow Exposure Doses - Screening (Step 2)
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	1.3	1.000	1.30E+00	0.011	1.48E-02	3.96E-01	NA	NA	NA	NA	NA	NA
Selenium	0.98	1.340	1.31E+00	3.012	2.95E+00	4.00E-01	0.44	0.81	1.50	9.09E-01	4.92E-01	2.67E-01
Vanadium	14.6	0.088	1.28E+00	0.010	1.42E-01	3.91E-01	0.344	0.486	0.688	**1.14E+00**	8.04E-01	5.69E-01
Semivolatile Organics												
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	6.39E-04	NA	NA	NA	NA	NA	NA

Orange shaded cell - Concentration based on detection limits; chemical not detected

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0044 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 1.000 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.000 = Proportion of diet composed of soil
BW = 0.0144 = Body weight (kg)

ATTACHMENT TABLE E-1-9
Summary of Norway Rat Exposure Doses - Baseline (Step 3A) - 95% UCL
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	0.66	1.000	6.60E-01	Regression	2.67E-02	3.47E-02	0.059	0.19	0.59	5.88E-01	1.86E-01	5.88E-02
Selenium	0.83	Regression	8.09E-01	Regression	4.13E-01	6.11E-02	0.20	0.26	0.33	3.06E-01	2.38E-01	1.85E-01
Vanadium	11.08	0.039	4.32E-01	0.005	5.31E-02	4.56E-02	4.16	5.88	8.31	1.10E-02	7.76E-03	5.49E-03
Semivolatile Organics												
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	2.53E-04	100	224	500	2.53E-06	1.13E-06	5.07E-07

Orange shaded cell - Concentration based on detection limits; chemical not detected. Hexachloroethane value represents maximum concentration; 95% UCL was greater than the maximum.

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0207	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.490	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.490	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.020	= Proportion of diet composed of soil
BW =	0.209	= Body weight (kg)

ATTACHMENT TABLE E-1-10

Summary of Indian Mongoose Exposure Doses - Baseline (Step 3A) - 95% UCL

Former Naval Ammunition Support Detachment

Vieques, Puerto Rico

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Soil-Mammal BAF	Small Mammal Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals														
Antimony	0.66	1.000	6.60E-01	Regression	2.67E-02	See footnote	3.50E-01	2.69E-02	0.059	0.19	0.59	4.56E-01	1.44E-01	4.56E-02
Selenium	0.83	Regression	8.09E-01	Regression	4.13E-01	Regression	6.15E-01	3.83E-02	0.20	0.26	0.33	1.91E-01	1.49E-01	1.16E-01
Vanadium	11.08	0.039	4.32E-01	0.005	5.31E-02	0.010	1.15E-01	3.21E-02	4.16	5.88	8.31	7.72E-03	5.46E-03	3.86E-03
Semivolatile Organics														
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	See footnote	2.55E-03	1.26E-04	100	224	500	1.26E-06	5.65E-07	2.53E-07

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF of 1.0 was assumed

Orange shaded cell - Concentration based on detection limits; chemical not detected. Hexachloroethane value represents maximum concentration; 95% UCL was greater than the maximum.

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0285	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.564	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.111	= Proportion of diet composed of food item (terrestrial plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (small mammals, dry weight basis)
PDFi =	0.297	= Proportion of diet composed of food item (small mammals)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.028	= Proportion of diet composed of soil
BW =	0.528	= Body weight (kg)

ATTACHMENT TABLE E-1-11

Summary of Fruit Bat Exposure Doses - Baseline (Step 3A) - 95% UCL

Former Naval Ammunition Support Detachment

Vieques, Puerto Rico

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	0.66	1.000	6.60E-01	Regression	2.67E-02	2.88E-03	0.059	0.19	0.59	4.88E-02	1.54E-02	4.88E-03
Selenium	0.83	Regression	8.09E-01	Regression	4.13E-01	4.45E-02	0.20	0.26	0.33	2.23E-01	1.73E-01	1.35E-01
Vanadium	11.08	0.039	4.32E-01	0.005	5.31E-02	5.73E-03	4.16	5.88	8.31	1.38E-03	9.74E-04	6.89E-04
Semivolatile Organics												
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	3.26E-04	100	224	500	3.26E-06	1.46E-06	6.51E-07

Orange shaded cell - Concentration based on detection limits; chemical not detected. Hexachloroethane value represents maximum concentration; 95% UCL was greater than the maximum.

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0044	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	1.000	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of soil
BW =	0.0408	= Body weight (kg)

ATTACHMENT TABLE E-1-12
Summary of Velvet Free-Tailed Bat Exposure Doses - Baseline (Step 3A) - 95% UCL
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	0.66	1.000	6.60E-01	Regression	2.67E-02	1.13E-01	0.059	0.19	0.59	**1.91E+00**	6.03E-01	1.91E-01
Selenium	0.83	Regression	8.09E-01	Regression	4.13E-01	1.38E-01	0.20	0.26	0.33	6.90E-01	5.37E-01	4.18E-01
Vanadium	11.08	0.039	4.32E-01	0.005	5.31E-02	7.37E-02	4.16	5.88	8.31	1.77E-02	1.25E-02	8.87E-03
Semivolatile Organics												
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	3.58E-04	100	224	500	3.58E-06	1.60E-06	7.16E-07

Orange shaded cell - Concentration based on detection limits; chemical not detected. Hexachloroethane value represents maximum concentration; 95% UCL was greater than the maximum.

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0017	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	1.000	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of soil
BW =	0.0101	= Body weight (kg)

ATTACHMENT TABLE E-1-13
Summary of Pearly-eyed Thrasher Exposure Doses - Baseline (Step 3A) - 95% UCL
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	0.66	1.000	6.60E-01	Regression	2.67E-02	6.32E-02	NA	NA	NA	NA	NA	NA
Selenium	0.83	Regression	8.09E-01	Regression	4.13E-01	8.66E-02	0.44	0.81	1.50	1.97E-01	1.07E-01	5.78E-02
Vanadium	11.08	0.039	4.32E-01	0.005	5.31E-02	1.00E-01	0.344	0.486	0.688	2.91E-01	2.06E-01	1.46E-01
Semivolatile Organics												
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	2.71E-04	NA	NA	NA	NA	NA	NA

Orange shaded cell - Concentration based on detection limits; chemical not detected. Hexachloroethane value represents maximum concentration; 95% UCL was greater than the maximum.

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0123	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.754	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.200	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.046	= Proportion of diet composed of soil
BW =	0.104	= Body weight (kg)

ATTACHMENT TABLE E-1-14

Summary of Red-tailed Hawk Exposure Doses - Baseline (Step 3A) - 95% UCL

Former Naval Ammunition Support Detachment

Vieques, Puerto Rico

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Soil-Mammal BAF	Small Mammal Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals														
Antimony	0.66	1.000	6.60E-01	Regression	2.67E-02	See footnote	3.50E-01	1.12E-02	NA	NA	NA	NA	NA	NA
Selenium	0.83	Regression	8.09E-01	Regression	4.13E-01	Regression	6.15E-01	1.97E-02	0.44	0.81	1.50	4.47E-02	2.42E-02	1.31E-02
Vanadium	11.08	0.039	4.32E-01	0.005	5.31E-02	0.010	1.15E-01	3.68E-03	0.344	0.486	0.688	1.07E-02	7.56E-03	5.34E-03
Semivolatile Organics														
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	See footnote	2.55E-03	8.17E-05	NA	NA	NA	NA	NA	NA

Orange shaded cell - Concentration based on detection limits; chemical not detected. Hexachloroethane value represents maximum concentration; 95% UCL was greater than the maximum.

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF of 1.0 was assumed

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0363	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (terrestrial plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (small mammals, dry weight basis)
PDFi =	1.000	= Proportion of diet composed of food item (small mammals)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of soil
BW =	1.134	= Body weight (kg)

ATTACHMENT TABLE E-1-15
Summary of Common Ground Dove Exposure Doses - Baseline (Step 3A) - 95% UCL
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	0.66	1.000	6.60E-01	Regression	2.67E-02	1.25E-02	NA	NA	NA	NA	NA	NA
Selenium	0.83	Regression	8.09E-01	Regression	4.13E-01	9.30E-02	0.29	0.41	0.58	3.21E-01	2.27E-01	1.61E-01
Vanadium	11.08	0.039	4.32E-01	0.005	5.31E-02	1.29E-01	0.344	0.486	0.688	3.76E-01	2.66E-01	1.88E-01
Semivolatile Organics												
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	6.37E-04	NA	NA	NA	NA	NA	NA

Orange shaded cell - Concentration based on detection limits; chemical not detected. Hexachloroethane value represents maximum concentration; 95% UCL was greater than the maximum.

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0069	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.950	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.050	= Proportion of diet composed of soil
BW =	0.0320	= Body weight (kg)

ATTACHMENT TABLE E-1-16
Summary of Cave Swallow Exposure Doses - Baseline (Step 3A) - 95% UCL
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	95% UCL Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	0.66	1.000	6.60E-01	Regression	2.67E-02	1.58E-01	NA	NA	NA	NA	NA	NA
Selenium	0.83	Regression	8.09E-01	Regression	4.13E-01	1.94E-01	0.44	0.81	1.50	4.40E-01	2.38E-01	1.29E-01
Vanadium	11.08	0.039	4.32E-01	0.005	5.31E-02	1.03E-01	0.344	0.486	0.688	3.00E-01	2.12E-01	1.50E-01
Semivolatile Organics												
Hexachloroethane	0.0021	1.000	2.10E-03	1.439	3.02E-03	5.02E-04	NA	NA	NA	NA	NA	NA

Orange shaded cell - Concentration based on detection limits; chemical not detected. Hexachloroethane value represents maximum concentration; 95% UCL was greater than the maximum.

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0038	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	1.000	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of soil
BW =	0.0158	= Body weight (kg)

ATTACHMENT TABLE E-1-17
Summary of Norway Rat Exposure Doses - Baseline (Step 3A) - Arithmetic Mean
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	Mean Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	0.4	1.000	4.00E-01	Regression	1.67E-02	2.11E-02	0.059	0.19	0.59	3.57E-01	1.13E-01	3.57E-02
Selenium	0.44	Regression	5.08E-01	Regression	2.05E-01	3.56E-02	0.20	0.26	0.33	1.78E-01	1.38E-01	1.08E-01
Vanadium	5.55	0.039	2.16E-01	0.005	2.66E-02	2.28E-02	4.16	5.88	8.31	5.49E-03	3.88E-03	2.75E-03
Semivolatile Organics												
Hexachloroethane	0.002	1.000	2.00E-03	1.439	2.88E-03	2.41E-04	100	224	500	2.41E-06	1.08E-06	4.83E-07

Orange shaded cell - Concentration based on detection limits; chemical not detected

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0207 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.490 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.490 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.020 = Proportion of diet composed of soil
BW = 0.209 = Body weight (kg)

ATTACHMENT TABLE E-1-18

Summary of Indian Mongoose Exposure Doses - Baseline (Step 3A) - Arithmetic Mean

Former Naval Ammunition Support Detachment

Vieques, Puerto Rico

Chemical	Mean Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Soil-Mammal BAF	Small Mammal Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals														
Antimony	0.4	1.000	4.00E-01	Regression	1.67E-02	See footnote	2.12E-01	1.63E-02	0.059	0.19	0.59	2.76E-01	8.74E-02	2.76E-02
Selenium	0.44	Regression	5.08E-01	Regression	2.05E-01	Regression	4.84E-01	2.52E-02	0.20	0.26	0.33	1.26E-01	9.79E-02	7.63E-02
Vanadium	5.55	0.039	2.16E-01	0.005	2.66E-02	0.010	5.76E-02	1.61E-02	4.16	5.88	8.31	3.87E-03	2.73E-03	1.93E-03
Semivolatile Organics														
Hexachloroethane	0.002	1.000	2.00E-03	1.439	2.88E-03	See footnote	2.43E-03	1.20E-04	100	224	500	1.20E-06	5.38E-07	2.41E-07

Orange shaded cell - Concentration based on detection limits; chemical not detected

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF of 1.0 was assumed

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0285	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.564	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.111	= Proportion of diet composed of food item (terrestrial plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (small mammals, dry weight basis)
PDFi =	0.297	= Proportion of diet composed of food item (small mammals)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.028	= Proportion of diet composed of soil
BW =	0.528	= Body weight (kg)

ATTACHMENT TABLE E-1-19
Summary of Fruit Bat Exposure Doses - Baseline (Step 3A) - Arithmetic Mean
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	Mean Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	0.4	1.000	4.00E-01	Regression	1.67E-02	1.80E-03	0.059	0.19	0.59	3.05E-02	9.64E-03	3.05E-03
Selenium	0.44	Regression	5.08E-01	Regression	2.05E-01	2.21E-02	0.20	0.26	0.33	1.10E-01	8.60E-02	6.70E-02
Vanadium	5.55	0.039	2.16E-01	0.005	2.66E-02	2.87E-03	4.16	5.88	8.31	6.89E-04	4.88E-04	3.45E-04
Semivolatile Organics												
Hexachloroethane	0.002	1.000	2.00E-03	1.439	2.88E-03	3.10E-04	100	224	500	3.10E-06	1.39E-06	6.20E-07

Orange shaded cell - Concentration based on detection limits; chemical not detected

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0044 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 1.000 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.000 = Proportion of diet composed of soil
BW = 0.0408 = Body weight (kg)

ATTACHMENT TABLE E-1-20
Summary of Velvet Free-Tailed Bat Exposure Doses - Baseline (Step 3A) - Arithmetic Mean
Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Chemical	Mean Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	0.4	1.000	4.00E-01	Regression	1.67E-02	6.82E-02	0.059	0.19	0.59	**1.16E+00**	3.66E-01	1.16E-01
Selenium	0.44	Regression	5.08E-01	Regression	2.05E-01	8.67E-02	0.20	0.26	0.33	4.33E-01	3.37E-01	2.63E-01
Vanadium	5.55	0.039	2.16E-01	0.005	2.66E-02	3.69E-02	4.16	5.88	8.31	8.87E-03	6.28E-03	4.44E-03
Semivolatile Organics												
Hexachloroethane	0.002	1.000	2.00E-03	1.439	2.88E-03	3.41E-04	100	224	500	3.41E-06	1.53E-06	6.82E-07

Orange shaded cell - Concentration based on detection limits; chemical not detected

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0017	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	1.000	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of soil
BW =	0.0101	= Body weight (kg)

ATTACHMENT TABLE E-1-21

Summary of Pearly-eyed Thrasher Exposure Doses - Baseline (Step 3A) - Arithmetic Mean

Former Naval Ammunition Support Detachment

Vieques, Puerto Rico

Chemical	Mean Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	0.4	1.000	4.00E-01	Regression	1.67E-02	3.83E-02	NA	NA	NA	NA	NA	NA
Selenium	0.44	Regression	5.08E-01	Regression	2.05E-01	5.27E-02	0.44	0.81	1.50	1.20E-01	6.48E-02	3.51E-02
Vanadium	5.55	0.039	2.16E-01	0.005	2.66E-02	5.02E-02	0.344	0.486	0.688	1.46E-01	1.03E-01	7.30E-02
Semivolatile Organics												
Hexachloroethane	0.002	1.000	2.00E-03	1.439	2.88E-03	2.58E-04	NA	NA	NA	NA	NA	NA

Orange shaded cell - Concentration based on detection limits; chemical not detected

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0123	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.754	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.200	= Proportion of diet composed of food item (terrestrial plants)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.046	= Proportion of diet composed of soil
BW =	0.104	= Body weight (kg)

ATTACHMENT TABLE E-1-22

Summary of Red-tailed Hawk Exposure Doses - Baseline (Step 3A) - Arithmetic Mean

Former Naval Ammunition Support Detachment

Vieques, Puerto Rico

Chemical	Mean Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Soil-Mammal BAF	Small Mammal Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals														
Antimony	0.4	1.000	4.00E-01	Regression	1.67E-02	See footnote	2.12E-01	6.79E-03	NA	NA	NA	NA	NA	NA
Selenium	0.44	Regression	5.08E-01	Regression	2.05E-01	Regression	4.84E-01	1.55E-02	0.44	0.81	1.50	3.52E-02	1.91E-02	1.03E-02
Vanadium	5.55	0.039	2.16E-01	0.005	2.66E-02	0.010	5.76E-02	1.84E-03	0.344	0.486	0.688	5.35E-03	3.79E-03	2.68E-03
Semivolatile Organics														
Hexachloroethane	0.002	1.000	2.00E-03	1.439	2.88E-03	See footnote	2.43E-03	7.78E-05	NA	NA	NA	NA	NA	NA

Orange shaded cell - Concentration based on detection limits; chemical not detected

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF of 1.0 was assumed

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.0363	= Food ingestion rate (kg/day dry weight)
FCxi =	Chemical-specific	= Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (soil invertebrates)
FCxi =	Chemical-specific	= Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi =	0.000	= Proportion of diet composed of food item (terrestrial plants)
FCxi =	Chemical-specific	= Concentration of chemical in food item (small mammals, dry weight basis)
PDFi =	1.000	= Proportion of diet composed of food item (small mammals)
SCx =	Chemical-specific	= Concentration of chemical in soil (mg/kg, dry weight)
PDS =	0.000	= Proportion of diet composed of soil
BW =	1.134	= Body weight (kg)

ATTACHMENT TABLE E-1-23

Summary of Common Ground Dove Exposure Doses - Baseline (Step 3A) - Arithmetic Mean

Former Naval Ammunition Support Detachment

Vieques, Puerto Rico

Chemical	Mean Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	0.4	1.000	4.00E-01	Regression	1.67E-02	7.68E-03	NA	NA	NA	NA	NA	NA
Selenium	0.44	Regression	5.08E-01	Regression	2.05E-01	4.64E-02	0.29	0.41	0.58	1.60E-01	1.13E-01	8.02E-02
Vanadium	5.55	0.039	2.16E-01	0.005	2.66E-02	6.48E-02	0.344	0.486	0.688	1.88E-01	1.33E-01	9.42E-02
Semivolatile Organics												
Hexachloroethane	0.002	1.000	2.00E-03	1.439	2.88E-03	6.07E-04	NA	NA	NA	NA	NA	NA

Orange shaded cell - Concentration based on detection limits; chemical not detected

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0069 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.950 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.050 = Proportion of diet composed of soil
BW = 0.0320 = Body weight (kg)

ATTACHMENT TABLE E-1-24

Summary of Cave Swallow Exposure Doses - Baseline (Step 3A) - Arithmetic Mean

Former Naval Ammunition Support Detachment

Vieques, Puerto Rico

Chemical	Mean Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals												
Antimony	0.4	1.000	4.00E-01	Regression	1.67E-02	9.57E-02	NA	NA	NA	NA	NA	NA
Selenium	0.44	Regression	5.08E-01	Regression	2.05E-01	1.22E-01	0.44	0.81	1.50	2.76E-01	1.50E-01	8.11E-02
Vanadium	5.55	0.039	2.16E-01	0.005	2.66E-02	5.18E-02	0.344	0.486	0.688	1.51E-01	1.06E-01	7.53E-02
Semivolatile Organics												
Hexachloroethane	0.002	1.000	2.00E-03	1.439	2.88E-03	4.78E-04	NA	NA	NA	NA	NA	NA

Orange shaded cell - Concentration based on detection limits; chemical not detected

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0038 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 1.000 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.000 = Proportion of diet composed of soil
BW = 0.0158 = Body weight (kg)

Appendix F
Technology Screening

APPENDIX F

Technology Screening Summary for UXO 18

1.1 Description of Remedial Technologies and General Response Actions

The technology types and process options available for remediation of various media were screened. The purpose of this step is to identify the technologies that may be applicable for remediation of the media of concern at UXO 18.

Based on the site-specific conditions presented in the RI sections, the remedial technologies were evaluated using a screening process for applicability to UXO 18. This appendix provides a general overview and evaluation of the remediation technologies for perchlorate as identified by ITRC guidance. In addition, other remedial technologies (removal) and general response actions (including no action, institutional controls, and containment) that may be appropriate for the potential MEC are evaluated. In order to meet the RAOs, a combination of several technologies and/or response actions may be necessary.

1.1.1 No Action

No Action means that nothing is done to the site. It is typically retained as a remedial alternative to provide a baseline option to which other alternatives can be compared. No Action does not control, contain, or remediate potential MEC hazards or exposure.

1.1.2 Land Use Controls (LUCs)

Land use controls and institutional controls (ICs) are used to establish site access restrictions, limitation or prevention of exposure. ICs potentially applicable at the site include administrative restrictions such as LUC and deed notations for land use restrictions, intrusive activities, as well as access restrictions (security fences/signs). ICs alone do not control, contain, or remediate potential contaminant sources or reduce the mobility, volume, or toxicity of the contamination; rather, they reduce the potential for contact through control of exposure pathways. The Navy uses a Web-based management tool, LUC Tracker, as part of the Naval Installation Restoration Information System (NIRIS). Several ICs could be implemented at the site at a reasonable cost. However, ICs alone will not meet all of the RAOs for the site. ICs are retained for consideration as a component to be combined with other possible actions.

1.1.3 Long-term Monitoring (LTM)

MEC LTM would include periodic site inspections for trespassing, fencing/signage conditions, and occurrence of MEC in areas accessible to the public. The practices used on Vieques to-date for MEC-specific site inspections are well suited for a LTM program, as the extrapolation of data from the inspection is used to conservatively evaluate the potential presence of MEC at the site.

1.1.4 Engineered Cap

Engineered Cap is a containment technology involving placement of asphalt, concrete, geomembrane, or clay cap. An engineered cap, effective in limiting the potential for direct contact with MEC and erosion of the ground surface, could minimize the MEC hazard on land. However, placement of an engineered cap would require MEC clearance and, thus, full vegetation clearance. Further, installation of the cap at UXO 18 could have significant negative impacts on the cultural resources located on the island. Because this technology is typically used in conjunction with urban development or construction purposes, it may be applicable for future land development of the island, if hard surfaces such as concrete/asphalt sidewalks, drives, and parking lots are desired; however, given the current and projected use of the island these types of surfaces are planned and would be exceedingly difficult to install and maintain. Based on this information, this technology is not retained for further evaluation.

1.1.5 Native-soil Cover

Native-soil Cover involves placement of a soil cover, which is effective in limiting the potential for direct contact with potential MEC and exposure of subsurface MEC through erosion. While the cost associated with this technology would be less than that of an engineered cap, the limitations on being able to install the cap are similar. Therefore, this technology is not retained for further evaluation.

