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TECHNICAL MEMORANDUM FOR OCUSED SITE INSPECTION SITE UXO-06 BORROW PIT
EXPANSION AREA SOIL EXCAVATION AND CONFIRMATION SAMPLING APPROACH FOR
DETONATION AREAS MCB CAMP LEJEUNE NC

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Focused Site Inspection, Site UXO-06 Borrow Pit Expansion Area – Soil Excavation and Confirmation Sampling Approach for Detonation Areas, Marine Corps Base Camp Lejeune, North Carolina

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Introduction

A munitions and explosives of concern (MEC) intrusive investigation is being conducted within the Borrow Pit Expansion Area (BPEA) at Marine Corps Base Camp Lejeune (MCB CamLej) in accordance with the *Focused Site Inspection Work Plan Addendum for UXO-06 Base Borrow Pit Expansion, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina* (CH2M HILL, 2009) and MCB CamLej Munitions Response Program Master Project Plans (MRP MPP) (CH2M HILL, 2008). This Technical Memorandum presents background information and the detailed approach for confirmation soil sampling and soil excavation to be implemented within the controlled detonation area (CDA) and at each blow-in-place (BIP) operation area at the BPEA.

Background

MEC intrusive investigation field activities completed to-date within the BPEA included land surveying, vegetation clearing, digital geophysical mapping (DGM), intrusive anomaly investigation, and collection of post detonation surface soil samples. The DGM survey was conducted using a single coil EM61-MK2¹, linked to a robotic total station (RTS) system. Areas that could not be geophysically surveyed because of the terrain were surveyed using handheld magnetometers (Schonstedt GA-52Cx, Whites, and EM61for QC) to identify anomalies. The purpose of the DGM survey was to identify geophysical anomalies that could represent potential subsurface MEC. A total of 10,388 geophysical anomalies have been identified from the DGM within the BPEA to-date as potentially representing subsurface MEC. All 10,388 anomalies identified as representing potential subsurface MEC have been intrusively investigated resulting in the discovery of a total of 29 MEC items.

¹ The EM61-MK2 is a high-resolution time-domain electromagnetic instrument designed to detect shallow ferrous and non-ferrous metallic objects with high spatial resolution.

All MEC items were disposed of by demolition using explosives within a 2,912 square foot CDA or the items were BIP. As of January 3, 2011, 10 MEC demolition events involving explosives were performed in the CDA and five BIP MEC demolition events were performed throughout the BPEA (**Figure 1**). Soil within the BPEA will be used as borrow material to support various facility projects underway throughout MCB CamLej; therefore, any impacted soils as a result of explosive operations performed during the MEC intrusive investigation within the BPEA must be excavated and disposed of offsite.

Post detonation surface soil sampling has been performed to evaluate the presence and nature of impacts to soils in the CDA and BIP operations areas as a result of explosives operations. Analytical results from post detonation sampling showed concentrations of metals and explosives residues above the adjusted United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs) and the North Carolina Soil Screening Levels (NC SSLs); therefore, excavation of the impacted soil and additional soil sampling will be conducted within the CDA and BIP operations areas (**Figure 2**).

Metallic anomalies that represent potential subsurface MEC or material potentially presenting an explosive hazard (MPPEH) were not identified within the grid encompassing the CDA or encountered during excavations performed to construct the CDA. Additionally, the maximum depth that subsurface MEC was identified and disposed of by BIP operations was one foot below ground surface (bgs). Therefore MEC is not anticipated to be encountered at depths greater than the depth that DGM and intrusive investigation activities were completed to which ranged from one to six feet bgs.

Sampling Approach Overview

Controlled Detonation Area

Pre-Excavation Sampling

A total of 10 MEC demolition events involving explosives were performed during the MEC intrusive investigation activities through January 3, 2011, at the BPEA within a 2,912 square foot CDA (**Figure 1**). Demolitions were completed at depths up to 4 feet below ground surface (bgs). Surface and subsurface soil sampling will be performed to evaluate the presence and nature of impacts to soils in the CDA as a result of explosives operations and to determine the extent of soil for excavation.