1.1.6 Removal

Removal can include both surface and subsurface clearance of MEC. MEC clearance is a proven technology successfully used at the former VNTR and NASD to effectively minimize human exposure to potential MEC. Standard procedures of MEC removal have been utilized at multiple sites in Vieques; therefore, this technology is retained for further evaluation.

1.2 Summary of Technology Screening

Certain technologies are not appropriate for implementation at UXO 18 because of impracticality, site conditions, cost (relative to benefit or anticipated performance), and or access, and were excluded from further consideration. Based on the screening of potential technologies, the following technologies and response actions are retained for incorporation into remedial alternatives at UXO 18:

- No Action
- Land Use Controls
- Long-term Monitoring
- Removal

The above technologies and response actions have been grouped in order to present a range of alternatives that can be compared against NCP criteria and compliance with site-specific RAOs.

Appendix G
Sustainability Analysis for UXO 18

APPENDIX G

Sustainability Analysis for UXO 18

1.1 Introduction

This appendix presents the approach taken and results obtained from a sustainability analysis performed for Site UXO 18, Former Vieques Naval Training Range, Vieques, Puerto Rico. A site description and history of UXO 18 is provided in Section 1 of the Remedial Investigation/Feasibility Study (RI/FS).

Remedial alternatives were developed to reduce the explosive hazard associated with MEC to be compatible with current and future land use and reduce the potential for unauthorized access to the site. A detailed summary of the remedial alternatives is provided in Section 10 of the RI/FS. A sustainability analysis was performed using SiteWise™ Version 3.0 (Battelle, 2013) for the following remedial alternatives:

- Alternative 1 - No Action
- Alternative 2 – Land Use Controls (LUCs) and Munitions and Explosives of Concern (MEC) Inspections
- Alternative 3 – Limited MEC Removal, LUCs, and MEC Inspections
- Alternative 4 – MEC Removal, LUCs, and MEC Inspections

1.2 Method and Assumptions

The SiteWise™ tool consists of a series of Excel-based spreadsheets used to conduct a baseline assessment of sustainability metrics. The assessment is carried out using a spreadsheet-based building block approach, where every remedial alternative is first broken down into modules that mirror the phases of remedial action work, such as: remedial investigation (RI), remedial action construction (RAC), remedial action operation (RAO), and long-term monitoring (LTM). For this analysis only the RAC and LTM phases were applicable.

SiteWise™ uses various emission factors from governmental or non-governmental research sources to determine the environmental impact of each activity. The quantitative metrics calculated by the tool include:

1) Greenhouse gases (GHGs) reported as carbon dioxide equivalents (CO_2e), consisting of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O)
2) Energy usage (expressed as British Thermal Units [BTU])
3) Water usage (gallons of water)
4) Air emissions of criteria pollutants consisting of nitrogen (NO_x), sulfur oxides (SO_x), and particulate matter (PM_{10})
5) Accident risk (risk of injury and risk of fatality)

For the purpose of this discussion the term footprint will be used to describe the quantified emissions or quantities for each metric. To estimate the sustainability footprint for each remedial alternative, only those elements possessing important sustainability elements were included in the assessment. The first four metrics are collectively referred to as the environmental footprint. The footprints of each remedial phase are combined into overall footprints for each remedial action.

A lower footprint indicates lower deleterious impacts to environmental and social metrics, which collectively make up the SiteWise™ sustainability metrics. Conversely, a higher footprint indicates higher deleterious impacts associated with the SiteWise™ metrics. The major conclusions of this sustainability analysis are incorporated into the short-term effectiveness criteria evaluation of the RI/FS.

1.2.1 General Assumptions

The specific assumptions made for the individual remedies are presented in **Tables G-1** through **G-4**. The following overall assumptions are used for the SiteWise™ tool evaluation:

- The complete environmental footprint for production of equipment used, or production of the vehicles used for transportation, is not considered in this analysis.
- All personnel are assumed to be already onsite and mobilization was not included.
- Support boats are assumed to consist of two 250 horse power engines.

1.3 Results and Conclusions

The overall quantitative footprints for each alternative are provided along with the relative impact of each alternative in each footprint (**Table G-5**). The relative impact is a qualitative assessment of the relative footprint of each alternative, a rating of high, medium, or low is assigned to each alternative based on its performance against the other alternatives. The tool assigns a ranking of high to the highest footprint in each category and assigns the rankings of other alternatives based on the difference in the data between alternatives. The ranking is based on a 30 percent difference, if the footprints of two alternatives are within 30 percent of each other they will be given the same rating and there is essentially no difference between the alternatives. This allows for some uncertainty inherent in the assumptions used in the model.

It should be noted that while this analysis compares the environmental footprints of each of the alternatives, the alternatives provide different end-uses. Therefore, a comparison of the results of the alternatives needs to be made in the context of the benefits (e.g., ARAR compliance, contaminant reduction, cost effectiveness, and etc.) of each of the alternatives.

A comparative analysis for the Alternatives is summarized in **Figure G-1**. **Table G-5** presents a comparison of the quantitative environmental footprint metrics evaluated for each of the remedial alternatives. Because Alternative 4 incorporates all of the components of Alternative 2 and Alternative 3 in addition to full MEC removal, this Alternative has the larger footprint in all categories. Overall, Alternative 4 was given a “High” relative rank for all categories except accident risk fatality and injury. Alternative 3 was given a “Medium” relative rank for all categories except accident risk fatality and injury. All footprint categories for Alternative 2 and Alternative 1 were given a rank of “low” because they were less than 30 percent of the maximum footprints. As previously discussed, a smaller footprint is more desirable. The footprints for each alternative are discussed below.

- Alternative 1— No Action
  This alternative only includes onsite activities during five-year reviews, included in the LTM phase. Onsite labor hours contribute primarily to accident risk footprints and daily travel to and from the site accounts for the PM_{10}, NO_x, and SO_x footprints. Results are provided in **Table G-6**.
- Alternative 2 –Maintain Existing LUCs
  This alternative only includes activities during the LTM phase. Boat use accounts for the majority of the GHG, total energy, water use, PM_{10}, NO_x, and SO_x footprints. Transportation of personnel also contributes to the PM10, NO_x, and SO_x footprints. Onsite labor hours and transportation of personnel contribute to the accident risk fatality and injury footprints. Results are provided in **Table G-7**.
- Alternative 3 – Limited MEC Removal, LUCs, and MEC Inspections
  This alternative includes both the RAC and LTM phases. The LTM phase has the potential to contribute seven to ten times greater impacts in all categories than the RAC phase. In both phases, boat use accounts for the majority of the GHG, total energy, water use, PM_{10}, NO_x, and SO_x footprints. Onsite labor hours encompass the majority of the accident risk injury and fatality footprints. Transportation of personnel and residual handling also contribute to the GHG, total energy, PM_{10}, NO_x, SO_x and accident risk footprints. Results are provided in **Table G-8**.
- Alternative 4 – MEC Removal, LUCs, and MEC Inspections
  This alternative includes both the RAC and LTM phases. The RAC and LTM phases each contribute approximately 50 percen of the overall footprint. In both phases, boat use accounts for the majority of the GHG, total energy, water use, PM_{10}, NO_x, and SO_x footprints. Onsite labor hours encompass the majority of the

accident risk injury and fatality footprints. Transportation of personnel and residual handling also contribute to the GHG, total energy, PM_{10}, NO_x, SO_x and accident risk footprints. Results are provided in **Table G-9**.

1.4 Uncertainty Assessment

SiteWise™ uses industry averages to estimate potential footprint and does not reflect actual emissions or risks.

An electricity mix for Puerto Rico was unavailable; an electricity mix for Florida was used to estimate the impacts from electricity use.

1.5 Recommendations

The estimates from the SiteWise™ tool were used to estimate the environmental footprint of the alternatives. Once the alternative is selected, it is recommended that the footprint of the selected alternative be further evaluated in the design phase of the projects to explore opportunities to optimize the environmental footprint of the project and integrate sustainable remediation best practices in the design, construction, and operation of the alternative.

In this evaluation, the use of already onsite personnel, contributed to significantly smaller impacts in all categories for all alternatives. Additionally, reducing boat use, if feasible, would reduce impacts in all categories for all alternatives.

1.6 References

Battelle. 2013. *SiteWise™*. NAVFAC Engineering Service Center, UG-2092-ENV. October.

Tables

TABLE G-1

Alternative 1 - No Action

UXO 18 RI/FS

Former Atlantic Fleet Weapons Training Area

Vieques, Puerto Rico

Phase	Assumptions
Remedial Action Construction	No Actions
Longterm Monitoring	**Five-year Review**
Transportation	LTM = 30 years, site visit every 5 years, 2 days/site visit, 5 miles/day, 1 truck, 2 people/truck = **60 miles of light truck, diesel engine**
Labor Hours Onsite	LTM = 30 years, site visit every 5 years, 2 days/site visit, 10 hours/day, 2 people = **240 hours onsite labor**

Notes:

LTM : Long-Term Monitoring

TABLE G-2

Alternative 2 - LUCs and MEC Inspections

UXO 18 RI/FS

Former Atlantic Fleet Weapons Training Area

Vieques, Puerto Rico

Sitewise Tab	Assumptions
Remedial Action Construction	No Actions
Longterm Monitoring	**Annual Inspections, LTM, Five-year Review**
Transportation	Inspection of Signs at Blue Beach Access Points and Cayo la Chiva = 30 years, 1 day/year, 5 miles per day/truck, 1 truck, 2 people/truck = **150 miles of light truck, diesel engine**
	LTM/Demo = 10 events, 2 days/event, 5 miles per day/truck, 3 trucks, 2 people/truck = **300 miles of light truck, diesel engine**
	LTM = 30 years, 2 days/year, 5 miles per day/truck, 1 truck, 2 people/truck = **300 miles of light truck, diesel engine**
Equipment Use	Boat Support for Inspection of Signs at Blue Beach Access Points and Cayo la Chiva = 30 years, 1 event/year, 2 hours/event, 1 boat = **60 hours of two 250 hp engines**
	Boat Support for Demo/LTM = 10 events, 2 days/event, 5 hours/day, 2 boats = **200 hours of 2 250 hp engines**
	Boat Support for LTM = 30 years, 2 days/year, 5 hours/day, 1 boat = **300 hours of 2 250 hp engines**
Labor Hours Onsite	Inspection of Signs at Blue Beach Access Points and Cayo la Chiva = 30 years, 1 event/year, 1 day/event, 4 hours/day, 2 people = **240 hours onsite labor**
	Demo/LTM = 10 events, 2 days/event, 10 hours/day, 6 people = **1200 hours onsite labor**
	LTM = 30 years, 1 event/year, 2 days/event, 10 hours/day, 2 people = **1200 hours onsite labor**

Notes:

LTM: Long-Term Monitoring

hp = horsepower

demo = demolition

TABLE G-3

Alternative 3 - Limited MEC Removal, LUCs, and MEC Inspections

UXO 18 RI/FS

Former Atlantic Fleet Weapons Training Area

Vieques, Puerto Rico

Sitewise Tab	Assumptions
Remedial Action Construction	**MEC Removal, LUC/IC Implementation**
Transportation	MEC Clearance = 10 days, 5 miles per day/truck, 3 trucks, 2 people/truck) = **150 miles of light truck, diesel engine**
	Archeological Survey = 4 days, 5 miles per day/truck, 1 truck, 1 person/truck = **20 miles of light truck, diesel engine**
Equipment Use	Boat support for MEC Clearance = 10 days, 5 hours/day, 2 boats = **100 hours of 2 250 hp engines**
	Boat support for Archeological Survey = 4 days, 5 hours/day, 1 boat = **20 hours of 2 250 hp engines**
Labor Hours Onsite	MEC Clearance = 10 days, 10 hours/day, 6 people = **600 hours onsite labor**
	Archeological Survey = 4 days, 10 hours/day, 1 person = **40 hours onsite labor**
Residual handling	Scrap (MD and other) - 4 ton, 4 tons/trip, 1 trips, transported 15 miles one way
Longterm Monitoring	**Annual Inspections, Five-year Review**
Transportation	Inspection of Signs at Blue Beach Access Points and Cayo la Chiva = 30 years, 1 day/year, 5 miles per day/truck, 1 truck, 2 people/truck = **150 miles of light truck, diesel engine**
	LTM/Demo = 15 events, 2 days/event, 5 miles per day/truck, 3 trucks, 2 people/truck = **450 miles of light truck, diesel engine**
	LTM = 30 years, 2 days/year, 5 miles per day/truck, 1 truck, 2 people/truck = **300 miles of light truck, diesel engine**
Equipment Use	Inspection of Signs at Blue Beach Access Points and Cayo la Chiva = 30 years, 1 event/year, 2 hours/event, 1 boat = **60 hours of two 250 hp engines**
	Boat Support for LTM/Demo = 15 events, 4 days/event, 5 hours/day, 2 boats = **600 hours of 2 250 hp engines**
	Boat Support for LTM = 30 years, 4 days/year, 5 hours/day, 1 boat = **600 hours of 2 250 hp engines**
Labor Hours Onsite	Inspection of Signs at Blue Beach Access Points and Cayo la Chiva = 30 years, 1 event/year, 1 day/event, 4 hours/day, 2 people = **240 hours onsite labor**
	LTM/Demo = 15 events, 2 days/event, 10 hours/day, 6 people = **1800 hours onsite labor**
	LTM = 30 years, 1 event/year, 4 days/event, 10 hours/day, 2 people = **2400 hours onsite labor**

Notes:

LTM: Long-Term Monitoring

hp = horsepower

demo = demolition

MD = munitions debris

TABLE G-4

Alternative 3 - MEC Removal, LUCs, and MEC Inspections

UXO 18 RI/FS

Former Atlantic Fleet Weapons Training Area

Vieques, Puerto Rico

Sitewise Tab	Assumptions
Remedial Action Construction	**MEC Removal, LUC/IC Implementation**
Transportation	MEC Clearance = 56 days, 5 miles per day/truck, 3 trucks, 2 people/truck) = **840 miles of light truck, diesel engine**
	Archeological Survey = 5 days, 5 miles per day/truck, 1 truck, 3 people/truck = **25 miles of light truck, diesel engine**
	Site Restoration = 5 years, 5 days/year, 5 miles per day/truck, 3 trucks, 2 people in 2 trucks, 1 person in 1 truck = **375 miles of light truck, diesel engine**
Equipment Use	Boat support for MEC Clearance = 120 days, 5 hours/day, 2 boats = **1200 hours of 2 250 hp engines**
	Boat support for Archeological Survey = 5 days, 5 hours/day, 1 boat = **25 hours of 2 250 hp engines**
	Boat Support for Site Restoration = 5 years, 5 days/year, 5 hours/day, 1 boat = **125 hours of 2 250 hp engines**
Labor Hours Onsite	MEC Clearance = 56 days, 10 hours/day, 6 people = **3360 hours onsite labor**
	Archeological Survey = 5 days, 10 hours/day, 3 people = **150 hours onsite labor**
	Site Restoration = 5 years, 5 days/year, 10 hours/day, 5 people = **1250 hours onsite labor**
Residual handling	Scrap (MD and other) - 24 ton, 12 tons/trip, 2 trips, transported 15 miles one way
Longterm Monitoring	**Annual Inspections, Five-year Review**
Transportation	Inspection of Signs at Blue Beach Access Points and Cayo la Chiva = 30 years, 1 day/year, 5 miles per day/truck, 1 truck, 2 people/truck = **150 miles of light truck, diesel engine**
	LTM/Demo = 15 events, 2 days/event, 5 miles per day/truck, 3 trucks, 2 people/truck = **450 miles of light truck, diesel engine**
	LTM = 30 years, 2 days/year, 5 miles per day/truck, 1 truck, 2 people/truck = **300 miles of light truck, diesel engine**
Equipment Use	Inspection of Signs at Blue Beach Access Points and Cayo la Chiva = 30 years, 1 event/year, 2 hours/event, 1 boat = **60 hours of two 250 hp engines**
	Boat Support for LTM/Demo = 15 events, 4 days/event, 5 hours/day, 2 boats = **600 hours of 2 250 hp engines**
	Boat Support for LTM = 30 years, 4 days/year, 5 hours/day, 1 boat = **600 hours of 2 250 hp engines**
Labor Hours Onsite	Inspection of Signs at Blue Beach Access Points and Cayo la Chiva = 30 years, 1 event/year, 1 day/event, 4 hours/day, 2 people = **240 hours onsite labor**
	LTM/Demo = 15 events, 2 days/event, 10 hours/day, 6 people = **1800 hours onsite labor**
	LTM = 30 years, 1 event/year, 4 days/event, 10 hours/day, 2 people = **2400 hours onsite labor**

Notes:

LTM: Long-Term Monitoring

hp = horsepower

demo = demolition

MD = munitions debris

TABLE G-5

Relative Impact of Alternatives

UXO 18 RI/FS

Former Atlantic Fleet Weapons Training Area

Vieques, Puerto Rico

Remedial Alternatives	GHG Emissions	Total energy Used	Water Used	NO_x emissions	SO_x Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
	metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Alternative 1- No Action	0.0	0	0	1.75E-05	1.88E-07	2.06E-06	1.38E-05	5.60E-03
Alternative 2 - LUCs and MEC Inspections	135	2325	106486	1.42E-01	2.40E-01	1.18E-01	1.53E-04	6.17E-02
Alternative 3 - Limited MEC Remvoal, LUCs, and MEC Inspections	332	5725	262412	3.50E-01	5.92E-01	2.92E-01	2.89E-04	1.18E-01
Alternative 4 - MEC Remvoal, LUCs, and MEC Inspections	628	10829	496301	6.61E-01	1.12E+00	5.51E-01	5.25E-04	2.14E-01

Remedial Alternatives	GHG Emissions	Total energy Used	Water Used	NO_x emissions	SO_x Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
Alternative 1- No Action	Low	Low	Low	Low	Low	Low	Low	Low
Alternative 2 - LUCs and MEC Inspections	Low	Low	Low	Low	Low	Low	Low	Low
Alternative 3 - Limited MEC Remvoal, LUCs, and MEC Inspections	Medium	Medium	Medium	Medium	Medium	Medium	Low	Low
Alternative 4 - MEC Remvoal, LUCs, and MEC Inspections	High	High	High	High	High	High	Low	Low

The relative impact is a qualitative assessment of the relative footprint of each alternative, a rating of High for an alternative is assigned if it is at least 70 percent of the maximum footprint, a rating of Medium is assigned if it is between 30 and 70 percent of the maximum footprint, and a rating of Low is assigned if it is less than 30 percent of the maximum footprint.

Notes:

MMBTU - million British Thermal Unit

NOx - Nitrogen Oxides

SOx - Sulfur Oxides

LUCs - land use controls

PM10 - Particulate Matter

GHG - Greenhouse Gases

MEC - munitions and explosives of concern

TABLE G-6

Alternative 1 - No Action Results

UXO 18 RI/FS

Former Atlantic Fleet Weapons Training Area

Vieques, Puerto Rico

Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x Emissions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Longterm Monitoring	Consumables	0.0E+00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	3.39E-02	4.08E-01	NA	1.75E-05	1.88E-07	2.06E-06	9.36E-07	7.53E-05
	Transportation-Equipment	0.00E+00	0.00E+00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Equipment Use and Misc	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	1.28E-05	5.52E-03
	Residual Handling	0.00E+00	0.00E+00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Sub-Total	3.39E-02	4.08E-01	0	1.75E-05	1.88E-07	2.06E-06	1.38E-05	5.60E-03
Total		**3.39E-02**	**4.08E-01**	**0**	**1.75E-05**	**1.88E-07**	**2.06E-06**	**1.38E-05**	**5.60E-03**

Notes:
MMBTU - million British Thermal Unit
NOx - Nitrogen Oxides
SOx - Sulfur Oxides
PM10 - Particulate Matter
NA - Not Applicable
GHG - Greenhouse Gases

TABLE G-7

Alternative 2 - LUCs and MEC Inspections

UXO 18 RI/FS

Former Atlantic Fleet Weapons Training Area

Vieques, Puerto Rico

Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x Emissions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Longterm Monitoring	Consumables	0.00E+00	0.00E+00	NA	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	4.24E-01	5.09E+00	NA	2.18E-04	2.35E-06	2.58E-05	1.17E-05	9.42E-04
	Transportation-Equipment	0.00E+00	0.00E+00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Equipment Use and Misc	1.34E+02	2.32E+03	1.06E+05	1.42E-01	2.40E-01	1.18E-01	1.41E-04	6.07E-02
	Residual Handling	0.00E+00	0.00E+00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Sub-Total	1.35E+02	2.33E+03	1.06E+05	1.42E-01	2.40E-01	1.18E-01	1.53E-04	6.17E-02
Total		**1.35E+02**	**2.33E+03**	**1.06E+05**	**1.42E-01**	**2.40E-01**	**1.18E-01**	**1.53E-04**	**6.17E-02**

Notes:
MMBTU - million British Thermal Unit
NOx - Nitrogen Oxides
SOx - Sulfur Oxides
PM10 - Particulate Matter
NA - Not Applicable
GHG - Greenhouse Gases

TABLE G-8

Alternative 3 - Limited MEC Removal, LUCs, and MEC Inspections

UXO 18 RI/FS

Former Atlantic Fleet Weapons Training Area

Vieques, Puerto Rico

Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x Emissions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Action Construction	Consumables	0.0E+00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	9.60E-02	1.15E+00	NA	4.95E-05	5.32E-07	5.85E-06	2.50E-06	2.01E-04
	Transportation-Equipment	0.00E+00	0.00E+00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Equipment Use and Misc	2.88E+01	4.97E+02	2.28E+04	3.04E-02	5.15E-02	2.53E-02	3.42E-05	1.47E-02
	Residual Handling	4.34E-02	5.67E-01	NA	1.36E-05	2.41E-07	1.21E-06	2.34E-07	1.88E-05
	Sub-Total	2.90E+01	4.99E+02	2.28E+04	3.04E-02	5.15E-02	2.54E-02	3.70E-05	1.49E-02
Longterm Monitoring	Consumables	0.0E+00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	5.1E-01	6.1E+00	NA	2.6E-04	2.8E-06	3.1E-05	1.4E-05	1.1E-03
	Transportation-Equipment	0.0E+00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	3.0E+02	5.2E+03	2.4E+05	3.2E-01	5.4E-01	2.7E-01	2.4E-04	1.0E-01
	Residual Handling	0.0E+00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	3.03E+02	5.23E+03	2.40E+05	3.19E-01	5.40E-01	2.66E-01	2.52E-04	1.03E-01
Total		**3.32E+02**	**5.73E+03**	**2.62E+05**	**3.50E-01**	**5.92E-01**	**2.92E-01**	**2.89E-04**	**1.18E-01**

Notes:
MMBTU - million British Thermal Unit
NOx - Nitrogen Oxides
SOx - Sulfur Oxides
PM10 - Particulate Matter
NA - Not Applicable
GHG - Greenhouse Gases

TABLE G-9

Alternative 4 - MEC Removal, LUCs, and MEC Inspections

UXO 18 RI/FS

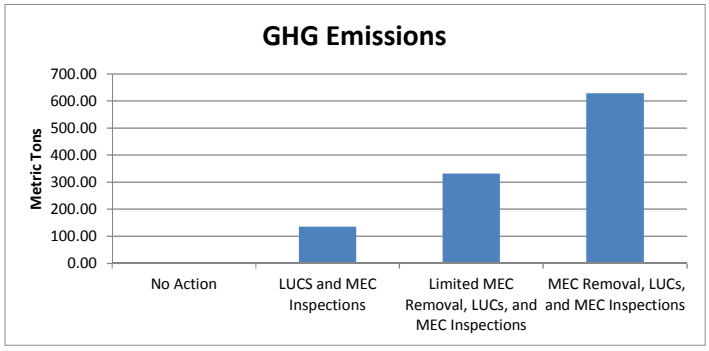
Former Atlantic Fleet Weapons Training Area

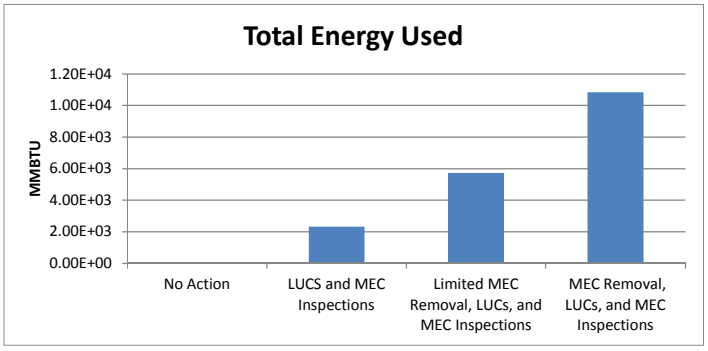
Vieques, Puerto Rico

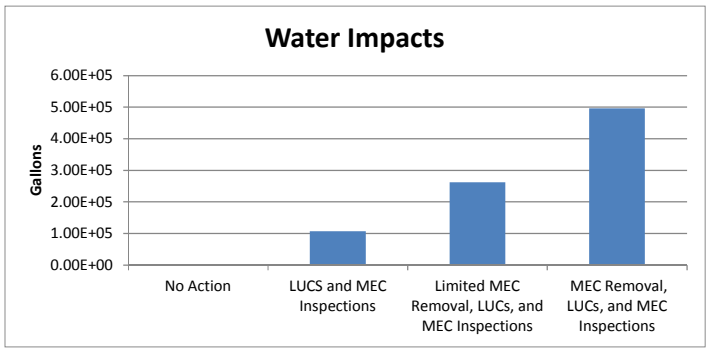
Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x Emissions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Action Construction	Consumables	0.0E+00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	7.00E-01	8.42E+00	NA	3.61E-04	3.88E-06	4.27E-05	1.86E-05	1.49E-03
	Transportation-Equipment	0.00E+00	0.00E+00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Equipment Use and Misc	3.24E+02	5.59E+03	2.57E+05	3.42E-01	5.79E-01	2.85E-01	2.55E-04	1.09E-01
	Residual Handling	9.28E-02	1.21E+00	NA	2.92E-05	5.16E-07	2.59E-06	4.68E-07	3.77E-05
	Sub-Total	3.25E+02	5.60E+03	2.57E+05	3.42E-01	5.79E-01	2.85E-01	2.74E-04	1.11E-01
Longterm Monitoring	Consumables	0.0E+00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	5.1E-01	6.1E+00	NA	2.6E-04	2.8E-06	3.1E-05	1.4E-05	1.1E-03
	Transportation-Equipment	0.0E+00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	3.0E+02	5.2E+03	2.4E+05	3.2E-01	5.4E-01	2.7E-01	2.4E-04	1.0E-01
	Residual Handling	0.0E+00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	3.03E+02	5.23E+03	2.40E+05	3.19E-01	5.40E-01	2.66E-01	2.52E-04	1.03E-01
Total		**6.28E+02**	**1.08E+04**	**4.96E+05**	**6.61E-01**	**1.12E+00**	**5.51E-01**	**5.25E-04**	**2.14E-01**

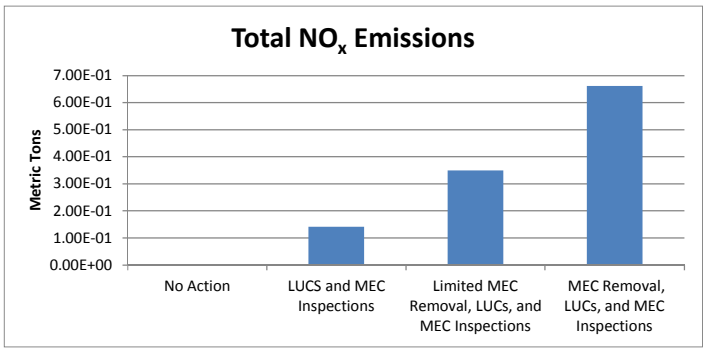
Notes:
MMBTU - million British Thermal Unit
NOx - Nitrogen Oxides
SOx - Sulfur Oxides
PM10 - Particulate Matter
NA - Not Applicable
GHG - Greenhouse Gases

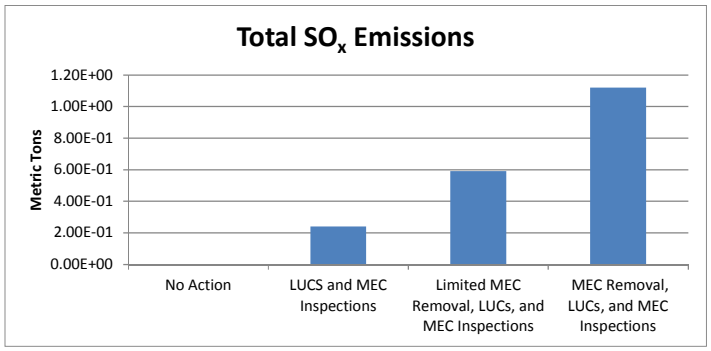
Figures

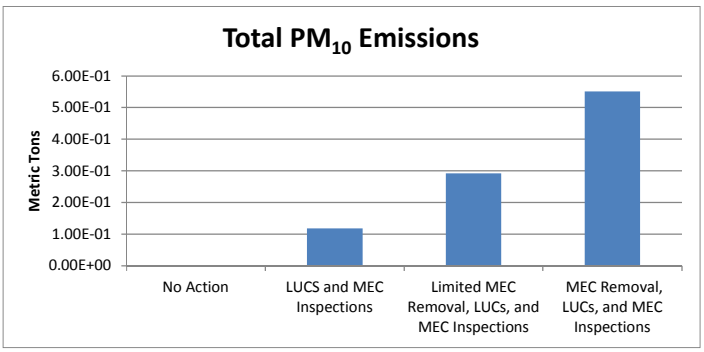


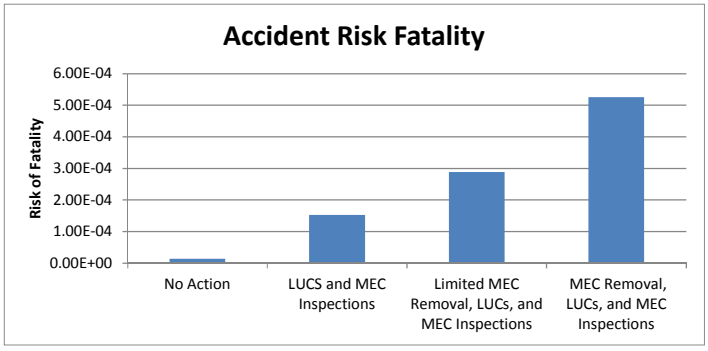












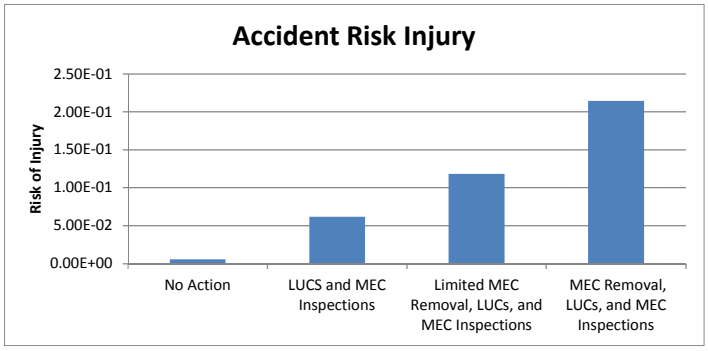


Figure G-1
Summary of Results
RI/FS
UXO 18
Former Atlantic Fleet Weapons Training Area
Vieques, Puerto Rico

Appendix H
Cost Estimates

Table H-1
Alternative 2 Costs
UXO 18 Remedial Investigation/Feasibility Study
Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Alternative 2 - Land Use Controls and MEC Inspections

Site: UXO 18, Former Atlantic Fleet Weapons Training Area - Vieques
Location: Vieques, Puerto Rico
Phase: Feasibility Study
Alternative Description:
- Maintenance of existing signs
- Implement ICs that restrict access and intrusive work and future site development;
- Implement monitoring plan to verify LUCs are sufficiently protective of residual risk at the site.

Base Year: 2014
Date: April 2014

Description	Quantity	Unit	$/Unit	Total Cost	Notes
(1) Sign Maintenance and LTM					
3.1 Net present value of sign maintenance and LTM activities	1	EA	$92,366	$1,243,014.06	See Table H-2 for the assumptions and estimates for the sign and LTM elements and Table H-3 for the net present value calculation.
Subtotal 1				$1,243,014	
CONTINGENCY	20%		$1,243,014	$249,000	EPA July 2000 guidance
SUBTOTAL - CONSTRUCTION COST				**$1,493,000**	
(2) DESIGN&CM&PM					
Project Management	5%		$1,493,000	$74,650	EPA July 2000 guidance page 5-13
Construction Management	6%		$1,493,000	$89,580	EPA July 2000 guidance page 5-13
General&Administration (G&A)	9.2%		$1,493,000	$137,356	RSMeans 5% to 15%
Pollution Liability Insurance	2%		$1,493,000	$29,860	market price
Payment & Performance Bond	1.25%		$1,493,000	$18,663	market price
Fee	8%		$1,630,356	$130,428	
Tax	7%		$1,493,000	$104,510	Puerto Rico tax
TOTAL - Design &CM&PM				**$586,000**	
TOTAL Capital Cost				**$2,079,000**	

This estimate has been developed and provided as an Order of Magnitude Estimate (ROM)/Budgetary Estimate and as such is suitable for the purpose of budget development and/or planning only. This estimate is offered as an opinion of cost to perform the work and is not an offer to contract for construction services, procure and/or provide such services.
(Cost Accuracy Range: +50% / -30%)

Table H-2

Estimated Sign Maintenance and LTM Unit Rates for Alternative 2

UXO 18 Remedial Investigation/Feasibility Study

Atlantic Fleet Weapons Training Area—Vieques

Former Vieques Naval Training Range

Vieques, Puerto Rico

Description	Quantity	Unit	$/Unit	Total Cost	Notes
1 Inspection of Signs at Blue Beach Access Points and Cayo la Chiva	1	EA	$850	$850	Costs estimated using the following assumptions: on-site personnel will inspect signs (no mobilization); inspection team consists of 2 people; working one 4-hr/event; assume use of project boat; assume $100/hr/person; miscellaneous sign repair materials/equipment/replacement signs (estimated $50); assume monitoring for 30 years; 1 event per year
2 Inspection of Accessible Area Using MEC Surface Clearance Team	1.2	Acres	$11,839	$14,207	Average cost of MEC surface clearance on USAE contract VT004; through October 2013; assume 10% (1.2 ac) of island inspected during LTM activities; assume 1 LTM event/year for 30 years ; assume 1 major storm every 2 years requiring inspection (15 total)
3 Boat Support for LTM	3	Day	$1,300	$3,900	Assume surface MEC inspection will take 2 days/event; assume inspection team covers 0.5 acre/day; assume 1.2 acres of island inspected during LTM activities
4 LTM Demolition/Explosive Venting	1	Event	$13,760	$13,760	Assume 1 demo event every other year of monitoring; Cost estimate is based on average demolition costs for USAE on VT004 through October 2013 plus adding 2 boats for demo support ($1,300/day each; one for demo team transport, one for patrolling/stopping access to bay by other boats)
5 LTM Report following Monitoring Event	1	Ea	$20,000	$20,000	Assume one report/year for 30 years; assume 1 LTM event/year for 30 years; cost estimated; assume no report prepared following storm-related monitoring

Table H-3

Estimated Sign Maintenance and LTM Net Present Value for Alternative 2

UXO 18 Remedial Investigation/Feasibility Study
Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Assumed discount rate ** 1.9%

Year	Assumed Activities Performed in Year	Estimated Cost (2014 Dollars) *	NPV Multiplier	NPV Cost
1	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.981	$38,230.42
2	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.963	$68,207.11
3	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.945	$36,818.04
4	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.927	$65,687.28
5	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.910	$35,457.85
6	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.893	$63,260.54
7	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.877	$34,147.90
8	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.860	$60,923.46
9	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.844	$32,886.35
10	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.828	$58,672.71
11	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.813	$31,671.40
12	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.798	$56,505.12
13	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.783	$30,501.34
14	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.768	$54,417.60
15	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.754	$29,374.50
16	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.740	$52,407.21
17	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.726	$28,289.30
18	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.713	$50,471.09
19	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.699	$27,244.18
20	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.686	$48,606.50
21	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.674	$26,237.68
22	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.661	$46,810.79
23	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.649	$25,268.36
24	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.637	$45,081.42
25	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.625	$24,334.85
26	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.613	$43,415.94
27	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.602	$23,435.83
28	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.590	$41,811.99
29	Sign maintenance, LTM of 10% of island, LTM Report	$38,957	0.579	$22,570.02
30	Sign maintenance, LTM of 10% of island, Demolition event, LTM Report, Post-major storm inspection	$70,824	0.569	$40,267.30
	Estimated total cost in 2014 dollars (non-discounted cost)	**$1,646,706**		
	Estimated total NPV cost (discounted cost)	**$1,243,014**		

* Unit rates for elements provided in Table H-4

** The discount rate used is based on the current Real Interest Rates on Treasury Notes and Bonds published in Circular A-94 Appendix C in accordance with the EPA guidance for cost estimating during the feasibility study (http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c)

NPV Net present value

Table H-4
Alternative 3 Costs
UXO 18 Remedial Investigation/Feasibility Study
Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Alternative 3 - Limited MEC Removal, Land Use Controls, and MEC Inspections

Site: UXO 18, Former Atlantic Fleet Weapons Training Area - Vieques
Base Year: 2014
Location: Vieques, Puerto Rico
Date: April 2014
Phase: Feasibility Study
Alternative Description:
- Surface and subsurface MEC clearance up to 1 ft bgs at the beaches, planned trails, and observation tower area.
- Maintenance of existing signs.
- Implement ICs that restrict access and intrusive work and future site development.
- Implement monitoring plan to verify LUCs are sufficiently protective of residual risk at the site.

Description	Quantity	Unit	$/Unit	Total Cost	Notes
(1) Mobilization/Demobilization and Site Setup					
1.1 Work Plans	1	EA	$60,000	$60,000	Estimate
1.2 Mobilization	1	EA	$0	$0	Assume current MR contractor on-island staff will be used; no mobilization required
1.3 Demobilization	1	EA	$0	$0	Assume current MR contractor on-island staff will be used; no mobilization required as project staff will be relocated to other on-island projects
1.4 Establish Trail Layout	1	LS	$20,000	$20,000	Estimate per similar work (EE-CA, 2008) to establish grid system.
1.5 Archaeological Survey	5	days	$4,800	$24,000	Estimate per similar work conducted on CLEAN 8012 CTO 006; arch survey $3,500/day plus contracted boat support ($1,300/day).
Subtotal 1				$104,000	
(2) MEC Clearance					
2.1 Manual Vegetation Clearance	1	Acres	$15,048	$15,048	Average cost of vegetation clearance on USAE contract VT004; through October 2013; assume 1 acres cleared of vegetation. Due to nature of clearing, cost for clearing is increased 25% to account for slower, more precise MEC clearance and limited working area.
2.2 MEC Surface Clearance	2	Acres	$11,839	$23,678	Average cost of MEC surface clearance on USAE contract VT004; through October 2013; Assume 1 acres currently accessible and clear of vegetation plus additional 1 acre for trails.
2.3 MEC Subsurface Removal to 1 ft bgs (50 items/acre)	100	Anomaly	$341	$34,100	Assuming 50 anomalies per acre; Average cost of MEC subsurface anomaly removal on USAE contract VT004
2.4 Archaeologist for MEC Removal Support	4	Days	$1,250	$5,000	Assume full time oversight of MEC clearance in archaeological site area; assume archaeological site may be impacted by all trail cutting/MEC clearance (approx.. 2 acre); assume MEC clearance at a rate of 0.5 acre/day; assume 10 hr days for archaeologist at $125/hr
2.5 Boat Support for MEC Removal	8	Days	$1,300	$10,400	Assume vegetation clearance by 2 teams, vegetation clearance rate of 0.25 acre/day/team; assume surface MEC clearance by 2 teams, MEC clearance at a rate of .5 acre/day/team; assume 2 mag and dig teams, mag and dig of 25 anomalies/day/team; production rates slowed to account for losing time in transport to/from island for teams and equipment; Assume 2 boats needed (one for transportation of crew and equipment, one for maintaining exclusion zone)
2.6 RRD Scrap Management	2	ton	$929	$1,858	Assume 1 ton/acre; Estimate per similar work (2011-CTC)
2.7 MD Scrap Management	2	ton	$929	$1,858	Assume 1 ton/acre; Estimate per similar work (2011-CTC)
2.8 Erosion Control (Silt Fencing/Hay Bales)	500	LF	$35	$17,500	Cost based on vendor quote and SWMU 1 silt fence installation costs; escalated 500% to account for maintenance costs and more difficult access to perform maintenance; Assume 500 ft along northern and eastern sides of the island.
2.9 Demolition/Explosive Venting	2	Event	$13,760	$27,520	Assume 2 events total; Cost estimate is based on average demolition costs for USAE on VT004 through October 2013 plus adding 2 boats for demo support ($1,300/day each; one for demo team transport, one for patrolling/stopping access to bay by other boats)
Subtotal 2				$136,962	

Alternative 3 - Limited MEC Removal, Land Use Controls, and MEC Inspections

Site: UXO 18, Former Atlantic Fleet Weapons Training Area - Vieques
Location: Vieques, Puerto Rico
Phase: Feasibility Study

Base Year: 2014
Date: April 2014

Alternative Description:
- Surface and subsurface MEC clearance up to 1 ft bgs at the beaches, planned trails, and observation tower area.
- Maintenance of existing signs.
- Implement ICs that restrict access and intrusive work and future site development.
- Implement monitoring plan to verify LUCs are sufficiently protective of residual risk at the site.

Description	Quantity	Unit	$/Unit	Total Cost	Notes
(3) Sign Maintenance and LTM					
3.1 Net present value of sign maintenance and LTM activities	1	EA	$1,608,744	$1,608,743.65	See Table H-5 for the assumptions and estimates for the sign and LTM elements and Table H-6 for the net present value calculation.
Subtotal 3				$1,608,744	
Subtotal for Tasks 1, 2, 3				$1,849,705	
CONTINGENCY	20%		$1,849,705	$370,000	EPA July 2000 guidance
SUBTOTAL - CONSTRUCTION COST				**$2,220,000**	
(5) DESIGN&CM&PM					
Project Management	5%		$2,220,000	$111,000	EPA July 2000 guidance page 5-13
Construction Management	6%		$2,220,000	$133,200	EPA July 2000 guidance page 5-13
General&Administration (G&A)	9.2%		$2,220,000	$204,240	RSMeans 5% to 15%
Pollution Liability Insurance	2%		$2,220,000	$44,400	market price
Payment & Performance Bond	1.25%		$2,220,000	$27,750	market price
Fee	8%		$2,424,240	$193,939	
Tax	7%		$2,220,000	$155,400	Puerto Rico tax
TOTAL - Design &CM&PM				**$870,000**	
TOTAL Capital Cost				**$3,090,000**	

Note:
This estimate has been developed and provided as an Order of Magnitude Estimate (ROM)/Budgetary Estimate and as such is suitable for the purpose of budget development and/or planning only. This estimate is offered as an opinion of cost to perform the work and is not an offer to contract for construction services, procure and/or provide such services.
(Cost Accuracy Range: +50% / -30%)

Table H-5

Estimated Sign Maintenance and LTM Unit Rates for Alternative 3

UXO 18 Remedial Investigation/Feasibility Study

Atlantic Fleet Weapons Training Area—Vieques

Former Vieques Naval Training Range

Vieques, Puerto Rico

Description	Quantity	Unit	$/Unit	Total Cost	Notes
1 Inspection of Signs at Blue Beach Access Points and Cayo la Chiva	1	EA	$850	$850	Costs estimated using the following assumptions: on-site personnel will inspect signs (no mobilization); inspection team consists of 2 people; working one 4-hr/event; assume use of project boat; assume $100/hr/person; miscellaneous sign repair materials/equipment/replacement signs (estimated $50); assume monitoring for 30 years; 1 event per year
2 Inspection of Accessible Area Using MEC Surface Clearance Team	2	Acres	$11,839	$23,678	Average cost of MEC surface clearance on USAE contract VT004; through October 2013; assume inspection of all open and recreational areas (approximatley 2 acres); assume 1 LTM event/year for 30 years; assume 1 major storm every 2 years requiring inspection (15 total);assume inspection team covers 1 acre/day
3 Boat Support for LTM	4	Day	$1,300	$5,200	Assume surface MEC inspection will take 4 days/event; assume 2 acres of island inspected during LTM activities assume inspection team covers 0.5 acre/day;
4 LTM Demolition/Explosive Venting	1	Event	$13,760	$13,760	Assume 1 demo event every other year of monitoring; Cost estimate is based on average demolition costs for USAE on VT004 through October 2013 plus adding 2 boats for demo support ($1,300/day each; one for demo team transport, one for patrolling/stopping access to bay by other boats)
5 LTM Report following Monitoring Event	1	Ea	$20,000	$20,000	Assume one report/year for 30 years; assume 1 LTM event/year for 30 years; cost estimated; assume no report prepared following storm-related monitoring

Table H-6

Estimated Sign Maintenance and LTM Net Present Value for Alternative 3

UXO 18 Remedial Investigation/Feasibility Study
Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Assumed discount rate ** 1.9%

Year	Assumed Activities Performed in Year	Estimated Cost (2014 Dollars) *	NPV Multiplier	NPV Cost
1	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.981	$48,800.79
2	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.963	$88,953.65
3	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.945	$46,997.90
4	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.927	$85,667.36
5	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.910	$45,261.62
6	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.893	$82,502.49
7	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.877	$43,589.48
8	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.860	$79,454.53
9	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.844	$41,979.12
10	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.828	$76,519.18
11	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.813	$40,428.25
12	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.798	$73,692.27
13	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.783	$38,934.68
14	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.768	$70,969.80
15	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.754	$37,496.28
16	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.740	$68,347.90
17	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.726	$36,111.03
18	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.713	$65,822.87
19	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.699	$34,776.95
20	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.686	$63,391.12
21	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.674	$33,492.16
22	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.661	$61,049.22
23	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.649	$32,254.83
24	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.637	$58,793.83
25	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.625	$31,063.21
26	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.613	$56,621.76
27	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.602	$29,915.62
28	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.590	$54,529.94
29	Sign maintenance, LTM of recreational areas, LTM Report	$49,728	0.579	$28,810.42
30	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$92,366	0.569	$52,515.39
	Estimated total cost in 2014 dollars (non-discounted cost)	**$2,131,410**		
	Estimated total NPV cost (discounted cost)	**$1,608,744**		

* Unit rates for elements provided in Table H-4

** The discount rate used is based on the current Real Interest Rates on Treasury Notes and Bonds published in Circular A-94 Appendix C in accordance with the EPA guidance for cost estimating during the feasibility study (http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c)

NPV Net present value

Table H-7
Alternative 4 Costs
UXO 18 Remedial Investigation/Feasibility Study
Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Alternative 4 - MEC Removal, Land Use Controls, and MEC Inspections

Site: UXO 18, Former Atlantic Fleet Weapons Training Area - Vieques
Base Year: 2014
Location: Vieques, Puerto Rico
Date: April 2014
Phase: Feasibility Study
Alternative Description:
- Surface and subsurface MEC clearance up to 1 ft bgs
- Maintenance of existing signs
- Implement ICs that restrict access and intrusive work and future site development;
- Implement monitoring plan to verify LUCs are sufficiently protective of residual risk at the site.