In order to reduce the potential volume of soil that will require offsite disposal, the CDA will be divided into four 46-foot X 16-foot decision units as shown on **Figure 1**. One composite surface and subsurface soil sample will be collected from each of the four decisions units using a modified incremental sampling approach. Five incremental samples will be collected within each decision unit and composited into a single sample in accordance with the *Homogenization of Soil and Sediment Samples* SOP in Appendix C of the MCB CamLej Munitions Response Program Master Project Plans (MRP MPP) (CH2M HILL, 2008). The sample increments will be approximately equal in the amount of soil and will be collected from 0 to 1 feet bgs for each surface soil sample and 4 to 5 feet bgs for each subsurface soil sample.

Additionally, the surface soil surrounding the CDA may have been impacted by the demolition events; therefore, surface soil samples will be collected outside the CDA from four decision units. The surface soil samples will be collected in accordance with the *Systematic Random Incremental Sampling* SOP in Appendix C of the MRP MPP (CH2M HILL, 2008). The incremental samples will be collected from depths of 0 - 2 inches bgs where the highest munitions constituents (MC) concentrations are mostly likely to exist, if present (Thiboutot, Ampleman, and Hewitt, 2002).

The decision unit dimensions were selected to assess surface soil 50 feet from the edge of the CDA. The distance of 50 feet is based on the document titled *Explosive Residues from Blow-in-Place Detonations of Artillery Munitions* (Pennington, 2008) which concluded that the majority of the explosives residue mass falls within 50 feet of the detonation center.

All soil samples from both inside and outside the CDA will be analyzed by a fixed base laboratory for the following parameters:

- Explosives residues (SW-846 USEPA Method 8330)
- Pentaerythritol tetranitrate (PETN) (SW-846 USEPA Method 8330)
- Nitroglycerine (SW-846 USEPA Method 8332)
- Perchlorate (SW-846 USEPA Method 6850)

Soil Excavation

The analytical results from the pre-excavation sampling will be compared to the adjusted United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs) and the North Carolina Soil Screening Levels (NC SSLs). If the concentrations in soils for a decision unit are above these screening levels, then supplemental soil sampling will be performed in order to delineate the extent of impacted soils. Upon completion of delineating the extent of impacted soils within a decision unit, soil will be excavated within the decision unit to a depth 1 foot below the extent of the impacted soil (or less if the water table is shallow) and disposed of offsite. After the excavation is complete, to confirm that no remaining MEC/MPPEH are present at depth, a magnetometer (Schonstedt GA-52Cx) and/or geophysics (EM61-MK2) will be utilized to inspect the area.

Post Excavation Sampling

After decision units are excavated for offsite disposal, confirmation soil samples will be collected to confirm all of the impacted soil was excavated. Confirmation sampling will consist of a composite soil sample from the floor and four side walls of each excavation. The composite soil samples will be collected using the TR-02-1 sampling approach described in the USACE Technical Report ERDC/CRREL TR-02-1, *Guide for Characterization of Sites Contaminated with Energetic Materials* (Thiboutot, Ampleman, and Hewitt, 2002). Soil samples will be collected by compositing a minimum of 30 sample increments from random locations within each area (e.g., either the floor of the excavation or one of the side walls). The sample increments will be approximately equal in the amount of soil, which will be collected from 0 to 2 inches. The sample increments at each location will be composited into a single sample in accordance with the *Homogenization of Soil and Sediment Samples* SOP in Appendix C of the MRP MPP (CH2M HILL, 2008).

All samples from both the floor and side walls of each excavation will be analyzed by a fixed base laboratory with a 24-hour turnaround time for the following parameters:

- Explosives residues (SW-846 USEPA Method 8330)
- Pentaerythritol tetranitrate (PETN) (SW-846 USEPA Method 8330)
- Nitroglycerine (SW-846 USEPA Method 8332)
- Perchlorate (SW-846 USEPA Method 6850)

If any of the analytical results from the confirmation samples are above the screening levels additional excavation and sampling will be conducted until the concentrations are below screening levels.