Description	Quantity	Unit	$/Unit	Total Cost	Notes
(1) Mobilization/Demobilization and Site Setup					
1.1 Work Plans	1	EA	$60,000	$60,000	Estimate
1.2 Mobilization	1	EA	$0	$0	Assume current MR contractor on-island staff will be used; no mobilization required
1.3 Demobilization	1	EA	$0	$0	Assume current MR contractor on-island staff will be used; no mobilization required as project staff will be relocated to other on-island projects
1.4 Establish Grids	1	LS	$20,000	$20,000	Estimate per similar work (EE-CA, 2008)
1.5 Archaeological Survey	5	days	$4,800	$24,000	Estimate per similar work conducted on CLEAN 8012 CTO 006; arch survey $3,500/day plus contracted boat support ($1,300/day).
Subtotal 1				$104,000	
(2) MEC Clearance					
2.1 Manual Vegetation Clearance	12	Acres	$24,076	$288,912	Average cost of vegetation clearance on USAE contract VT004; cost escalated by 200% to account for difficulties in getting equipment and personnel to island; assume entire island cleared of vegetation
2.2 MEC Surface Clearance	12	Acres	$23,678	$284,136	Average cost of MEC surface clearance on USAE contract VT004; cost escalated by 200% to account for difficulties in getting equipment and personnel to island;
2.3 MEC Subsurface Removal to 1 ft bgs (50 items/acre)	600	Anomaly	$341	$204,600	Assuming 50 anomalies per acre; Average cost of MEC subsurface anomaly removal on USAE contract VT004
2.4 Archaeologist for MEC Removal Support	24	Days	$1,250	$30,000	Assume full time oversight of MEC clearance ; assume surface MEC clearance by 2 teams, MEC clearance at a rate of .5 acre/day/team; assume 2 mag and dig teams, mag and dig of 25 anomalies/day/team;; assume 10 hr days for archaeologist at $125/hr
2.5 Boat Support for MEC Removal	72	Days	$1,300	$93,600	Assume vegetation clearance by 2 teams, vegetation clearance rate of 0.5 acre/day/team; assume surface MEC clearance by 2 teams, MEC clearance at a rate of .5 acre/day/team; assume 2 mag and dig teams, mag and dig of 25 anomalies/day/team; production rates slowed to account for losing time in transport to/from island for teams and equipment; Assume 2 boats needed (one for transportation of crew and equipment, one for maintaining exclusion zone)
2.6 RRD Scrap Management	12	ton	$929	$11,148	Assume 1 ton/acre; Estimate per similar work (2011-CTC)
2.7 MD Scrap Management	12	ton	$929	$11,148	Assume 1 ton/acre; Estimate per similar work (2011-CTC)
2.8 Erosion Control (Silt Fencing/Hay Bales)	2500	LF	$35	$87,500	Cost based on vendor quote and SWMU 1 silt fence installation costs; escalated 500% to account for maintenance costs and more difficult access to perform maintenance; Assume 2,500 ft along northern and eastern sides of the island.
2.9 Demolition/Explosive Venting	2	Event	$13,760	$27,520	Assume 2 events total; Cost estimate is based on average demolition costs for USAE on VT004 through October 2013 plus adding 2 boats for demo support ($1,300/day each; one for demo team transport, one for patrolling/stopping access to bay by other boats).
2.10 Restoration of Subtropical Dry Forrest with Appropriate Species	1	LS	$373,863	$373,863	Assume 12 acres of UXO 18 will require restoration; assume will need to pay for greenhouse to be built (assume 2,000 ft2 greenhouse, with tempered glass, $50/ft2; from RS Means, Site Work & Landscape Cost Data 2011), plants/trees to be started (assume 20 ft spacing on plantings, 108 plants per acre, 1,300 plants total, estimate $75/plant), and transplanted on the island (assume 5 weeks of labor, 4 laborers for planting, $50/hr, 10 hr days; Assume 2 UXO avoidance support staff $125/hr; 25 days of boat support at $1,300/day); assume spreading native wildflower mix seed over 12 ac using push spreader ($60/1,000 ft2, from RS Means, Site Work & Landscape Cost Data 2011)
Subtotal 2				$1,412,427	

Alternative 4 - MEC Removal, Land Use Controls, and MEC Inspections

Site: UXO 18, Former Atlantic Fleet Weapons Training Area - Vieques
Location: Vieques, Puerto Rico
Phase: Feasibility Study

Base Year: 2014
Date: April 2014

Alternative Description:
- Surface and subsurface MEC clearance up to 1 ft bgs
- Maintenance of existing signs
- Implement ICs that restrict access and intrusive work and future site development;
- Implement monitoring plan to verify LUCs are sufficiently protective of residual risk at the site.

Description	Quantity	Unit	$/Unit	Total Cost	Notes
(3) Sign Maintenance and LTM					
3.1 Net present value of sign maintenance and LTM activities	1	EA	$1,742,003	$1,742,003.16	See Table H-8 for the assumptions and estimates for the sign and LTM elements and Table H-9 for the net present value calculation.
Subtotal 3				$1,742,003	
Subtotal for Tasks 1, 2, 3				$3,258,430	
CONTINGENCY	20%		$3,258,430	$652,000	EPA July 2000 guidance
SUBTOTAL - CONSTRUCTION COST				**$3,911,000**	
(5) DESIGN&CM&PM					
Project Management	5%		$3,911,000	$195,550	EPA July 2000 guidance page 5-13
Construction Management	6%		$3,911,000	$234,660	EPA July 2000 guidance page 5-13
General&Administration (G&A)	9.2%		$3,911,000	$359,812	RSMeans 5% to 15%
Pollution Liability Insurance	2%		$3,911,000	$78,220	market price
Payment & Performance Bond	1.25%		$3,911,000	$48,888	market price
Fee	8%		$4,270,812	$341,665	
Tax	7%		$3,911,000	$273,770	Puerto Rico tax
TOTAL - Design &CM&PM				**$1,533,000**	
TOTAL Capital Cost				**$5,444,000**	

Note:
This estimate has been developed and provided as an Order of Magnitude Estimate (ROM)/Budgetary Estimate and as such is suitable for the purpose of budget development and/or planning only. This estimate is offered as an opinion of cost to perform the work and is not an offer to contract for construction services, procure and/or provide such services.
(Cost Accuracy Range: +50% / -30%)

Subsurface anomalies may comprise a combination of MEC, RRD, MD, trash, and rocks with a high iron content. Therefore, the number of anomalies may be considerably higher than the actual number of MEC. For the purposes of the Alternative 3 cost estimate, it is assumed there are 50 anomalies per acre. This assumption is based on subsurface anomaly densities observed at nearby Blue Beach and PAOC EE

Table H-8

Estimated Sign Maintenance and LTM Unit Rates for Alternative 4

UXO 18 Remedial Investigation/Feasibility Study

Atlantic Fleet Weapons Training Area—Vieques

Former Vieques Naval Training Range

Vieques, Puerto Rico

Description	Quantity	Unit	$/Unit	Total Cost	Notes
1 Inspection of Signs at Blue Beach Access Points and Cayo la Chiva	1	EA	$850	$850	Costs estimated using the following assumptions: on-site personnel will inspect signs (no mobilization); inspection team consists of 2 people; working one 4-hr/event; assume use of project boat; assume $100/hr/person; miscellaneous sign repair materials/equipment/replacement signs (estimated $50); assume monitoring for 30 years; 1 event per year
2 Inspection of Accessible Area Using MEC Surface Clearance Team	2.4	Acres	$11,839	$28,414	Average cost of MEC surface clearance on USAE contract VT004; through October 2013; assume 20% of island inspected during LTM activities and 5-yr reviews (increase from Alt 2 is due to vegetation being cut from island as part of MEC removal); assume 1 LTM event/year for 30 years; assume 1 major storm every 2 years requiring inspection (15 total); assume inspection team covers 0.5 acre/day (slower than Alternative 3 because it is assumed the trails in Alternative 3 will be maintained)
3 Boat Support for LTM	5	Day	$1,300	$6,500	Assume surface MEC inspection will take 5 days/event; assume 20% of island inspected during LTM activities; assume inspection team covers 0.5 acre/day; assume 1 LTM event/year for 30 years; assume 1 major storm every 2 years requiring inspection (15 total)
4 LTM Demolition/Explosive Venting	1	Event	$13,760	$13,760	Assume 1 demo event every other year of monitoring; Cost estimate is based on average demolition costs for USAE on VT004 through October 2013 plus adding 2 boats for demo support ($1,300/day each; one for demo team transport, one for patrolling/stopping access to bay by other boats)
5 LTM Report following Monitoring Event	1	Ea	$20,000	$20,000	Assume one report/year for 30 years; assume 1 LTM event/year for30 years; cost estimated; assume no report prepared following storm-related monitoring

Table H-9

Estimated Sign Maintenance and LTM Net Present Value for Alternative 4

UXO 18 Remedial Investigation/Feasibility Study
Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Assumed discount rate ** 1.9%

Year	Assumed Activities Performed in Year	Estimated Cost (2014 Dollars) *	NPV Multiplier	NPV Cost
1	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.981	$54,723.85
2	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$104,437	0.963	$100,578.89
3	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.945	$52,702.14
4	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$104,437	0.927	$96,863.13
5	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.910	$50,755.12
6	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$104,437	0.893	$93,284.63
7	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.877	$48,880.04
8	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$104,437	0.860	$89,838.35
9	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.844	$47,074.22
10	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$104,437	0.828	$86,519.38
11	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.813	$45,335.12
12	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$104,437	0.798	$83,323.02
13	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.783	$43,660.27
14	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$104,437	0.768	$80,244.75
15	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.754	$42,047.29
16	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$104,437	0.740	$77,280.21
17	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.726	$40,493.91
18	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$104,437	0.713	$74,425.18
19	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.699	$38,997.91
20	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection		0.686	$0.00
21	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.674	$37,557.18
22	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$104,437	0.661	$69,027.66
23	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.649	$36,169.67
24	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$104,437	0.637	$66,477.52
25	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.625	$34,833.43
26	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$104,437	0.613	$64,021.59
27	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.602	$33,546.55
28	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$104,437	0.590	$61,656.39
29	Sign maintenance, LTM of recreational areas, LTM Report	$55,764	0.579	$32,307.21
30	Sign maintenance, LTM of recreational areas, Demolition event, LTM Report, Post-major storm inspection	$104,437	0.569	$59,378.57
	Estimated total cost in 2014 dollars (non-discounted cost)	**$2,298,575**		
	Estimated total NPV cost (discounted cost)	**$ 1,742,003**		

* Unit rates for elements provided in Table H-7

** The discount rate used is based on the current Real Interest Rates on Treasury Notes and Bonds published in Circular A-94 Appendix C in accordance with the EPA guidance for cost estimating during the feasibility study (http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c)

Appendix I
Responses to Regulator Comments

Responses to EPA Comments
DRAFT REMEDIAL INVESTIGATION/FEASIBILTY STUDY REPORT
UXO 18
DATED MAY 2014

FORMER VIEQUES NAVAL TRAINING RANGE
VIEQUES, PUERTO RICO

GENERAL COMMENTS

1. The RI/FS does not provide sufficient details of the statistical analysis of the MEC discovered during the investigations conducted. There is no discussion of the statistical program employed, the confidence intervals, or the detailed reasoning behind the determination that Alternative 2 - Land Use Controls and MEC Inspections is as protective as is stated.

   Table 11-1, Detailed Evaluation of Remedial Alternatives, notes that Alternative 2 "… will meet RAOs because the explosive hazard associated with the site is low and this alternative implements LUCs to discourage site access with a monitoring program to perform MEC inspections (and removal if found) in accessed areas and ensure warning signs are operational." This is repeated in Section 12, Summary and Conclusions of the FS, where the second bullet (Alternative 2-Land Use Controls and MEC Inspections) in the second paragraph noted that, "Because only five isolated MEC have been identified on the island, this site has a relatively low explosive hazard associated with it." However, this statement is based on transects searching for MEC over approximately five percent of the island surface and an additional three percent of transects done in support of the Biological Assessment.

   No statistical confirmation is presented that this quantity/area of transects is sufficient to characterize the MEC hazard on the island as stated. Based upon this, the cited definitive statements concerning the low explosive hazard presented on the site appear to be presumptive. This could result in the questioning of the validity of the statements concerning the existing MEC hazard on the site and the comparison of Alternatives 2 and 3.

   Revise the RI/FS to provide the noted review of the statistical evaluation of the transects, the munitions items found, and its sufficiency for determining that the site has a low explosive hazard.

Navy Response: Statistical evaluation of the transects was not performed. The transects covered the accessible portions (i.e., relatively sparsely vegetated) of the island and accounted for approximately 8 percent of the island, which is consistent with other MEC inspections conducted on Vieques. Since the inspections covered the accessible portions of the island, because there are no known records of use of the island for training exercises, and because so few munitions were found and all of the same type (which indicates use of the island was very likely one-time), the Navy feels the residual explosive risk is low, which is a subjective term appropriate for use in this context. To provide additional justification in the document, the following text has been added:

The following has been added to the end of the first paragraph in Section 2.1: "Coupled with the

inspections that were performed to support the Biological Assessment, MEC clearance was performed across approximately 8 percent of the island, which included the accessible (relatively sparsely vegetated) area. In addition, MEC avoidance was performed along the sampling unit transects and no MEC was found."

The following has been added at the end of the second paragraph in Section 3.1: "In general, the island is heavily vegetated. Accessible (relatively sparsely vegetated) areas account for a small percentage of the island area, based on observations during MEC clearance activities conducted on the island."

The following bullet has been added to Alternative 2 in Section 10.2: "MEC clearance has already been performed on the accessible area (relatively sparsely vegetated) of Cayo La Chiva."

2. A number of different terms are employed in the RI/FS to describe the process that the Department of Defense Ammunition and Explosives Safety Standards (DoD 6055.09-M) refers to as "anomaly avoidance." Among the terms used are "anomaly avoidance," "MEC avoidance," and "UXO avoidance." The U.S. Naval Sea Systems Command (NAVSEA) Ordnance Pamphlet (OP) 5, Volume 1, Revision 7 (Ammunition and Explosives Safety Ashore), notes that, "Anomaly avoidance is sometimes referred to as UXO avoidance." However, "UXO avoidance" is not noted in the DoD 6055.09-M, Volume 8 (Glossary) definition. As UXO (unexploded ordnance) is not the only category to be avoided, the use of the term "UXO avoidance" should be discouraged and "anomaly avoidance" should be used.

   In addition, the term "Detector-aided surface sweep" is used to describe what DoD 6055.09-M, V8, and NAVSEA OP 5, Volume 1, define as a "Technology-aided surface removal." Neither document uses the term "sweep" to refer to the activities involved in the described work process.

   Munitions identified as "smoke canisters" and "smoke canisters (ABC-M5)" were classified as "Range Related Debris (RRD)," which is incorrect. The correct term for these items is "Smoke Pot, Ground, HC, ABC-M5." In addition, RRD is defined in DoD 6055-09, V8, and NAVSEA OP 5, Volume 1, as:

   > Range-Related Debris. Debris, other than munitions debris, collected from operational ranges or from former ranges (e.g., target debris, military munitions packaging and crating material).
   > As the term "munitions debris" is used in the preceding definition, its definition is:
   > Munitions debris (MD). Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal.

   These "smoke canisters" should be properly identified and classified as munitions debris (MD), or as material potentially presenting an explosive hazard (MPPEH) until they are properly inspected and certified as free of explosive hazards.

   Revise the RI/FS to replace the incorrect terms with the appropriate ones as described above.

   Navy Response: The terms have been corrected, as noted in the comment, and the smoke canisters have been identified as MD.

3. The RI/FS does not demonstrate that use of a background data set is applicable and appropriate at UXO 18. Section 1.2.2, Previous Investigations and Activities, states that "background data were collected from the eastern portion of Vieques to represent soil types similar to those where environmental sites are located within the former VNTR [Vieques Naval Training Range];" however, the RI/FS does not discuss how the soil type encountered at UXO 18 compares with those sampled in development of the background data set. To demonstrate that use of the background data set to screen UXO 18 data is applicable and appropriate, revise the RI/FS to describe the how the soil type encountered at UXO 18 compares with those sampled in development of background data.

   Navy Response: Additional clarification, including a reference to the Master SAP, has been added to Section 1.2.2.1 that states the background inorganic constituent concentrations from the Tl zone are used for comparison with soil inorganic constituent concentrations collected during the RI at UXO 18, since it falls within the same lithologic zone.

4. Section 9.4, General Response Actions, does not discuss what the general response actions (GRAs) for UXO 18 are specifically. According to the second sentence in this section, "GRAs may include no action, land use controls, monitoring, containment, removal, treatment or any combination of these;" however, specific GRAs are not described. Revise the Section 9.4 to describe specific GRAs that are applicable to UXO 18.

   Navy Response: The GRAs for UXO 18 are provided and discussed in Appendix F. The reference to this appendix was inadvertently excluded from Section 9.4. A statement has been added to the text of Section 9.4 directing the reader to Appendix F for a discussion of the UXO 18 GRAs.

5. The screening of technologies summary presented in Appendix F, Technology Screening Summary for UXO 18, is inconsistent with the technology screening summary presented in Table 9-2, Technology Screening Summary. For example, "long-term monitoring" and "native soil cover" are listed as remedial technologies in Appendix F, but are not listed in Table 9-2. Similarly, Table 9-2 lists "physical treatment" as a remedial technology, but this is not discussed in Appendix F. In addition, it is noted that the second paragraph of Appendix F states that "this appendix provides a general overview and evaluation of the remediation technologies for perchlorate…." Based on review of the RI/FS, perchlorate is not a contaminant of concern at UXO 18; as such, it is unclear whether all of the remedial technologies presented are applicable to UXO 18. Revise Appendix F and Table 9-2 to ensure that the information presented is consistent, and that the remedial technologies considered are applicable to UXO 18.

   Navy Response: All of the technologies presented in Appendix F are not intended to be shown in Table 9-2; the text in Section 9.5 states that "Table 9-2 summarizes the results of the technology screening process and process options retained for further evaluation." As such, the intent of Table 9-2 was to summarize just the GRAs that were considered reasonable options for addressing MEC at UXO 18; at the end of each discussion for the technologies presented in Appendix F, the text states whether the technology was or was not retained for further evaluation. To clarify this in Section 9.5, the sentence in the text has

been revised to read: "Table 9-2 summarizes the results of the technology screening process and presents only those technologies retained for further evaluation via the screening process presented in Appendix F."

6. Appendix F, Technology Screening Summary for UXO 18, and Section 10.3, Alternative 3 – MEC Removal, Land Use Controls, and MEC Inspections, do not describe the specific detection, recovery, and disposal technologies that will be used as part of the munitions and explosives of concern (MEC) removal process. As such, it is unclear if Alternative 3 was appropriately scoped and costed so as to reflect a -30%/+50% margin as allowed for during the FS process. Revise Appendix F and Section 10.3 to describe the MEC removal alternative in more detail, specifying the detection, recovery, and disposal technologies, and ensure that all assumptions are noted and substantiated in Appendix H, Cost Estimates.

   Navy Response: As noted previously, Appendix F presents broad categories for potential suitable types of remediation strategies for the site. This step in the FS process is to segregate the technologies that warrant further consideration from those not viable alternatives or not worthy of further consideration (relative to those retained). Further, the level of detail in Appendix F and Section 10.3 is appropriate to adequately compare alternatives against one another and is consistent with the EPA's RI/FS guidance for evaluating process options (Section 4.2.5) which states "The representative process provides a basis for developing performance specifications during preliminary design; however, the specific process actually used to implement the remedial action at a site may not be selected until the remedial design phase."

   With regards to the level of detail and the cost estimate associated with Alternative 3, site-specific data regarding cost were used as the basis for the estimated cost of this alternative. The basis for the unit rates and any adjustments to the unit rates are provided in each line item.

7. Based on review of Table 11-2, Comparative Analysis of Remedial Alternatives, it is unclear which alternative performs the best overall in each category. For example, it appears that Alternative 3 (MEC Removal, Land Use Controls, and MEC Inspections) would result in greater long-term effectiveness and permanence than Alternative 2 (Land Use Controls and MEC Inspections), given that Alternative 3 includes MEC removal over the entire area of UXO 18 (i.e., Alternative 3 performs the best overall in this category); however, these two alternatives appear to be ranked the same for this category in Table 11-2. The RI/FS Guidance states in Section 6.2.5 (Comparative Analysis of Alternatives) that "[a]n effective way of organizing this section is, under each individual criterion, to discuss the alternative(s) that performs the *best overall* in that category, with other alternatives discussed in the *relative order in which they perform* [emphasis added]….the presentation of differences among alternatives can be measured either qualitatively or quantitatively, as appropriate, and should identify substantive differences." Ensure that Section 11.3, Comparative Evaluation of Remedial Alternatives, and Table 11-2 clearly indicate which alternative(s) perform the best overall in each category.

   Navy Response: The Harvey Balls used in Table 11-2 are intended to provide a quick visual comparison for the alternatives with how they perform relative to each other for a given

performance criterion. With the exception of three evaluation criteria (Adequacy and Reliability of Controls, Degree to Which Treatment is Irreversible, Type and Quantity of Residual Remaining After Treatment), the relative rankings are not the same for a given criterion. Because the new alternative was added and Table 11-2 presents a relative comparison for the various alternatives, each alternative was re-calibrated against each other.

Finally, Section 11.3 of the FS presented the evaluation of the alternatives in a step-wise manner that mirrored how the alternatives were introduced and how they were evaluated in Table 11-2. However, to help facilitate review of the alternatives, the text has been re-ordered as noted in the comment.

8. The human health risk assessment (HHRA) in Appendix D cites the Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors, dated May 25, 1991 (OSWER Directive 9285.6-03). Please note that on February 6, 2014, USEPA issued OSWER Directive 9200.1-120, which contains updated standard default exposure parameters and "supersedes and replaces certain portions of OSWER Directive 9285.6-03, issued March 25, 1991 and updates the Risk Assessment Guidance for Superfund, Part E, issued July 2004 (RAGS, Part E)." Ensure that the updated values are considered in revision to the HHRA.

Navy Response: Section 1.2 of the HHRA in Appendix D has been modified to remove the reference to the 1991 Standard Default Exposure Factors and the reference to the 2014 version has been added. The 2nd sentence of Section 1.2 has been revised to:

> "The protocol is consistent with EPA Region II policy and EPA guidance, including: Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual, Parts A, D, E, and F (EPA, 1989, 2001, 2004, 2009a), and Human Health Evaluation Manual (HHEM), Supplemental Guidance: Update of Standard Default Exposure Factors (EPA, 2014a)."

Section 3.2.2 of Appendix D has also been modified to reflect these changes. The 3rd sentence of Section 3.2.2 has been revised to:

> "The primary references for exposure factors are standard default exposure factors presented in EPA guidance (EPA, 2004; 2014a)."

The EPA 1991 reference has been removed from Section 6 (References) of Appendix D, and EPA 2014a has been added.

Tables 4.1, 4.2, and 4 Supplement C (attached) of Attachment D-1 of Appendix D have been revised to incorporate the updated exposure factors.

These revisions also affect Sections 6 and 13 of the main body of the RI/FS report. Section 6 has been modified to remove the reference to the 1991 Standard Default Exposure Factors and the reference to the 2014 version has been added. The 3rd sentence of Section 6 has been revised to:

"The primary guidance documents used in preparation of the HHRA are the USEPA Risk Assessment Guidance for Superfund (RAGS) Parts A, D, E, and F (EPA, 1989; 2001; 2004; 2009) and Human Health Evaluation Manual (HHEM), Supplemental Guidance: Update of Standard Default Exposure Factors (EPA, 2014)."

The EPA 1991 reference has been removed from Section 13 (References), and EPA 2014 has been added.

9. Appendix B, Data Quality Evaluation (DQE), indicates that data quality was not impacted because results were not rejected (or rejected results were resampled), but the DQE does not discuss whether any biases or trends were noted in the quality control (QC) results and if they negatively affect the usability of the data. The DQE should discuss how biases and trends were evaluated and provide sufficient information is provided to support the data usability conclusions. Revise the DQE to discuss biases or trends in the QC results, if they may impact data usability, and ensure sufficient information is provided to support the data usability conclusions.

   Navy Response: The third sentence of the first paragraph under Section B.0.6 has been revised to read: "To help identify trends, for each combination, the count (number of results that possess this combination) is provided as well as the determination of whether such a result is affected by a bias, is available for use as reported, is available for use as qualified, or is not available for use (rejected)."

   In addition, Table B-2 has been updated to state whether a result is affected by a bias, as evinced by its DV_Qual_Code.

10. The Appendix B DQE does not discuss whether the field QC samples (e.g., equipment blanks and field duplicates) were collected and analyzed at the necessary frequencies for all methods. For example, Table 4-1 appears to indicate that the duplicate sample for VE- UXO18-01SO01 was not analyzed for metals. Revise the DQE to discuss whether field QC samples were collected at the appropriate frequencies for all methods and if not, discuss whether data usability is impacted.

    Navy Response: The following text has been added at the end of the first paragraph of Section B.0.4: "Field QC samples were collected and analyzed at the planned frequencies with the exception of one duplicate sample (VE-UXO18-01SS01P-0001), which was not analyzed for metals due to limited sample volume. The UXO 18 sampling was part of a multi-UXO site sampling effort where multiple duplicate soil samples were collected for metals analysis. The laboratory results for these samples indicated there were no precision or sampling issues that could affect data quality and usability."

11. Appendix E, Ecological Risk Assessment, states that no drinking water source is present on UXO 18 and therefore exposure from the ingestion of drinking water was not included in the Ecological Risk Assessment (ERA). Even though this approach was followed in the ERA, the dietary intake equations shown in the text (Section 1.3.4) and in the Attachment tables of Appendix E include a water ingestion rate and a chemical concentration in water as variables in the equations. The attachment tables also include a column for surface water

concentration, which appropriately contain no values. The inclusion of water ingestion in the dietary intake equations and surface water concentrations in the dose tables is confusing since water intake is not considered as an exposure media in the ERA. It is suggested to remove all references to water intake in the dose equations and tables to eliminate any possible confusion. This proposed change will clarify how the ERA was conducted but will not affect the results of the Screening Level Ecological Risk Assessment (SLERA).

Navy Response: Appendix E references to water intake have been removed from the dietary intake equation (Section 1.3.4, Tables E-10 and E-11, and Attachment Tables E-1-1 through E-1-24).

12. Soil samples were collected using two different methods. Incremental sampling was conducted at two sampling areas across the island by collecting 100 subsamples 0-2" deep from each area which were then composited into one sample per area for analysis. In addition, three discrete samples were collected 0-12" deep at former smoke canister locations. Sections 2.2.1 and 2.2.2 of the RI/FS describe these two sampling methods, both of which are acceptable. However, the results of the incremental sampling effort represent an average across each of the two sampled areas whereas the discrete sampling method yields results which pertain only to the specific sampling locations. This distinction is important because when a maximum value is used in the ERA screening process, the maximum of the two incremental samples is really the maximum of an "averaged" value represented by 100 subsamples.

    The two incremental samples were combined with the three discrete samples in Table E-20 to calculate hazard quotients for birds and mammals. Combining the soil sample results collected by the two different methods and representing two different depth intervals and exposure areas is inappropriate and creates uncertainty. It is not suggested to redo the exposure calculations for each data set separately because the risk conclusions would not likely change. However, the issues with this blended approach need to be comprehensively discussed in the uncertainty section of Appendix E. Revise the text accordingly.

    Navy Response: The following language has been added to the Uncertainty section (Section 1.6) of Appendix E:

    "Surface soil concentrations used for the evaluation of food web exposures were based on the combination of chemical data collected by two different methods, multi-incremental soil (SMI) sampling and discrete sampling. Each SMI analytical result represents a composite of 100 subsamples collected from the 0-2 inch soil profile across approximately 1 acre in areas where MEC was previously identified; two SMI samples were collected at UXO 18. Discrete soil samples were collected from 0-12 inches at three former smoke canister locations. Samples from both data groupings were combined considering that wide ranging birds and mammals may forage throughout UXO 18. However, the results of the SMI sampling effort represent an average across each of the two sampled areas whereas the discrete sampling method yields results which pertain only to the three specific sampling locations. Therefore, when a maximum value is used in the food web exposure evaluation, the maximum of the two SMI samples is really the maximum of an "averaged" value represented by 100 subsamples. As a result there is uncertainty associated with combining

data that represents both discrete locations and area-wide averages. However, considering there are only five total surface soil samples at UXO 18, it was determined that a better representation would be to evaluate all surface soil data for exposure of wide ranging wildlife as opposed to separate evaluations of the three discrete samples separately and the two SMI samples and is the approach concurred upon by the Vieques Technical Subcommittee."

13. Five Year Review costs are not remedial action costs. The cost of no action is always zero. Please segregate Five Year Review costs from the remedial alternatives.

    Navy Response: The cost estimates have been revised to remove 5-year reviews.

SPECIFIC COMMENTS

1. **Section 4.2.3, Inorganic Constituents, Page 4-2:** The last paragraph in this section states, "it is important to note that all other inorganics, including zinc and aluminum, were detected below background concentrations and screening criteria." However, based on review of Table 4-1, Explosives and Inorganic Constituents Detections and Exceedances in Soil, this statement is inaccurate. In addition to the detections of thallium, antimony, and hexavalent chromium discussed in Section 4.2.3, review of the data in Table 4-1 indicates that concentrations of several metals (aluminum, arsenic, cobalt, iron, manganese) detected in various samples exceed their applicable Soil Screening Level (SSL) for protection of groundwater and/or Regional Screening Level (RSL) for residential soil. In addition, the concentration of arsenic detected in sample VE-UXO18-01SO03 exceeds arsenic's RSL for industrial soil. No evaluation and discussion of the significance (or lack thereof) of these exceedances and whether they warrant additional investigation is provided. Revise Section 4.2.3 to discuss and evaluate these exceedances.

   Navy Response: The statement is accurate in that no other inorganics were detected above background <u>AND</u> screening criteria. Several were detected above screening criteria, but none of those was above background. To avoid confusion, the first sentence of the last paragraph was revised to remove "and screening criteria." Since no inorganic (other than those discussed in preceding paragraphs) was detected above background, further discussion of them is not necessary in the Nature and Extent of Contamination section. Please note that all constituents above screening criteria were included in the risk assessments, regardless of whether they were below background.

2. **Table 4-1, Explosives and Inorganic Constituents Detections and Exceedances in Soil:** The second paragraph of Section 4.2.3, Inorganic Constituents, discusses the concentrations of antimony detected at the site; however, the analytical results for antimony are not presented in Table 4-1. For clarity and completeness, revise Table 4-1 to present the analytical results for antimony.

   Navy Response: As with all RI reports for Vieques, Table 4-1 is a summary of detects and exceedances, as noted in the table title. Because all soil antimony results were non-detect, antimony does not appear on this table. For complete analytical results (including soil

antimony), please refer to the raw results in Appendix C, as indicated in the first paragraph of Section 4.2. Please note the Level IV laboratory reports in Appendix C have been replaced with the raw analytical table and the last sentence of the first paragraph in Section 4.2 has been revised to read: "Raw analytical data are included in **Appendix C**."

3. **Table 4-1, Explosives and Inorganic Constituents Detections and Exceedances in Soil:** Appendix B indicates that all explosives results and picric acid results for the incremental soil samples collected in June were rejected, but this table indicates there were no detections for explosives in samples collected June 12, 2013. Revise this table to indicate that the June explosives incremental soil sample results were rejected as discussed in Appendix B.

   Navy Response: A footnote was added to Table 4-1 that states: "All 8330B explosives and picric acid results for the June 2013 SMI samples were rejected and deemed not usable. These samples were re-collected in November 2013." Please refer to Appendix C for complete analytical results (including rejections). This appendix has been revised to replace the Level IV laboratory reports with the raw analytical table.

4. **Section 10.2, Alternative 2 – Land Use Controls and MEC Inspections, Page 10-1:** This section states that one of the components of Alternative 2 is "implementing institutional controls (ICs, e.g., deed notations to restrict future access)." However, the RI/FS does not explicitly state what the land use controls (LUCs) will include/restrict (e.g., trespassing restrictions only, dig restrictions, etc.). For clarity and completeness, and to ensure that their effectiveness can be properly monitored, revise Section 10.2 to explicitly state what the LUCs will include/restrict.

   Navy Response: The first bullet in Section 10.2 has been revised to read: ". . . any long-term monitoring (LTM) program, while deterring any use not approved for the site (e.g., trespassing, uncontrolled construction, etc.). Once the actual land use is determined, the details of LUCs will be presented in a work plan for their implementation."

5. **Section 10.2, Alternative 2 – Land Use Controls and MEC Inspections, Page 10-2:** It is unclear whether existing signs will be maintained as part of Alternative 2 or whether new signs will be installed. The first bulleted item on Page 10-2 states that "it is assumed that 5 signs on island and 19 signs on Blue Beach and Punta Galintez would be maintained;" however, this section does not explicitly state whether existing signs will be maintained or whether new signs will be installed. The first bulleted item on Page 11-5 states that "alternative 2 involves installing signs at locations where signs have already been installed;" whereas, Table H-2 of Appendix H, Cost Estimates, indicates that existing signs will be maintained only. Revise Section 10.2 to clearly state whether existing signs will be maintained as part of Alternative 2 or whether new signs will be installed and maintained.

   Navy Response: For the purposes of FS cost estimating, maintaining existing signs is sufficient because the actual number of signs necessary could be more or less. Please note that the assumption is conceptual and that the actual number and locations of signs, as applicable, will be included in the remedial action work plan.

6. **Section 11.2, Detailed Evaluation of Remedial Alternatives, Page 11-3:** This section states

that a detailed analysis of each of the three alternatives is presented in Table 11-1, Detailed Evaluation of Remedial Action Alternatives; however, no analysis is provided in the text of the document. The RI/FS Guidance specifies that a narrative discussion be presented and accompanied by a summary table. Revise the RI/FS to provide a discussion of the detailed analysis of each alternative in Section 11.2.

Navy Response: Table 11-1 is intended to facilitate a user-friendly review of the alternatives by the regulatory agencies as well as the public. The table provides all the pertinent details for the alternatives that would have been included in the text. As stated in Section 11.2, the information was not repeated in the text to reduce redundancy.

7. **Table 11-2, Comparative Analysis of Remedial Alternative, Page 1 of 1:** The Cost row of this table indicates that the costs for each alternative are present value costs; however, these costs appear to be the same as Appendix H, Cost Estimates, which only includes capital costs. Based on Chapter 4 (Present Value Analysis) of A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, dated July 2000 (Cost Estimate Guidance), present value analysis is a standard methodology, which allows for cost comparisons of different remedial alternatives on the basis of a single cost figure for each alternative. This single number, referred to as the present value, is the amount needed to be set aside at the initial point in time (base year) to assure that funds will be available in the future as they are needed, assuming certain economic conditions. Revise Appendix H and the text of the RI/FS to provide a present value analysis for all remedial alternatives.

   Navy Response: The costs have been adjusted to include present value costs for LTM activities.

8. **Appendix B, Section B.0.2, Data Validation, Page B-2:** The text discusses QC parameters that were reviewed during data validation, but it is unclear if all of the necessary QC parameters were evaluated (e.g., column confirmations, post-digestion spikes, and serial dilutions). Revise this section to clarify all of the QC parameters evaluated during data validation.

   Navy Response: The text was revised to read: "Example areas of review include holding time compliance, surrogate recovery accuracy, matrix spiked sample precision and accuracy, blank contamination, initial and continuing calibration accuracy and precision, laboratory control sample accuracy, internal standard response and retention time accuracy, instrument tune criteria accuracy, and duplicate sample precision (laboratory replicates and field duplicates). Please refer to the complete data validation report for full areas of review."

9. **Appendix B, Section B.1, Vieques Cayo la Chiva Soil, Pages B-7 to B-8:** The validation reason codes are not defined in the validation qualifier summary tables for each method. Revise these tables to include definitions for the reason codes.

   Navy Response: The following sentence has been added to the end of the first paragraph of Section B.1: "Please refer to Table B-2 for a complete listing and description (Comment column) of all data validation qualifiers (DV_Qual column) and reason codes (DV_Qual_Code column) that are presented in the following subsections."

10. **Appendix E, Ecological Risk Assessment, Attachment Table E-1-9 Summary of Norway Rat Exposure Doses-Baseline (Step 3A) -95% UCL:** The 95% Upper Confidence Limit (UCL) surface soil concentration for hexachloroethane (2.17 mg/kg) exceeds the range of non-detect values (1.9-2.10 µg/kg) from Table E-19. Note that the hexachloroethane value in Table E-19 is presented in units of µg/kg, whereas the 95% UCLs in Attachment Table E-1-9 are in units of mg/kg. It does not appear that the hexachloroethane values were converted to mg/kg in the Attachment table. This error also occurs in Attachment Tables E-1-10 through E-1-16. Revise the 95% UCLs for hexachloroethane in these tables and insure they are in the correct units. Adjust all dose calculations as needed.

    Navy Response: The 95% UCL for hexachloroethane was corrected to 0.00217 mg/kg in Attachment Tables E-1-9 through E-1-16, and associated dose calculations were updated. Ecological risk conclusions regarding this chemical did not change.

11. **Appendix E, Ecological Risk Assessment, Attachment Tables E-1-17 through E-1-22 Summary Exposure Doses-Baseline (Step 3A) - Arithmetic Mean:** The mean surface soil value for hexachloroethane (2.00) is in µg/kg and should be converted to mg/kg (0.002 mg/kg). Revise the hexachloroethane value in these tables and adjust all dose calculations.

    Navy Response: The arithmetic mean for hexachloroethane was corrected to 0.002 mg/kg in Attachment Tables E-1-17 through E-1-24, and associated dose calculations were updated. Ecological risk conclusions regarding this chemical did not change.

12. **Appendix H, Cost Estimates, Table H-3, Alternative 3 Costs:** Line-item 2.3 states that MEC removal costs are based on the assumption of 50 anomalies per acre. However, based on review of the RI/FS, it is unclear whether this is an accurate estimate of the number of anomalies per acre. For example, according to Section 4.1, MEC, "it can be assumed that other isolated MEC may be present throughout UXO 18." In addition, only four MEC items have been discovered in approximately two acres thus far (based on Section 2, Summary of RI Field Investigation). Based on this, it is unclear if Alternative 3 was appropriately scoped and costed so as to reflect a -30%/+50% margin as allowed for during the FS process. Revise Appendix H to include justification for the number of anomalies assumed in development of the MEC removal costs.

    Navy Response: The following has been added as bullet under the major components and assumptions for Alternative 3 under Section 10.3:

    "Subsurface anomalies may comprise a combination of MEC, RRD, MD, trash, and rocks with a high iron content. Therefore, the number of anomalies may be considerably higher than the actual number of MEC. For the purposes of the Alternative 3 cost estimate, it is assumed there are 50 anomalies per acre. This assumption is based on subsurface anomaly densities observed at nearby Blue Beach and PAOC EE."

    In addition, a footnote with this assumption has been added to the cost table in Appendix H."

Responses to PREQB Comments on the Draft Remedial Investigation/Feasibility Study Report, UXO 18, Atlantic Fleet Weapons Training Area – Vieques, Former Naval Ammunition Support Detachment, Vieques, Puerto Rico

GENERAL COMMENTS

1. Please revise the document to reflect the ownership of the site and any future land use plans the owner has for the site. Note that this may impact the remedial alternatives proposed for this site.

   Navy Response: Ownership of the land is still in the process of confirmation. However, ownership is not pertinent for evaluating alternatives because the existing alternatives evaluated are applicable regardless of ownership. Also, an additional alternative has been added between Alternatives 2 and 3 to support potential recreational use (e.g., beach access, interpretive trails, observation tower), which can be evaluated independent of land ownership. Therefore, all references to land ownership have been removed. For example, where "USFWS worker" was used, a generic "worker" has been substituted since the assumptions used for recreational and maintenance activities would be similar regardless of who is performing them.

2. As currently developed the FS evaluates 1) no action, 2) Land Use Controls (LUCs), and 3) LUCs plus full vegetation removal followed by MEC removal. It is very possible that a fourth alternative, lying between the current #2 and #3 in complexity and scope, may be advantageous and should be considered. This alternative can possibly take advantage of the sparse vegetation in the interior of the site to achieve significant MEC removal without cutting vegetation.

   Navy Response: As stated in Section 4.1, the past inspections included the accessible parts of the island, which are those that are sparsely vegetated. Therefore, the additional alternative suggested is not necessary. To make this information more clear in the document, the following text has been added:

   The following has been added to the end of the first paragraph in Section 2.1: "Coupled with the inspections that were performed to support the Biological Assessment, MEC clearance was performed across approximately 8 percent of the island, which included the accessible (relatively sparsely vegetated) area. In addition, MEC avoidance was performed along the sampling unit transects and no MEC was found."

   The following has been added at the end of the second paragraph in Section 3.1: "In general, the island is heavily vegetated. Accessible (relatively sparsely vegetated) areas account for a small percentage of the island area, based on observations during MEC clearance activities conducted on the island."

   The following bullet has been added to Alternative 2 in Section 10.2: "MEC clearance has already been performed on the accessible area (relatively sparsely vegetated) of Cayo La Chiva."

PAGE-SPECIFIC COMMENTS

1. Figure 1-3:
    a. Please clarify why the site inspection did not cover the area where a terrestrial MEC item was discovered (the one terrestrial MEC item with the label for "Terrestrial MEC").

       Navy Response: The site inspections did cover that area. Because of the vegetation canopy present on the island, the GPS coverage and associated positioning tracking would be periodically lost during the inspections. However, the team was able to use the GPS to record the location of the MEC item in question. Figure 1-3 has been revised to show the approximate locations of the transects (as dashed green lines) that are not currently shown within the vegetated area. In addition, the accessible beaches were also included in the site inspection. The figure has been updated to reflect that as well.

    b. Please consider adding a warning buoy directly south of the island so that if boaters approach the island from the south, a warning buoy is visible. Based on the positions of the southern warning buoys it appears that a boater could access the island without knowing about the MEC dangers if approached directly from the south.