Blow-in-Place Operations Areas

Soil Excavation

A total of five BIP MEC demolition events were performed throughout the BPEA during the MEC intrusive investigation activities through January 3, 2011 (**Figure 1**). Soil from each BIP location will be excavated to 1 foot below the depth of the detonation. In addition, material was projected approximately 15 feet from the BIP location during demolition events based on field team observations; therefore, soil within 15 feet of the BIP location will be excavated to 1 foot bgs. All soils that are excavated will be disposed of offsite. After the excavation is complete, to confirm that no remaining MEC/MPPEH are present at depth, a magnetometer (Schonstedt GA-52Cx) and/or geophysics (EM61-MK2) will be utilized to inspect the area.

Post Excavation Sampling

Confirmation soil sampling will be performed at each BIP location after the soils are excavated using the same procedure described above for the CDA post excavation sampling. All samples from both the floor and side walls of each excavation will be analyzed by a fixed base laboratory for the following parameters:

- Explosives residues (SW-846 USEPA Method 8330)
- Pentaerythritol tetranitrate (PETN) (SW-846 USEPA Method 8330)
- Nitroglycerine (SW-846 USEPA Method 8332)

- Perchlorate (SW-846 USEPA Method 6850)

If any of the analytical results from the confirmation samples are above the screening levels, additional excavation and sampling will be conducted until the concentrations are below screening levels.

Path Forward

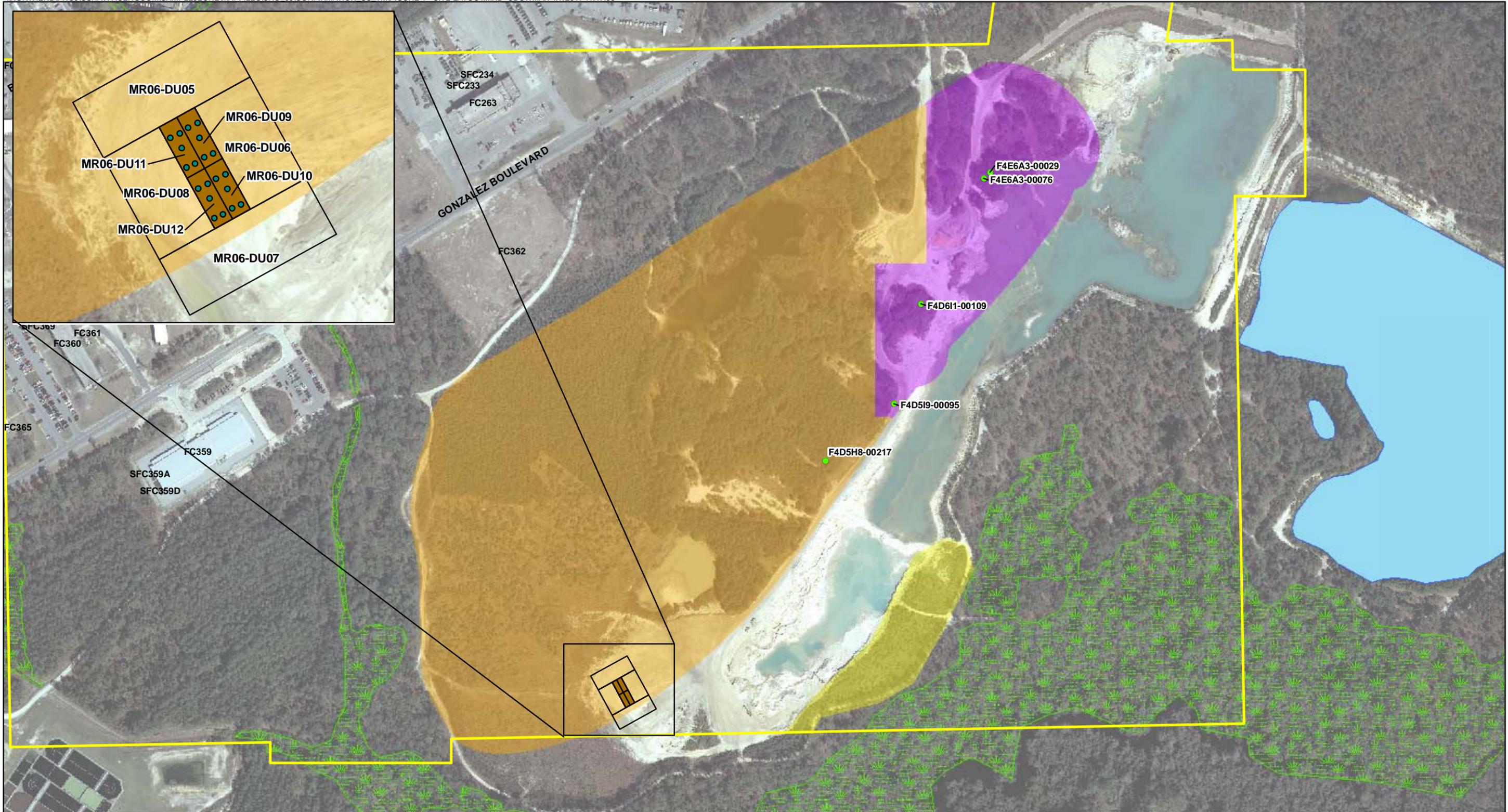
A technical memorandum will be prepared to document all soil excavation and confirmation soil sampling activities within the BPEA upon completion of the MEC intrusive investigation. The memorandum will include a description of soil excavation activities, confirmation sampling, analytical results, and conclusions.