       Navy Response: The warning buoys are not intended to deter access to the island (the dense vegetation and the munitions removal in the accessible areas were sufficient); they were installed in order to deter mariners approaching the island from anchoring in the water in the vicinity of the nine underwater MEC items. Mariners approaching the island from any direction would see the existing buoys. In addition, once the non-time critical removal action for the nine underwater MEC items is completed, the buoys will be removed.

2. Figure 1-4: It appears from this figure that a MEC item was found further from shore to the west than the distance from shore covered by the off-shore survey. Please clarify if this MEC item was discovered during the off-shore survey. If not, please clarify the basis for the coverage for the off-shore survey, as it appears from this figure that MEC items may be present at further distances from shore than covered by the off-shore survey.

   Navy Response: The figure shows that all offshore items lie within the area covered by the nearshore survey and the transect inspection. This is explained in the last paragraph of Section 1.2.2.

3. Page 2-1, Section 2.1: Please note whether the controlled detonation occurred on the island or off-island.

   Navy Response: The third sentence of the first paragraph of Section 2.1 has been revised to read ". . . ; each was destroyed through controlled detonation on Cayo La Chiva in March 2011."

4. Page 2-2, Section 2.2: The last paragraph of this section states that "Field activities were performed in general accordance with the *Standard Operating Procedures (SOPs) of the Master SAP* and the *Final Master Standard Operating Procedures, Protocols and Plans*….". Please discuss deviations from these SOPs in the report, if any.

   Navy Response: There were no deviations from the SOPs.

5. Page 2-2, Section 2.2.2: Please include the rationale for the depth selected for the discrete sampling discussed in this section.

   Navy Response: The first sentence of Section 2.2.2 was revised to include ", in accordance with soil sampling protocol in the MSOPPP (CH2M HILL, 2010b)," after "(bgs)."

6. Table 2-1, Footnote #8: Please clarify that the field duplicate was only collected for SVOCs, explosives and hexavalent chromium (and not metals) due to limited volume submitted to the laboratory.

   Navy Response: The footnote was revised to say "Field triplicate samples were collected for samples VE-UXO18-01SMI01-0613 and VE-UXO18-01SMI01-1113. A field duplicate sample was collected for sample VE-UXO18-01SS01-0001. The field duplicate for VE-UXO18-01SS01-0001 was analyzed for all analytes except metals by SW-846 6010C/6020A due to limited volume received at the laboratory."

7. Page 3-1, Section 3.1: This section states, "…Groundwater is within bedrock and saline due to proximity to the ocean…" Please also add the small size of the island to this site-specific qualitative assessment of groundwater potability.

   Navy Response: The sentence was revised as follows: "Groundwater is within bedrock and saline due to the thin veneer of soil, small size of the island, and proximity to the ocean."

8. Page 3-2, Section 3.2: This section indicates that rocky cliffs extend along the eastern shore of the island. However, Section 3.1 characterizes the eastern shoreline of the island as a narrow sandy beach. Please clarify.

   Navy Response: The last sentence of Section 3.1 was revised as follows: "The northern portion and very northeastern tip of the island consist of a narrow strand of sandy beach that extends to a very shallow seagrass bed within the bay. Along the eastern side, a very thin strip (less than several feet) of sand lies immediately adjacent to a steep rock slope."

9. Page 3-2, Section 3.4: Please clarify what adjustments, if any, were made to the environmental investigation based on encountering archeologically significant artifacts within 1DU01.

Navy Response: Please see Section 2.5, which provides this information.

10. Table 4-1:
    a. Please clarify the following footnote identified as **: "For metals data, an exceedance is not considered if the result is less than background." Chemicals below background but above screening criteria are considered chemicals of potential concern to be evaluated in the risk assessments if it is determined that a release occurred. Please revise the footnote accordingly.

       Navy Response: Please note that Section 4 is the Nature and Extent of Contamination discussion; risk assessments are provided in subsequent sections. To clarify, the footnote was revised as follows: "A metals exceedance (i.e., indication of potential contamination) is highlighted only if the parameter concentration exceeds both the screening value and the Vieques East Background value. Background is not considered in identifying chemicals of potential concern for risk assessment purposes, as discussed in Sections 6 and 7)."

    b. Please include antimony results on this table.

       Navy Response: As with all RI reports for Vieques, Table 4-1 is a summary of detects and exceedances, as noted in the table title. Because all soil antimony results were non-detect, antimony does not appear on this table. For complete analytical results (including soil antimony), please refer to the raw results in Appendix C, as indicted in the first paragraph of Section 4.2. Please note the Level IV laboratory reports in Appendix C have been replaced with the raw analytical table and the last sentence of the first paragraph in Section 4.2 has been revised to read: "Raw analytical data are included in Appendix C."

    c. Table 4-1: SVOC results for the incremental soil samples need to be "NA" since this analysis was only performed on the discrete soil samples.

       Navy Response: A footnote was added to "No Detections" under "Semivolatile Organic Compounds (ug/kg)" and defined in the "Notes" as "SVOCs analysis was performed only on discrete soil samples."

11. Page 5-2, Section 5.1: As discussed during the June 2014 Environmental Restoration Program Subcommittee meeting, please note that the Department of Natural and Environmental Resources owns the cayo.

    Navy Response: Please see the response to PREQB General Comment #1.

12. Page 6-1, Section 6.1: Please clarify whether it is illegal for the public to access this site. This report states that public access is "discouraged" but acknowledges that recreational use of the site is occurring. It appears that inclusion of a recreational user is warranted for this site unless institutional controls are in-place prohibiting access. For

clarity, please note whether the trespasser exposure scenario is protective of recreational use of the site.

Navy Response: It is unknown whether public access to the Cayo La Chiva illegal. However, the trespasser scenarios evaluated in the HHRA involve being at the site 104 days per year for 6 years as a child, 10 years as an adolescent, and 24 years as an adult, and incidentally ingesting and dermally contacting soil at the same intake rates as residents. Since it is reasonable to assume that recreational use of the site by the same person would not occur more frequently, longer, or at higher ingestion or dermal contact rates than those assumed for trespassers, the trespasser exposure scenarios are protective of potential recreational use of the site. This information has been added to Section 6.2.

13. Figures 10-1 and 10-2: A warning sign is not shown at the westernmost access way to Blue Beach. Please discuss why a warning sign is not shown at this location and whether warning signs would be posted at all access points to the beach.

    Navy Response: The figures present the status of the signs at the time the Draft RI/FS was issued. The access to the location in question was not open to the public at the time the Draft RI/FS was submitted because the path for this beach access went through an active CERCLA site (PI 21). Since a No Action Decision Document has since been finalized for PI 21, a warning sign will be installed at this beach. Figures 10-1 and 10-2 have been updated to show a warning sign on this beach.

14. Page 7-1, Section 7.2: The area of habitat consisting of dry scrub forest (7 acres), secondary growth forest (2 acres) and mangrove forest (1 acre) do not match the overall size of Cayo La Chiva which is reportedly 12 acres. Please indicate whether unvegetated areas such as sand beaches and exposed rock comprise the remaining 2 acres of the island.

    Navy Response: The first sentence of Section 7.2 has been replaced with the following: "Cayo La Chiva is an approximately 12-acre rocky island offshore of Blue Beach (Playa La Chiva), which includes approximately 7.2 acres of dry scrub forest, 2.4 acres of secondary growth forest, 0.8 acres of mangrove forest, and 1.6 acres of unvegetated rocky shoreline and sandy beach."

15. Page 10-2, Section 10-2: Alternative 2 (and Alternative 3) assumes 5 access restriction signs, all posted on the north/northeast side of the island. However, most MEC was located on/near the southern half of the island. While it is recognized that the limited number of signs was considered for costing in the FS, it is reasonable to assume that additional signage would be needed around the perimeter of the island to warn recreational trespassers to stay away from the shoreline as well as upland areas of the island. Note that at least one photo posted on Google Earth shows a trespasser on the shoreline of what appears to be the west side of the island. The need for this additional signage including inspection and maintenance, should be considered in the cost for these alternatives and would affect short-term effectiveness since the additional signs would be installed in new areas where signs currently do not exist.

Navy Response: For the purposes of FS cost estimating, maintaining existing signs is sufficient because the actual number of signs necessary could be more or less. Please note that the assumption is conceptual and that the actual number and locations of signs, as applicable, will be included in the remedial action work plan.

16. Page 10-3, Section 10.3: Please describe why full vegetative removal is necessary to implement an MEC removal alternative. Given that groundcover is sparse and that soil cover is generally limited to a few inches of soil, please clarify whether most, if not all, of the remaining MEC would be able to be identified through more thorough site recon without the complete removal of vegetation.

    Navy Response: The first bullet of Section 10.3 has been revised to read: ". . . to ensure vegetation does not obstruct the ability to perform island-wide MEC removal (i.e., visual inspection, instrument use, anomaly removal)."

17. Page 11-4, Section 11.3.3: Given that signs and warning buoys have been in place since 2012, it appears that sufficient observational data are available regarding how effective these measures are in dissuading trespassers from accessing UXO 18. Please discuss how effective these signs and warning buoys have been in keeping trespassers from accessing the island.

    Navy Response: While the signs and buoys have been installed and maintained since 2012, dedicated tracking and documentation of trespassing on/around the island are not performed. Further, since the signs are intended to deter trespassing, it is not possible to know how much trespassing would occur in the absence of the signs.

18. Table 11-2: Please explain why the magnitude of residual risk for Alternatives 2 and 3 is given identical scores. If follows that since the vast majority (if not all) MEC would be removed under Alternative 3 whereas all undiscovered MEC would remain under Alterative 2, it seems that Alternative 2 would have greater residual risk and should thus be scored lower than Alternative 3.

    Navy Response: Because the new alternative was added and Table 11-2 presents a relative comparison for the various alternatives, each alternative was re-calibrated against each other.

19. Appendix A, Data Validation Reports: For SDG 70987:
    a. Cover page: Please replace "PAH" with "SVOC" as hexachloroethane is not a PAH.

       Navy Response: The cover page was revised to read "TYPES OF ANALYSES: <u>Semivolatile Organics (SVOA-Hexachloroethane only)</u>, Explosives, Perchlorate, Picric Acid, Total Metals, Total Hexavalent Chromium"

    b. Page 12, Paragraph 4: Please replace "antimony" with "thallium".

Navy Response: The sentence in Paragraph 4 of Page 12 was revised to read: "The concentration of thallium in the equipment blank was less than the LOD but greater than the DL; therefore, the positive thallium result in sample VE-UXO18-01SS03-0001, which was greater than the LOD but less than 10X the blank concentration, was qualified as estimated biased high (J+)."

20. Appendix D, Human Health Risk Assessment:
    a. Page 3-1, Section 3.2.1: Please note that two methods are available for calculating a 95% UCL for MIS data, where a minimum of three replicates of the mean are available: Student's t-test and Chebyshev. Please refer to ITRC's "Incremental Sampling Methodology" dated February 2012, Section 4.2.2. Please also note that the on-line version of this document includes a calculator for calculating a 95%UCL using MIS data.

Navy Response: Two incremental samples (one per sampling unit for 1 decision unit) and three discrete samples are available for the site.

As indicated on SAP Worksheet #9-1 of the Final Master Sampling and Analysis Plan, East Vieques Terrestrial UXO Sites (CH2MHILL, 2013),

> *"Replicate samples will only be used to evaluate the analytical variability within one sampling unit for QC purposes (not to calculate an upper confidence limit (UCL) on the mean concentration). The maximum concentration of the three samples will be used to represent the analytical results from that sampling unit. ProUCL software will be used to calculate the 95% UCL on the mean for MIS results in each decision unit, even when there are only 2 sampling units in the decision unit."*

As a conservative approach, the maximum detected concentration between the two sampling units and the discrete samples was used to represent the exposure point concentration for each COPC in the HHRA.

The ITRC's online Incremental Sampling Methodology (ISM) Calculator was used to calculate 95% UCLs of the incremental samples using both Chebyshev and Student's-t methods (Table 1 of Attachment D-5, attached). The maximum detected concentrations (between the three replicates) were used to represent the sampling unit with the replicates, consistent with the SAP. The calculated 95% UCLs were higher than the maximum detected concentrations of the two incremental samples, but lower than the maximum detected concentrations of the discrete samples (Table 2 of Attachment D-5, attached). Therefore, no change is proposed to the EPCs used in the HHRA.

The following text was added to the end of Section 5.5.2 of the HHRA:

> "The ITRC's online Incremental Sampling Methodology (ISM) Calculator was used to calculate 95% UCLs of the incremental samples using both Chebyshev and Student's-t methods (Table 1 of Attachment D-5). The maximum detected concentrations (between the three replicates) were used to represent the sampling unit

with the replicates, consistent with the SAP (CH2MHILL, 2013). The calculated 95% UCLs were higher than the maximum detected concentrations of the two incremental samples, but lower than the maximum detected concentrations of the discrete samples (Table 2 of Attachment D-5)."

Additionally, Attachment D-5 of the draft HHRA was changed to Attachment D-6.

b. Page 3-1, Section 3.2.2:

i. The exposure factors developed for UXO 1 reflect site-specific exposure scenarios developed in consultation with USFWS for UXO 1 for five USFWS worker scenarios. Therefore, please include a discussion of each exposure parameter taken from the UXO 1 risk assessment and discuss why the value is appropriate for use at UXO 18 for a USFWS worker, based on consultation with USFWS.

Navy Response: In the revised HHRA, the only exposure factor used from UXO 1 for workers was an exposure frequency of 35 days/year (2 days/week for 4 months per year), which is a reasonable exposure duration based on island maintenance regardless of ownership. Based on information provided in SAP Worksheet #10o (CH2MHILL, 2013), the shoreline is not a suitable turtle nesting area. There are no surface water features on the small (12-acre) island. Based on professional judgment, the primary purpose for current or future workers to be present onsite is for general wildlife and/or recreational management activities; 35 days/year is expected to be a reasonable exposure frequency for workers. Note that EPA RAGS Part A guidance (EPA, 1989) does not require that every exposure factor value be an upper-bound value since the multiplicative effect of using numerous upper-bound values in the intake equations would result in unrealistic exposure estimates.

The 4th and 5th sentences of Section 3.2.2 of the HHRA were replaced with the following text:

> "Based on information provided in SAP Worksheet #10o (CH2MHILL, 2013), the shoreline is not a suitable turtle nesting area. In addition, there are no surface water features on the small (12-acre) island. Based on professional judgment, the primary purpose for current or future workers to be present onsite is for general wildlife and/or recreational management activities; 35 days/year is expected to be a reasonable exposure frequency for current and future site workers."

ii. Please note that a recreational scenario appears warranted for this site unless institutional controls are in-place prohibiting such use. For clarity, please discuss whether the trespasser exposure scenario is protective of recreational use of the site.

Navy Response: Please see response to PREQB General Comment 1 and Page-Specific Comment 12.

c. Section 5.5.4: Please replace "reporting limits" with "LOQs" to be consistent with the terminology utilized in the remainder of this report.

   Navy Response: "Reporting limits" has been replaced with "LOQs" throughout the HHRA, including Section 2.2, 5.5.4, Table 1 of Attachment D-3, and Attachment D-5.

d. Attachment D-5: Please replace "reporting limit" with "LOQ" to be consistent with the terminology utilized in the remainder of this report.

   Navy Response: Please see response to Page-Specific Comment 20c.

21. Appendix E, Ecological Risk Assessment:

a. Section 1.3.1: Please replace "sample quantitation limit" with "LOD" or "LOQ", as appropriate, to be consistent with the terminology utilized in the remainder of this report.

   Navy Response: "Sample quantitation limit" was changed to "limit of detection (LOD)" in Section 1.3.1.

b. Page 1-4, Section 1.2.1: The numbered subheadings for Dry Scrub Forest, Secondary Growth Forest and Mangrove Forest appear to be incorrect. Please correct.
   Navy Response: The format of these subheadings has been corrected.

c. Page 1-4, Section 1.2.1: The area of habitat consisting of dry scrub forest (7 acres), secondary growth forest (2 acres) and mangrove forest (1 acre) do not match the overall size of Cayo La Chiva which is reportedly 12 acres (Section 1.1). Please indicate whether unvegetated areas such as sand beaches and exposed rock comprise the remaining 2 acres of the island.

   Navy Response: Text in Section 1.2.1 has been updated to note that approximately 1.6 acres of unvegetated rocky shoreline and sandy beach occur along the island shoreline. In addition, acreages of the dominant habitat types have be updated as follows: dry scrub forest (7.2 acres), secondary growth forest (2.4 acres), and mangrove forest (0.8 acres).

d. Table E-2: The sampling depth of the discrete soil samples is indicated to be 0 to 12 feet. Please correct.

   Navy Response: Table E-2 has been corrected to show 0 to 1 foot.

e. Tables E-6, E-8 and E-9: The basis for the baseline plant, invertebrate, and/or small mammal BCFs indicate Table L-7 for many of the inorganic constituents. Please correct to Table E-7.

Navy Response: Tables E-6, E-8, and E-9 have been updated.

Responses to USFWS Comments on the
Draft UXO 18 Remedial Investigation/Feasibility Study Report

As was discussed in the Vieques Technical Meeting in San Juan the week of June 16, Cayo La Chiva does not appear as having been transferred to the Service and therefore is not part of the Vieques National Wildlife Refuge. This has been stated by the Service previously on numerous occasions and is substantiated by documents and maps related to the transfer of lands. For this reason, the document should be revised throughout to reflect that the Commonwealth of Puerto Rico is the owner of Cayo La Chiva and is the entity that will determine land use of the area. In particular , the Human Health Risk Assessment should be revised to reflect the land use plan provided by the Commonwealth, for example to indicate that Commonwealth employees such as those of the Puerto Rico Department of Natural and Environmental Resources will be accessing the island for biological monitoring or other activities as specified.

Navy Response: Ownership of the land is still in the process of confirmation. However, ownership is not pertinent for evaluating alternatives because the existing alternatives evaluated are applicable regardless of ownership. Also, an additional alternative has been added between Alternatives 2 and 3 to support potential recreational use (e.g., beach access, interpretive trails, observation tower), which can be evaluated independent of land ownership. Therefore, all references to land ownership have been removed. For example, where "USFWS worker" was used, a generic "worker" has been substituted since the assumptions used for recreational and maintenance activities would be similar regardless of who is performing them.

Section 1 .2. l , Paragraph I : Please add the acronym for the Eastern Maneuver Area and Surface Impact Area to the first sentence.

Navy Response: Revised as requested, as well as including the acronym for the Eastern Conservation Area.

Section 2.2, Paragraph 3: The soil samples were also analyzed for several wet chemistry parameters (pH, TOC, and ORP) and these should be listed in the text.

Navy Response: pH, redox, and total organic carbon have been added to Paragraph 3.

Section 2.2.1, Paragraph 3: The text indicates that the incremental soil samples collected on June 12, 2013 and November 11, 2013 were submitted for analysis of explosives and inorganic constituents. However Table 4-1 indicates that semivolatile compounds were not detected. The Table should be revised to indicate that analyses were not conducted for semivolatile compounds.

Navy Response: A footnote was added to "No Detections" under "Semivolatile Organic

Compounds (ug/kg)" and defined in the "Notes" as "SVOCs analysis was performed only on discrete soil samples."

Section 10.2, Paragraph 2 and Section 10.3. Paragraph 4: For remedial option s 2 and 3, the text indicates that annual inspection s will be conducted to observe signs of trespassing, ensure signage is intact, and remove M EC that may have become exposed. There should be provisions for inspections to identify and remove MEC following significant storm events.

Navy Response: Insignificant erosion is anticipated due to the amount of vegetation, absence or thin veneer of soil, and steep cliffs across the island.

Responses to Puerto Rico DNER Comments on: Vieques NPL UXO-18 Draft RI/FS Report (CH2M HILL, May 2014) Comments prepared by Tim Reilly, LTCI (June 12, 2014)				
PDF Page #	**Doc. Page #**	**Section #**	**Highlighted Document Text/Summary of Content**	**Comments and Responses**
12	-	-	Figure 1-3 UXO 18 Cayo la Chiva MEC Investigation	What was the rationale for the selection of MEC transects; certain areas (central and southern) are without transects. Coverage is 5% (according to page 2-1)
				Navy Response: The 5-percent coverage is consistent with the other Site Inspection (SI) activities conducted at the former VNTR to meet the objectives of the investigation. As noted in Section 1.2.2, MEC inspection conducted as part of the biological assessment added another 3 percent. The following has been added to the end of the first paragraph in Section 2.1: "Coupled with the inspections that were performed to support the Biological Assessment, MEC clearance was performed across approximately 8 percent of the island, which included the accessible (relatively sparsely vegetated) area. In addition, MEC avoidance was performed along the sampling unit transects and no MEC was found." In addition, site inspections did cover the area that appears to be without transects in Figure 1-3. Because of the vegetation canopy present on the island, the GPS coverage and associated positioning tracking would be periodically lost during the inspections. However, the team was able to use the GPS to record the location of the MEC item in question. Figure 1-3 has been revised to show the approximate locations of the transects (as dashed green lines) that are not currently shown within the vegetated area. In addition, the accessible beaches were also included in

Responses to Puerto Rico DNER Comments on: Vieques NPL UXO-18 Draft RI/FS Report (CH2M HILL, May 2014) Comments prepared by Tim Reilly, LTCI (June 12, 2014)				
PDF Page #	**Doc. Page #**	**Section #**	**Highlighted Document Text/Summary of Content**	**Comments and Responses**
				the site inspection. The figure has been updated to reflect that as well.
22	4-1	4.1	The one-meter-wide transects from the Preliminary Inspection covered approximately 5 percent of the island, and another 3 percent of the island was covered (and no MEC identified) during the biological survey. In addition, no MEC was identified during the RI sampling within the two sampling units or adjacent to the former smoke canister locations. The transect inspections covered the accessible areas of UXO 18, which indicated only a few isolated MEC were present. Based on these findings, it can be assumed that other isolated MEC may be present throughout UXO 18. Based the relatively thin soil horizon (i.e., non-existent to less than about a foot), all potential MEC is at or close to the ground surface.	Addresses issue of why transects are located where they are. That said, only 8% of the island was searched for MEC (plus areas where incremental sampling occurred..). Given that MEC (5 inch) rockets were found on and off Cayo La Chiva, is there no reasonable way of conducting a more expansive search for MEC and RRD (i.e., smoke cannisters), especially given the accessibility from Blue Beach? [DNER: What is the anticipated use of this island? This will matter if we want to compel more rigorous MEC/RRD detection – thoughts??]
				Navy Response: As stated in Section 4.1, the past inspections included the accessible parts of the island, which are those that are sparsely vegetated. Therefore, the additional alternative suggested is not necessary. To make this information more clear in the document, the following text has been added: The following has been added to the end of the first paragraph in Section 2.1: "Coupled with the inspections that were performed to support the Biological Assessment, MEC clearance was performed across approximately 8 percent of the island, which included the accessible (relatively sparsely vegetated) area. In addition, MEC avoidance was performed along the sampling unit transects and no MEC was found."