As with all munitions response site investigations, it is not possible to provide 100 percent assurance that all MEC items have been removed within the BPEA, including the CDA and BIP operations areas, so there is some residual risk of encountering subsurface MEC within the BPEA. Because of this, the Base provides "3R" (Recognize, Retreat, Report) training to site operators who will be excavating borrow material from this area and provides on-call support from MCB CamLej Explosive Ordnance Disposal (EOD) or a qualified UXO contractor for inspection and disposal of suspected MEC that may be unearthed.

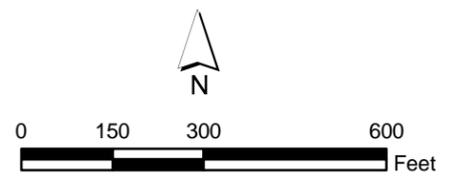
References

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- CH2M HILL. 2009. *Focused Site Inspection Work Plan Addendum for Site UXO-06 Base Borrow Pit Expansion, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*. August.
- Pennington, Judith C. et al. 2008. *Explosive Residues from Blow-in-Place Detonations of Artillery Munitions. Soil & Sediment Contamination* 17:163-180. 01 March 2008.
- Thiboutot, Ampleman, and Hewitt. 2002. *United States Army Corps of Engineers (USACE) Technical Report ERDC/CRREL TR-02-1, Guide for Characterization of Sites Contaminated with Energetic Materials*.