Responses to Puerto Rico DNER Comments on: Vieques NPL UXO-18 Draft RI/FS Report (CH2M HILL, May 2014) Comments prepared by Tim Reilly, LTCI (June 12, 2014)				
PDF Page #	**Doc. Page #**	**Section #**	**Highlighted Document Text/Summary of Content**	**Comments and Responses**
				The following has been added at the end of the second paragraph in Section 3.1: "In general, the island is heavily vegetated. Accessible (relatively sparsely vegetated) areas account for a small percentage of the island area, based on observations during MEC clearance activities conducted on the island." The following bullet has been added to Alternative 2 in Section 10.2: "MEC clearance has already been performed on the accessible area (relatively sparsely vegetated) of Cayo La Chiva."
23	4-2	4.2.3	Hexavalent chromium was not detected at UXO 18, but the non-detect reporting limits (4 to 12 mg/kg) exceeded the SSL (0.00059 mg/kg), the adjusted Residential RSL (0.29 mg/kg), and the adjusted Industrial RSL (5.6 mg/kg; at only one incremental soil sample and one discrete soil sample) (**Appendix B**). How the elevated reporting limits were considered in the human health risk is discussed in Section 6. Hexavalent chromium is not associated with the 5-inch rockets or smoke canisters identified at the site; therefore, a release of hexavalent chromium at the site is unlikely.	Hexavalent chromium has been historically used extensively by the U.S. military and could be associated with many other sources besides 5-inch rockets or smoke canisters
				Navy Response: Comment noted. Five-inch rockets and smoke canisters were the only items identified on the island.
27	5-1	5.2	…no chemical contamination was detected at UXO 18, so the migration of discussion pertains to naturally occurring chemicals or hypothetical contaminants.	

Responses to Puerto Rico DNER Comments on: Vieques NPL UXO-18 Draft RI/FS Report (CH2M HILL, May 2014) Comments prepared by Tim Reilly, LTCI (June 12, 2014)				
PDF Page #	**Doc. Page #**	**Section #**	**Highlighted Document Text/Summary of Content**	**Comments and Responses**
				Navy Response: The word "of" between "migration" and "discussion" has been removed.
27	5-1	5.2	Actual and potential receptors at the site are both human and ecological. USFWS workers (conservatively assumed, as land ownership is not known and there is no known future planned use) and…..	I thought DNER was land owner??? Is this correct? If so, need to edit. Also, does DNER have plans for Cayo La Chiva. Should state here as intended use may impact risk assessments.
				Navy Response: Ownership of the land is still in the process of confirmation. However, ownership is not pertinent for evaluating alternatives because the existing alternatives evaluated are applicable regardless of ownership. Also, an additional alternative has been added between Alternatives 2 and 3 to support potential recreational use (e.g., beach access, interpretive trails, observation tower), which can be evaluated independent of land ownership. Therefore, all references to land ownership have been removed. For example, where "USFWS worker" was used, a generic "worker" has been substituted since the assumptions used for recreational and maintenance activities would be similar regardless of who is performing them.
28	-	Fig. 5-1	Conceptual Site Model Figure.	Change "USFWS Workers.." to "DNER and USFWS Workers…" Similarly do this for the human health risk assessment (Appendix D of report)
				Navy Response: Please see the response to DNER Comment 27. Figure 5-1 has been updated to use the term "Workers" rather than "USFWS Workers." In addition, "USFWS Workers" has been changed to "Workers" throughout Sections 5 and 6 and Appendix D because the particular agency is not relevant to the

Responses to Puerto Rico DNER Comments on: Vieques NPL UXO-18 Draft RI/FS Report (CH2M HILL, May 2014) Comments prepared by Tim Reilly, LTCI (June 12, 2014)				
PDF Page #	**Doc. Page #**	**Section #**	**Highlighted Document Text/Summary of Content**	**Comments and Responses**
				receptor category.
29	6-1	6.1	Chemicals of Potential Concern: Trespassers may be exposed to six inorganics ((aluminum, arsenic, cobalt, iron, manganese, and thallium)); and USFWS workers exposed to only Arsenic.	Why are USFWS workers only exposed to As, when they will likely be on site more than "trespassers"; and Add DNER workers to USFWS, as it is DNER's island?!
				Navy Response: Please see response to previous comment regarding worker designation. With respect to exposure, Section 6.1 identifies the chemicals of potential concern (COPCs) in site soil based on comparison of maximum detected concentrations to EPA Regional Screening Levels (RSLs) for specific land uses and receptor types (industrial or residential). Industrial soil RSLs (which are based on adult receptors) were used for the worker scenario, and arsenic was the only COPC identified based on comparison with site data. Although other chemicals are present in soil, they are not present at significant levels for adult workers since they are below risk-based screening levels based on a target excess lifetime cancer risk of $1x10^{-6}$ and a target non-cancer hazard quotient of 0.1. Residential soil RSLs (which are based on aggregate adult and child receptors and more conservative [lower] than industrial soil RSLs) were used for the trespasser scenario since a child age group was included. Due to the use of lower RSLs for this receptor group, more COPCs were identified.
33	8-1	8.2	Recommendations: …. Since no COCs were identified, the remedial alternatives evaluation is	Yes, the major issue is the potential for additional MEC and Range Related Debris (RRD) in the remaining 92% -

Responses to Puerto Rico DNER Comments on: Vieques NPL UXO-18 Draft RI/FS Report (CH2M HILL, May 2014) Comments prepared by Tim Reilly, LTCI (June 12, 2014)				
PDF Page #	**Doc. Page #**	**Section #**	**Highlighted Document Text/Summary of Content**	**Comments and Responses**
			necessary only for potential explosive hazards associated with the potential presence of MEC.	95% of the non-surveyed areas…
				Navy Response: Comment noted.
35	9-2	9.2	Remedial Action Objectives – contemplate trespassers	What is DNER's plans for this island? Does it involve recreational use? This will affect RAO's and, subsequently, selected remedial strategies, including Land Use Controls (LUCs)
				Navy Response: Please see the response to DNER Comment 27.
39	-	Table 9-1(c)	Federal Location-Specific ARARs – CZMA Comments Section: "Activities at SWMU 4 that will affect Puerto Rico's coastal zone will be consistent to the maximum extent practicable with Puerto Rico's enforceable policies. Activities performed on-site and in compliance with CERCLA are not subject to administrative review; however the substantive requirements of making a consistency determination will be met."	Revise since statement addresses SWMU 4, and not UXO 18
				Navy Response: "SWMU 4" has been replaced with "UXO 18."
40	-	Table 9-1(d)	Puerto Rico Location-Specific ARARs – nothing is listed.	DNER: Need to discuss the applicability of the Wildlife Law (241): specifically, what would be the effective requirement to adhere to under 241. For example, if there is critical habitat for a Commonwealth plant or animal species, we should add it. Thoughts??
				Navy Response: The Navy is unaware of any wildlife resources on the island specific to Wildlife Law (241).
47	-	Figure 10-1	Figure 10-1: Alternative 2 – Land Use Controls and MEC Inspections	All the Access Restriction Signs are clustered at the north end of the Cayo. Is it not possible for a boat to approach the Cayo from another direction and land without seeing the 5 Access Restriction Signs?

Responses to Puerto Rico DNER Comments on: Vieques NPL UXO-18 Draft RI/FS Report (CH2M HILL, May 2014) Comments prepared by Tim Reilly, LTCI (June 12, 2014)				
PDF Page #	**Doc. Page #**	**Section #**	**Highlighted Document Text/Summary of Content**	**Comments and Responses**
				Navy Response: The signs are located in areas where access to the island has been known to occur because they represent the only realistic access to the island. Accessing via the other portions of the island is unlikely given the steep cliffs, rougher wave action, dense vegetation, and/or general absence of beach.
-	-	-	-	General question/comment: 1. How explosive/stable are the 5-inch rockets (MEC) found on the site. Are they highly explosive? This matters when choosing between Alternatives 2 (Land Use Controls (LUC) and Long Term Monitoring (LTM)) and 3 (Vegetation/MEC Removal on whole island, LUC and LTM).
				Navy Response: As stated in Section 2.1, the 5-inch rockets found on the site were destroyed through controlled detonation.
				2. What is DNER's intention with future use of this island: a reserve? Heavy people traffic? This matters when selecting between Alternatives 2 and 3.
				Navy Response: Please see the response to DNER Comment 27.
				3. It is disruptive to remove all vegetation, given that only a few MEC and RRD were found so far…
				Navy Response: Comment noted.

Additional Responses to Regulator Comments

EPA Evaluations of the Responses to EPA Comments (RTCs) on the Draft Remedial Investigation/Feasibility Study Report UXO 18, dated May 2014; Former Vieques Naval Training Range, Vieques, Puerto Rico (Draft RI/FS)

GENERAL COMMENTS

1. The RI/FS does not provide sufficient details of the statistical analysis of the MEC discovered during the investigations conducted. There is no discussion of the statistical program employed, the confidence intervals, or the detailed reasoning behind the determination that Alternative 2 - Land Use Controls and MEC Inspections is as protective as is stated.

   Table 11-1, Detailed Evaluation of Remedial Alternatives, notes that Alternative 2 "… will meet RAOs because the explosive hazard associated with the site is low and this alternative implements LUCs to discourage site access with a monitoring program to perform MEC inspections (and removal if found) in accessed areas and ensure warning signs are operational." This is repeated in Section 12, Summary and Conclusions of the FS, where the second bullet (Alternative 2-Land Use Controls and MEC Inspections) in the second paragraph noted that, "Because only five isolated MEC have been identified on the island, this site has a relatively low explosive hazard associated with it." However, this statement is based on transects searching for MEC over approximately five percent of the island surface and an additional three percent of transects done in support of the Biological Assessment.

   No statistical confirmation is presented that this quantity/area of transects is sufficient to characterize the MEC hazard on the island as stated. Based upon this, the cited definitive statements concerning the low explosive hazard presented on the site appear to be presumptive. This could result in the questioning of the validity of the statements concerning the existing MEC hazard on the site and the comparison of Alternatives 2 and 3.

   Revise the RI/FS to provide the noted review of the statistical evaluation of the transects, the munitions items found, and its sufficiency for determining that the site has a low explosive hazard.

   Navy Response: Statistical evaluation of the transects was not performed. The transects covered the accessible portions (i.e., relatively sparsely vegetated) of the island and accounted for approximately 8 percent of the island, which is consistent with other MEC inspections conducted on Vieques. Since the inspections covered the accessible portions of the island, because there are no known records of use of the island for training exercises, and because so few munitions were found and all of the same type (which indicates use of the island was very likely one-time), the Navy feels the residual explosive risk is low, which is a subjective term appropriate for use in this context. To provide additional justification in the document, the following text has been added:

   The following has been added to the end of the first paragraph in Section 2.1: "Coupled with the inspections that were performed to support the Biological Assessment, MEC clearance was performed across approximately 8 percent of the island, which included the accessible (relatively sparsely vegetated) area. In addition, MEC avoidance was performed along the sampling unit transects and no MEC was found."

   The following has been added at the end of the second paragraph in Section 3.1: "In general, the island is heavily vegetated. Accessible (relatively sparsely vegetated) areas account for a small percentage of the island area, based on observations during MEC clearance activities conducted on the island."

The following bullet has been added to Alternative 2 in Section 10.2: "MEC clearance has already been performed on the accessible area (relatively sparsely vegetated) of Cayo La Chiva."

EPA Evaluation of the Response to General Comment 1: The response partially addresses the comment. The response states that "The following bullet has been added to Alternative 2 in Section 10.2: 'MEC clearance has already been performed on the accessible area (relatively sparsely vegetated) of Cayo La Chiva.'" The wording of this statement appears to indicate that both a surface and subsurface removal has been conducted, which is not the case. Revise the response and the inserted bullet to reflect the fact that only a surface removal of munitions and explosives of concern (MEC) was conducted in the accessible portions of the site. Also, ensure that any other discussion of the removal action conducted does not appear to indicate that the action included a subsurface removal of MEC.

Navy Response to Evaluation: Section 2.1 has been revised as follows (underlined words are those that have been added): "Coupled with the inspections that were performed to support the Biological Assessment, MEC <u>surface</u> clearance was performed across approximately 8 percent of the island, which included the accessible (relatively sparsely vegetated) area. In addition, anomaly avoidance was performed along the sampling unit transects and no MEC was found. It is important to note that because only a thin veneer of soil is present across the island, it is unlikely any MEC could be present in the subsurface."

Section 3.1 has been edited as follows: "In general, the island is heavily vegetated. Accessible (relatively sparsely vegetated) areas account for a small percentage of the island area, based on observations during MEC <u>surface</u> clearance activities conducted on the island."

Section 10.2 has been edited as follows: "MEC <u>surface</u> clearance has already been performed on the accessible area (relatively sparsely vegetated) of Cayo La Chiva. In addition, because only a thin veneer of soil is present across the island, it is unlikely any MEC could be present in the subsurface."

2. A number of different terms are employed in the RI/FS to describe the process that the Department of Defense Ammunition and Explosives Safety Standards (DoD 6055.09-M) refers to as "anomaly avoidance." Among the terms used are "anomaly avoidance," "MEC avoidance," and "UXO avoidance." The U.S. Naval Sea Systems Command (NAVSEA)
   Ordnance Pamphlet (OP) 5, Volume 1, Revision 7 (Ammunition and Explosives Safety Ashore), notes that, "Anomaly avoidance is sometimes referred to as UXO avoidance." However, "UXO avoidance" is not noted in the DoD 6055.09-M, Volume 8 (Glossary) definition. As UXO (unexploded ordnance) is not the only category to be avoided, the use of the term "UXO avoidance" should be discouraged and "anomaly avoidance" should be used.

   In addition, the term "Detector-aided surface sweep" is used to describe what DoD 6055.09- M, V8, and NAVSEA OP 5, Volume 1, define as a "Technology-aided surface removal." Neither document uses the term "sweep" to refer to the activities involved in the described work process.

   Munitions identified as "smoke canisters" and "smoke canisters (ABC-M5)" were classified as "Range Related Debris (RRD)," which is incorrect. The correct term for these items is "Smoke Pot, Ground, HC, ABC-M5." In addition, RRD is defined in DoD 6055-09, V8, and NAVSEA OP 5, Volume 1, as:

   <u>Range-Related Debris.</u> Debris, other than munitions debris, collected from operational ranges or from former ranges (e.g., target debris, military munitions packaging and crating material).
   As the term "munitions debris" is used in the preceding definition, its definition is: <u>Munitions debris (MD).</u> Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal.

These "smoke canisters" should be properly identified and classified as munitions debris (MD), or as material potentially presenting an explosive hazard (MPPEH) until they are properly inspected and certified as free of explosive hazards.

Revise the RI/FS to replace the incorrect terms with the appropriate ones as described above.

Navy Response: The terms have been corrected, as noted in the comment, and the smoke canisters have been identified as MD.

EPA Evaluation of the Response to General Comment 2: The response partially addresses the comment. The response states that "The terms have been corrected, as noted in the comment, and the smoke canisters have been identified as MD." However, the term "UXO avoidance" is occasionally being used instead of the preferred term "anomaly avoidance." In addition, the term "MEC avoidance" is used in some of the responses to the comments presented by the other regulatory agencies. Replace "UXO avoidance" and "MEC avoidance" with "anomaly avoidance" as is indicated in the response to the EPA comment.

Navy Response to Evaluation: All occurrences of the terms "UXO avoidance" and "MEC avoidance" throughout the RI/FS and in responses to agency comments have been replaced with the term "anomaly avoidance."

5. The screening of technologies summary presented in Appendix F, Technology Screening Summary for UXO 18, is inconsistent with the technology screening summary presented in Table 9-2, Technology Screening Summary. For example, "long-term monitoring" and "native soil cover" are listed as remedial technologies in Appendix F, but are not listed in Table 9-2. Similarly, Table 9-2 lists "physical treatment" as a remedial technology, but this is not discussed in Appendix F. In addition, it is noted that the second paragraph of Appendix F states that "this appendix provides a general overview and evaluation of the remediation technologies for perchlorate…." Based on review of the RI/FS, perchlorate is not a contaminant of concern at UXO 18; as such, it is unclear whether all of the remedial technologies presented are applicable to UXO 18. Revise Appendix F and Table 9-2 to ensure that the information presented is consistent, and that the remedial technologies considered are applicable to UXO 18.

   Navy Response: All of the technologies presented in Appendix F are not intended to be shown in Table 9-2; the text in Section 9.5 states that "Table 9-2 summarizes the results of the technology screening process and process options retained for further evaluation." As such, the intent of Table 9-2 was to summarize just the GRAs that were considered reasonable options for addressing MEC at UXO 18; at the end of each discussion for the technologies presented in Appendix F, the text states whether the technology was or was not retained for further evaluation. To clarify this in Section 9.5, the sentence in the text has been revised to read: "Table 9-2 summarizes the results of the technology screening process and presents only those technologies retained for further evaluation via the screening process presented in Appendix F."

EPA Evaluation of the Response to General Comment 5: The response partially addresses the comment. It is understood that Table 9-2, Technology Screening Summary, summarizes the results of the technology screening process presented in Appendix F, Technology Screening Summary for UXO 18, and presents only those retained for further evaluation; however, the response does not address the fact that Table 9-2 lists "physical treatment" as a remedial technology, but this technology is not described or discussed in Appendix F. Revise Appendix F to describe and discuss the physical treatment remedial technology, or remove it from Table 9-2.

Navy Response to Evaluation: Because physical treatment consists of the destruction of identified/recovered MEC through detonation, which is an inherent component of the "MEC Removal" remedial technology, the "Treatment" row has been removed from Table 9-2.

6. Appendix F, Technology Screening Summary for UXO 18, and Section 10.3, Alternative 3 – MEC Removal, Land Use Controls, and MEC Inspections, do not describe the specific detection, recovery, and disposal technologies that will be used as part of the munitions and explosives of concern (MEC) removal process. As such, it is unclear if Alternative 3 was appropriately scoped and costed so as to reflect a -30%/+50% margin as allowed for during the FS process. Revise Appendix F and Section 10.3 to describe the MEC removal alternative in more detail, specifying the detection, recovery, and disposal technologies, and ensure that all assumptions are noted and substantiated in Appendix H, Cost Estimates.

   Navy Response: As noted previously, Appendix F presents broad categories for potential suitable types of remediation strategies for the site. This step in the FS process is to segregate the technologies that warrant further consideration from those not viable alternatives or not worthy of further consideration (relative to those retained). Further, the level of detail in Appendix F and Section 10.3 is appropriate to adequately compare alternatives against one another and is consistent with the EPA's RI/FS guidance for evaluating process options (Section 4.2.5) which states "The representative process provides a basis for developing performance specifications during preliminary design; however, the specific process actually used to implement the remedial action at a site may not be selected until the remedial design phase."

   With regards to the level of detail and the cost estimate associated with Alternative 3, site-specific data regarding cost were used as the basis for the estimated cost of this alternative. The basis for the unit rates and any adjustments to the unit rates are provided in each line item.

EPA Evaluation of the Response to General Comment 6: The response does not address the comment. While it is understood that Appendix F, Technology Screening Summary for UXO 18, presents the technology screening process for the FS and does not require further detail, Section 10.3, Alternative 3 – MEC Removal, Land Use Controls, and MEC Inspections (now Section 10.4), should present a detailed description of Alternative 3 (now Alternative 4). As outlined in the RI/FS Guidance, "Alternatives are defined during the development and screening phase (see Chapter 4) to match contaminated media with appropriate process options. However, the alternatives selected as the most promising may need to be better defined during the detailed analysis. Each alternative should be reviewed to determine if an additional definition is required to apply the evaluation criteria consistently and to develop order-of- magnitude cost estimates (i.e., having a desired accuracy of +50 percent to -30 percent)." As such, for completeness and to demonstrate that Alternative 3 was appropriately scoped and costed so as to reflect a -30%/ +50% margin, revise Section 10.3 (now Section 10.4) to provide a description of the detection, recovery, and disposal technologies that will be used as part of the MEC removal process. In addition, it is noted that the MEC removal cost presented in Appendix H, Cost Estimates, is based on "average cost of MEC subsurface anomaly removal on USAE contract VT004." Ensure that the costs presented in Appendix H do, in fact, reflect the detection, recovery, and disposal technologies that will be used as part of the MEC removal process. It should be noted that this comment also applies to the description of the new Alternative 3 – Limited MEC Removal, Land Use Controls, and MEC Inspections presented in Section 10.3.

Navy Response to Evaluation: The Navy feels that using actual costs for munitions removal that have been realized by the munitions removal contractor on Vieques for several years is sufficient to meet the -30/+50 accuracy target and that the detail provided in Section 10 and Appendix H are sufficient. These costs and the site condition (i.e., accessibility and working constraints) have been evaluated and the costs have been escalated, as appropriate, and noted in Appendix H, to account for difficulties in accessing the island and

other technical challenges to implementing the remedial action.

9. Appendix B, Data Quality Evaluation (DQE), indicates that data quality was not impacted because results were not rejected (or rejected results were resampled), but the DQE does not discuss whether any biases or trends were noted in the quality control (QC) results and if they negatively affect the usability of the data. The DQE should discuss how biases and trends were evaluated and provide sufficient information is provided to support the data usability conclusions. Revise the DQE to discuss biases or trends in the QC results, if they may impact data usability, and ensure sufficient information is provided to support the data usability conclusions.

   Navy Response: The third sentence of the first paragraph under Section B.0.6 has been revised to read: "To help identify trends, for each combination, the count (number of results that possess this combination) is provided as well as the determination of whether such a result is affected by a bias, is available for use as reported, is available for use as qualified, or is not available for use (rejected)."

   In addition, Table B-2 has been updated to state whether a result is affected by a bias, as evinced by its DV_Qual_Code.

EPA Evaluation of the Response to General Comment 9: The response partially addresses the comment. The response indicates that the bias for each qualification will be reported in Table B-2, but a discussion of any overall bias and trends in the quality control (QC) results is not provided. Revise the Data Quality Evaluation (DQE) to include a discussion of whether any significant biases and/or trends were observed in the QC results associated with the UXO 18 samples, how potential biases and trends were evaluated, and if significant biases or trends were observed, how this impacted the project decisions. Also, ensure this discussion includes sufficient information to support the data usability conclusions.