Figures



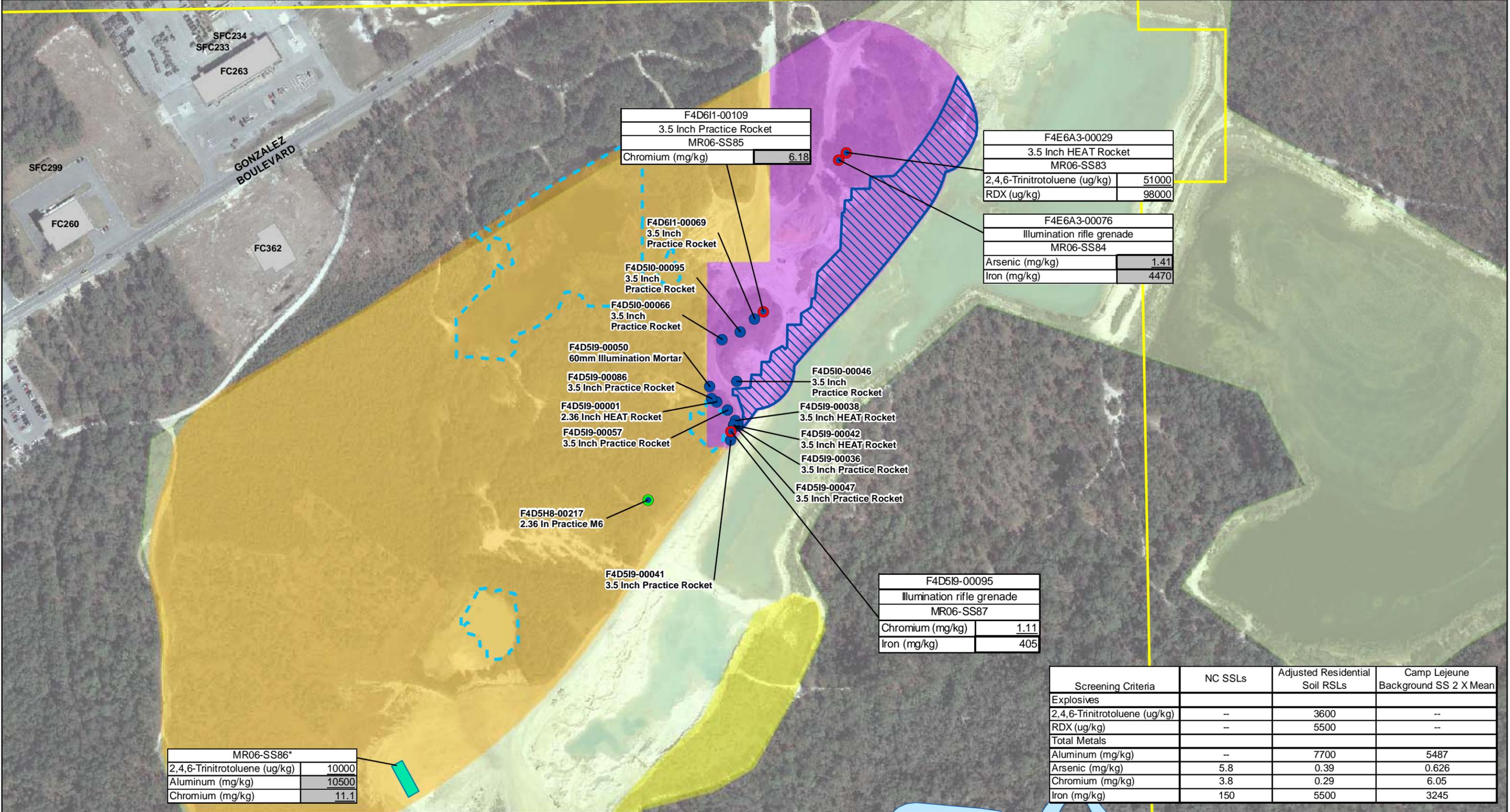
- Legend**
- Incremental Sampling Locations
 - BIP Locations
 - ▨ Jurisdictional Wetlands
 - Phase 1 Borrow Pit Expansion Area
 - Phase 1A Borrow Pit Expansion Area
 - Phase 2 Borrow Pit Expansion Area
 - ▭ UXO-06 Site Boundary
 - CDA Area
 - ▭ Decisions Units



1 inch = 300 feet

Figure 1
Site Layout
MCB CamLej
North Carolina





- Legend**
- Detonated Item (within CDA)
 - Detonated Item (Blown-in-Place)/Surface Soil Sample
 - Detonated Item (Blown-in-Place)
 - Controlled Detonation Area
 - Portion of the Investigation Area within the Borrow Pit Operation Area
 - Former Ponds
 - Phase 1 Borrow Pit Expansion Area
 - Phase 1A Borrow Pit Expansion Area
 - Phase 2 Borrow Pit Expansion Area
 - UXO-06 Site Boundary
 - Borrow Pit

Notes:
Underline indicates exceedance of Adjusted Residential Soil RSLs
 Shading indicates exceedance of two times the mean base background concentration for surface soil
Bold box indicates exceedance of NC SSL
 The higher result of the parent and the duplicate are shown
 * - Surface Soil Sample collected within the CDA

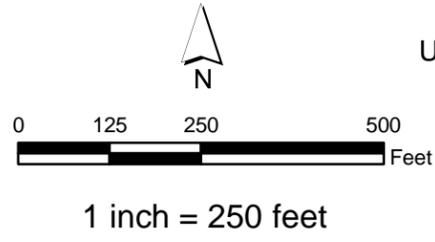


Figure 2
 UXO-06 Soil Exceedance/Detonated Items
 MCB CamLej
 North Carolina