Navy Response to Evaluation: Section B.2.2 (Accuracy) has been revised to read:
". . . Accuracy is also assessed by calibration recoveries. Potential biases and trends were evaluated by first determining whether a QA/QC exceedance may indicate a potential bias or trend. If so, then the exceedance was examined to determine whether the bias or trend was significant enough to warrant rejection of data. A significant negative bias was identified as evidenced by rejection of nondetect picric acid results due to low ground LCS recovery. However, because it was determined that these results would be rejected, and thus would not be available for use, a proactive decision was made to recollect the samples and modify the grinding procedure. Replacement points were acceptable, there are no data gaps, and there is no impact on the project decisions made using the data. Therefore, there is no negative impact . . ."

SPECIFIC COMMENTS

8. A**ppendix B, Section B.0.2, Data Validation, Page B-2:** The text discusses QC parameters that were reviewed during data validation, but it is unclear if all of the necessary QC parameters were evaluated (e.g., column confirmations, post-digestion spikes, and serial dilutions). Revise this section to clarify all of the QC parameters evaluated during data validation.

   Navy Response: The text was revised to read: "Example areas of review include holding time compliance, surrogate recovery accuracy, matrix spiked sample precision and accuracy, blank contamination, initial and continuing calibration accuracy and precision, laboratory control sample accuracy, internal standard response and retention time accuracy, instrument tune criteria accuracy, and duplicate sample precision (laboratory replicates and field duplicates). Please refer to the complete data validation report for full areas of review."

EPA Evaluation of the Response to Specific Comment 8: The response partially addresses the comment. The response indicates that validation reports contain a discussion of all areas of review. However, the validation reports do not always indicate if post digestion spikes (PDS) were analyzed (e.g., sample delivery group 70987). Revise Appendix B and/or the validation reports as necessary to clarify if PDS were analyzed when the metals matrix spike/matrix spike duplicate and/or serial dilution did not meet acceptance criteria, and if the PDS met acceptance criteria.

Navy Response to Evaluation: Please refer to Appendix A (data validation reports). Pages 129 through 130 (for SDG 70987) and pages 233 through 234 (for SDG 70988) document presence, review, and/or consideration of exceedances for PDS in the event that MS did not meet criteria. Note that above-referenced page numbers are out of a total of 293 pages and that SDG 72181 did not include metals.

10. **Appendix E, Ecological Risk Assessment, Attachment Table E-1-9 Summary of Norway Rat Exposure Doses-Baseline (Step 3A) -95% UCL:** The 95% Upper Confidence Limit (UCL) surface soil concentration for hexachloroethane (2.17 mg/kg) exceeds the range of non-detect values (1.9-2.10 µg/kg) from Table E-19. Note that the hexachloroethane value in Table E-19 is presented in units of µg/kg, whereas the 95% UCLs in Attachment Table E-1-9 are in units of mg/kg. It does not appear that the hexachloroethane values were converted to mg/kg in the Attachment table. This error also occurs in Attachment Tables E-1-10 through E-1-16. Revise the 95% UCLs for hexachloroethane in these tables and insure they are in the correct units. Adjust all dose calculations as needed.

    Navy Response: The 95% UCL for hexachloroethane was corrected to 0.00217 mg/kg in Attachment Tables E-1-9 through E-1-16, and associated dose calculations were updated. Ecological risk conclusions regarding this chemical did not change.

EPA Evaluation of the Response to Specific Comment 10 - Appendix E: Regarding hexachloroethane surface soil concentrations, some clarification and/or explanation is needed regarding the fact that the 95% UCL of 0.00217 mg/kg is greater than the maximum value of 0.0021 mg/kg. Further, the 0.00217 value exceeds the range of non-detect values.

Navy Response to Evaluation: Since the 95% UCL of 0.00217 mg/kg is greater than the maximum value of 0.0021 mg/kg, the 95% UCL should default to the maximum. As a result, Tables E-1-9 through E-1-16 have been updated to show 0.0021 mg/kg as the 95% UCL value, with a footnote indicating that hexachloroethane defaulted to the maximum concentration.

Technical Review of the Navy's Responses to PREQB Comments and the Draft Final Version of the Draft Remedial Investigation/Feasibility Study Report, UXO 18, Atlantic Fleet Weapons Training Area–Vieques, Former Naval Ammunition Support Detachment, Vieques, Puerto Rico

The Navy's responses to PREQB comments are accepted, with the exception of the following comments, as discussed below.

1. **PREQB General Comment 2**: As currently developed the FS evaluates 1) no action, 2) Land Use Controls (LUCs), and 3) LUCs plus full vegetation removal followed by MEC removal. It is very possible that a fourth alternative, lying between the current #2 and #3 in complexity and scope, may be advantageous and should be considered. This alternative can possibly take advantage of the sparse vegetation in the interior of the site to achieve significant MEC removal without cutting vegetation.

   Navy Response: As stated in Section 4.1, the past inspections included the accessible parts of the island, which are those that are sparsely vegetated. Therefore, the additional alternative suggested is not necessary. To make this information more clear in the document, the following text has been added:

   The following has been added to the end of the first paragraph in Section 2.1: "Coupled with the inspections that were performed to support the Biological Assessment, MEC surface clearance was performed across approximately 8 percent of the island, which included the accessible (relatively sparsely vegetated) area. In addition, MEC avoidance was performed along the sampling unit transects and no MEC was found." The following has been added at the end of the second paragraph in Section 3.1: "In general, the island is heavily vegetated. Accessible (relatively sparsely vegetated) areas account for a small percentage of the island area, based on observations during MEC clearance activities conducted on the island." The following bullet has been added to Alternative 2 in Section 10.2: "MEC surface clearance has already been performed on the accessible area (relatively sparsely vegetated) of Cayo La Chiva."

PREQB Evaluation of Response to General Comment 2: It appears that the response to General Comment 2 contradicts the response to General Comment 1 as General Comment 1 says that "… an additional alternative has been added between Alternatives 2 and 3 to support potential recreational use … which can be evaluated independent of land ownership", while the response to General Comment 2 says, "Therefore, the additional alternative suggested is not necessary" and then goes on to explain why the additional comment will not be added. Please note that adding a new remedial alternative is documented as an agreement in both the Navy meeting minutes and the UXO Pro meeting report from the October 2014 Subcommittee meeting and EQB recalls general agreement among the Navy, regulators and potential land managers that development and evaluation of an additional alternative falling between LUCs only and complete vegetation clearance and MEC removal, for the purpose of allowing some site use in the future, was needed. Review of the revised RI/FS Report shows that the agreed-upon additional remedial alternative for "Limited MEC Removal, Land Use Controls and MEC Inspections" has been added to Chapter 10 and is now Alternative 3. Therefore, please revise the response for consistency with the response to General Comment 1 and the draft final report.

Navy Response to Evaluation: The second sentence in the original response is inaccurate. Instead of that sentence, the following sentence should have been included at the very end of the response:

"As noted in the response to General Comment 1, a fourth alternative has been developed to include the limited MEC removal that facilitates to-be-determined recreational activities at Cayo la Chiva."

2. **PREQB Page-Specific Comment 20**, Appendix D, Human Health Risk Assessment, Page 3-1, Section 3.2.2(i): The exposure factors developed for UXO 1 reflect site-specific exposure scenarios developed in consultation with USFWS for UXO 1 for five USFWS worker scenarios. Therefore, please include a discussion of each exposure parameter taken from the UXO 1 risk assessment and discuss why the value is appropriate for use at UXO 18 for a USFWS worker, based on consultation with USFWS.

   Navy Response: In the revised HHRA, the only exposure factor used from UXO 1 for workers was an exposure frequency of 35 days/year (2 days/week for 4 months per year), which is a reasonable exposure duration based on island maintenance regardless of ownership. Based on information provided in SAP Worksheet #10o (CH2MHILL, 2013), the shoreline is not a suitable turtle nesting area. There are no surface water features on the small (12-acre) island. Based on professional judgment, the primary purpose for current or future workers to be present onsite is for general wildlife and/or recreational management activities; 35 days/year is expected to be a reasonable exposure frequency for workers. Note that EPA RAGS Part A guidance (EPA, 1989) does not require that every exposure factor value be an upper-bound value since the multiplicative effect of using numerous upper-bound values in the intake equations would result in unrealistic exposure estimates. The 4th and 5th sentences of Section 3.2.2 of the HHRA were replaced with the following text: "Based on information provided in SAP Worksheet #10o (CH2MHILL, 2013), the shoreline is not a suitable turtle nesting area. In addition, there are no surface water features on the small (12-acre) island. Based on professional judgment, the primary purpose for current or future workers to be present onsite is for general wildlife and/or recreational management activities; 35 days/year is expected to be a reasonable exposure frequency for current and future site workers."

PREQB Evaluation of Response to Page-Specific Comment 20: Please clarify if DNER was consulted in developing the proposed exposure duration. The meeting minutes from the October ERP meeting document that DNER is the land manager. Therefore, PREQB prefers that DNER be consulted on the development of exposure parameter values to be used to evaluate worker exposure.

Navy Response to Evaluation: DNER was not consulted for exposure duration, but DNER did review the draft document, which included the exposure assumptions. DNER has provided only a conceptual land use plan for Cayo la Chiva. The exposure durations used in the risk assessment are appropriate for the conceptual planned land use (recreational) and are in accordance with standard EPA protocol.

Additional Comments on New Text Added to Draft Final Version of the Report

1. Please note that as stated in DNER's first comment below, the planned use for this island is recreational. Therefore, it appears more appropriate to use the term "recreational user" rather than "trespasser" throughout the document. Please revise the document, including the HHRA, accordingly.

   Navy Response: The term "trespasser" has been replaced with "recreational user" at all applicable occurrences within the document.

2. Section 11.3.3 and Tables 11-1 and 11-2:

   a. The benefits of removal of MEC in Alternatives 3 and 4 appear to be overly minimized. This evaluation "anticipates" "very little remaining MEC;" however, MD and five MEC have been found on this small island during the RI. Please provide supporting rationale for the statement that "… the reduction in magnitude of residual risk associated with Alternatives 3 and 4 is negligible compared to Alternative 2. It should be assumed that MEC will be found and removed if Alternatives 3 and 4

are implemented and that this will result in significant risk reduction especially in the focused MEC removal in Alternative 3. This is especially relevant since the future land use isn't fully planned yet and it is being assumed that there will be some recreational use of the island. Therefore, MEC removal is needed to support this future use.

Navy Response: The assertion that there will be a marginal decrease in residual risk associated with access to the island through Alternatives 3 and 4 is supported by the fact that there have only been 5 MEC identified on the island to date despite numerous site visits, site inspections covered the accessible portion of the island, the thin soil veneer indicates subsurface MEC is highly unlikely, and there are no known or documented live fire training activities that occurred at the site (so the presence of five items of the same kind is likely the result of a single event). Further, it is highly likely that additional clearance activities (i.e., visual sweep, anomaly identification) would be needed to support recreational use of the island. Anomaly avoidance would be conducted during construction of recreational features such as trails and observations tower(s), but it is likely that little or no additional MEC would be found. This information has been added to Section 11.3.3 to support the statement about "very little remaining MEC" and why the difference in magnitude of additional risk is negligible between alternatives.

b. Please clarify the following statement, "… Alternatives 2, 3, and 4 all provide excellent reliability of controls". Please clarify what controls are being discussed. If the site is opened for recreational use, as is assumed, please clarify how the warning signs anticipated in Alternative 2 will be effective controls. Section 11.3.3 needs to be revised to recognize the risk reduction benefits associated with MEC removal in Alternatives 3 and 4.

   Navy Response: To reflect that Alternatives 3 and 4 have the potential to result in a more permanent solution, Alternative 4 has been described to have the highest score for this criterion and Alternative 3 has been given a ranking between Alternatives 2 and 4.

3. Section 11.3.4 and Tables 11-1 and 11-2: If, as is assumed, the site is opened for recreational use, performing the MEC removal indicated in Alternative 3 provides critical reduction in the volume of MEC in the specific areas required by the reuse. This should be recognized in the evaluation. Therefore, please revise the following statement, "… all three alternatives have similar (good) reduction of toxicity, mobility, or volume through treatment."

   Navy Response: To reflect that Alternatives 3 and 4 have the potential to result in higher reduction of toxicity, mobility, and toxicity, Alternative 4 has been described to have the highest score for this criterion and Alternative 3 will be given a ranking between Alternatives 2 and 4.

4. Table 11-1:

   a. Alternative 3 provides the same immediate protection (Time until protection is achieved) as Alternative 2 because they both include the same LUCs. Alternative 3 also has the additional benefit of providing increased protection through focused MEC removal when that portion of Alternative 3 is implemented. Please note the benefit of this.

      Navy Response: This benefit has been reflected in Table 11-1 for both Alternatives 3 and 4, as the LUCs proposed are the same for Alternatives 2, 3, and 4. The entry for Alternative 3 has been revised to "Immediate; permanent warning signs have been installed. Within an estimated 5 to 6 months vegetation and MEC clearance activities will be completed as well." Similarly, the entry for Alternative 4 has been revised to "Immediate; permanent warning signs have been installed. Within

an estimated 7 to 9 months vegetation and MEC clearance activities will be completed as well. However, vegetation restoration could take years."

b. The text on "Administrative feasibility" discusses erosion control and cultural resource protection which are "technical" not "administrative". Also, this description of "administrative feasibility" needs to note that the future recreational reuse of the site is only possible (feasible) if the safety of future site users is ensured through implementation of the focused MEC removal described in Alternative 3.

   Navy Response: While erosion control and cultural resource protection are technical processes, their inclusion is appropriate when considering administrative feasibility as the long-term protection of the receiving surface water and the cultural resources on the island must be considered when balancing the desire to open and promote public access to the island against any future remedial action and ultimate land use. The erosion control and cultural resource protection needs are considered in the technical feasibility portion of the table in the statement that "services and materials are available" when executing Alternatives 3 and 4.

   The following has been added after the term "Administrative feasibility" in Table 11-1: "Future recreational use of the site is only possible (feasible) if the safety of future site users is adequately ensured"

   In addition, the following statement has been added to the administrative feasibility summary for Alternatives 3 and 4: "It is assumed that Alternative 3 or 4 will be accepted by the land owner, as it will help facilitate to-be-determined recreational uses of the island."

5. Section 12:

   a. Third Bullet: Please provide supporting rationale for the statement that "… any reduction in MEC hazard due to removal is offset by increased accessibility to other areas on the island." Please clarify how this equal offset was determined. PREQB believes that if the focused MEC removal in Alternative 3 is properly planned and implemented in conjunction with the reuse planning the safety of the reuse can be ensured and there will be no MEC safety "offset" as described in this summary.

      Navy Response: While it may not be an "equal offset," the Navy feels that enhancing access to portions of the island may increase the accessibility to other portions not intended for recreational use and, therefore, not intended for MEC clearance activities. To help avoid the perception that the offset would be equal," the phrase "is offset" has been replaced with "may be at least partially offset."

   b. Also, please provide supporting rationale for the statement in this section that Alternative 3 has "significantly higher impact to the island's physical environment." It appears there is a higher physical impact for Alternative 3 over Alternative 2; however, the focused and limited vegetation and MEC removal described in Alternative 3 can be minimal if properly planned. Please revise the text as appropriate, including removal of the word "significant" unless adequate supporting rationale/documentation is provided.

      Navy Response: The sentence has been changed to read: "Compared with Alternative 2, Alternative 3 has a higher impact to the island's physical environment and potential exposure of cultural resources that would be mitigated to the extent possible during execution of this alternative."

Department of Natural and Environmental Resources Comments

DNER Comments on: Draft Final Remedial Investigation/Feasibility Study Report UXO 18 Comments Made by DNER on January 13, 2015					
PDF Page #	**Doc. Page #**	**Section #**	**Highlighted Document Text/Summary of Content**	**DNER Comments**	**Navy Response**
27	5-1	5.2	… as land ownership is not known and there is no known future planned use…	Now that Navy understands that the Commonwealth of Puerto Rico owns Cayo La Chiva, state here that the landowner is the Commonwealth of Puerto Rico and throughout document as appropriate. Future planned use by landowner is recreational use for visitors. This should be stated here and throughout document as well.	For the purposes of the FS, it is not necessary to identify the land owner throughout the document. A statement has been added to the beginning of the document noting that the Commonwealth of Puerto Rico is the land owner and that recreational use is planned for the island, but the remainder of the text will remain as currently written. Details of land ownership and actual land use will be included in the RA work plan.
28		Figure 5-1	Conceptual Site Model figure.	Commonwealth plans to turn Cayo La Chiva into a recreational destination island for the benefit of the public, consistent with new remedial alternative 3 (Limited MEC Removal, Land Use Controls and MEC Inspections as described in Section 10.3 of the Draft Final RI/FS). Accordingly, "trespassers" referred to in the Conceptual Site Model (and throughout the document) are simply members of the public or "visitors". Therefore, change "trespassers" to "visitors" in the CSM figure. This change should be made here and throughout the RI/FS (e.g., Chapter 6 as well).	The term "trespasser" has been changed to "recreational user" in Figure 5-1 and throughout the document, as applicable.

DNER Comments on: Draft Final Remedial Investigation/Feasibility Study Report UXO 18 Comments Made by DNER on January 13, 2015					
PDF Page #	**Doc. Page #**	**Section #**	**Highlighted Document Text/Summary of Content**	**DNER Comments**	**Navy Response**
35	9-2	9.2 (RAO)	Reduce the potential for unauthorized access to the site.	If Cayo La Chiva is converted to a destination for the public, then what would constitute "unauthorized access"?	If the island is turned into a "…recreational destination island for the benefit of the public, consistent with new remedial alternative 3…" as stated above, it is assumed that public access to the areas outside of the paths and other areas with an intended recreational use would constitute unauthorized access. However, unauthorized access will ultimately need to be defined and enforced by the land owner.
43		Table 9-2	Technology Screening Summary: Land Use Controls Row	Change "Trespassers" to "Visitors"	The term "trespasser" has been changed to "recreational user" throughout the document, as applicable.
43		Table 9-2	Technology Screening Summary: Access Restrictions/Signs and Buoys Row: "Warning signs and buoys installed and maintained to discourage access to the island.	Text Edit: Change "discourage" to "manage"	"Discourage" has been changed to "manage."
45	10-2		{Description of Alternative 3}	A conceptual land use plan that reflects the future public use of Cayo La Chiva pursuant to Alternative 3 was provided to the Navy in August 2014. Add this figure (or a similar representation thereof) - see figure below this comment table - to Section 10.3.	The conceptual land use plan is not necessary for the FS and is not recommended since it is subject to change prior to finalization. Details of the land use can be included in the RA Work Plan if provided by DNER during the RA Work Plan preparation.

DNER Comments on: Draft Final Remedial Investigation/Feasibility Study Report UXO 18 Comments Made by DNER on January 13, 2015					
PDF Page #	**Doc. Page #**	**Section #**	**Highlighted Document Text/Summary of Content**	**DNER Comments**	**Navy Response**
46	10-3	10.3	{No assumptions regarding management signage was found in the text of the RI/FS for Alterative 3}	Add a bullet to the assumptions for Alternative 3 that states that signage will be placed on Cayo La Chiva to direct foot traffic away from areas not cleared. An assumption regarding the number of these safety signs is needed as well.	The sign assumptions already included in Alternative 2 (and by reference in Alternatives 3 and 4) are sufficient for cost-estimating purposes.
47		10.4	Second Bullet: A technology-aided surface removal detector-aided (i.e., magnetometer) surface sweep of the ground surface would be conducted to remove MEC exposed at and near the ground surface. Subsurface anomalies may comprise a combination of MEC, RRD, MD, trash, and rocks with a high iron content. Therefore, the number of anomalies may be considerably higher than the actual number of MEC. For the purposes of the Alternative 3 cost estimate, it is assumed there are 50 anomalies per acre. This assumption is based on subsurface anomaly densities observed at nearby Blue Beach and PAOC EE.	Change Alternative "3" to Alternative "4"	"Alternative 3" has been changed to Alternative 4."
49		Figure 10-2	**Figure 10-2** **Alternative 3 - MEC Removal, Land Use Controls, and MEC Inspections**	Edit: Change Alternative "3" to Alternative "4"	"Alternative 3" has been changed to Alternative 4."

DNER Comments on: Draft Final Remedial Investigation/Feasibility Study Report UXO 18 Comments Made by DNER on January 13, 2015					
PDF Page #	**Doc. Page #**	**Section #**	**Highlighted Document Text/Summary of Content**	**DNER Comments**	**Navy Response**
60	12-1	10.1	Alternative 3 has a significantly higher impact to the island's physical environment and potential exposure of cultural resources.	Add the underlined to the text: Alternative 3 has a significantly higher impact to the island's physical environment and potential exposure of cultural resources, <u>while increasing the safety for visitors to Cayo La Chiva, who would visit the island in any event. Moreover, this alternative is consistent with the future planned use of this site by the landowner, the Commonwealth of Puerto Rico.</u>	The Navy does not concur with the additional text requested. The added text seemingly implies that visitation to the island would be the same regardless of whether the island is opened for public access. While there is a certain percentage of the population that will visit the island regardless of the availability to the public, warning buoys and signs and other access restrictions reduce the level of unauthorized access. Furthermore, singling out Alternative 3 as being consistent with future land use may lead to a perception that the alternative has been pre-selected at the FS stage.

USFWS Evaluations of the Responses to USFWS Comments on the Draft Remedial Investigation/Feasibility Study Report: UXO 18, dated May 2014; Former Vieques Naval Training Range, Vieques, Puerto Rico (Draft RI/FS)

We have reviewed the preliminary responses to comments on the Draft UXO 18 RI/FS Report and associated red-lined report.

A primary concern of the Fish and Wildlife Service (Service) was related to the ownership of Cayo La Chiva. In the original draft it was stated that the ownership was that of the Service. We had stated that we understand the island falls under jurisdiction of the Commonwealth. This was reflected in a letter of September 3, 2014 from the Puerto Rico Department of Natural and Environmental Resources (Department) Secretary Carmen Guerrero. A conceptual plan of proposed land use was also submitted by the Department. References to ownership have been removed from the report and human health exposure scenarios have been made generic. While we do not object to the Navy's response to Service comments, we do believe that the issue of ownership and future land use should be resolved

Navy Response: Comment noted.