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MCB CAMP LEJEUNE
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TECHNICAL MEMORANDUM REGARDING ENVIRONMENTAL INVESTIGATION
PRELIMINARY FINDINGS LANDFILL FIRING POSITION 2 MCB CAMP LEJEUNE NC
12/3/2008
CH2M HILL

Environmental Investigation - Preliminary Findings Landfill Firing Position 2, MCB Camp Lejeune, North Carolina

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Introduction

This technical memorandum presents a summary of CH2M HILL's October 2008 environmental investigation conducted at the Landfill Firing Position 2 located within Marine Corps Base (MCB) Camp Lejeune in Jacksonville, North Carolina. The site is located east of Piney Green Road and north of the current base landfill shown on **Figure 1**. Although referred to as Firing Position 2 and site number 2.212 in the *Range Identification and Preliminary Range Assessment* (USACE, 2001), this site is Former Gun Position 2 with several firing positions located within the investigation area. For consistency with the *Range Identification and Preliminary Range Assessment* and investigation work plan, this site will still be referred to as Firing Position 2. Firing Position 2 consists of a four-acre tract with approximately 60 percent of the investigation area being wooded along with several 'fox holes' identified during site reconnaissance.

The primary objective of this environmental investigation was to evaluate the potential presence and nature of impacts to environmental media resulting from historical munitions usage at the subject site. Accordingly, this investigation focused upon impacts to soil and groundwater by munitions constituents (MC). A secondary objective was to gather geophysical data as a preliminary step in determining the nature and extent of subsurface munitions and explosives of concern (MEC) that may be present at the site.

Background

Landfill Firing Position 2 was used as a firing position from the 1950s through at least 1985. Howitzers were positioned at Firing Position 2 and fired 105 millimeter (mm) and 155 mm projectiles into the G-10 Impact Area. Other munitions suspected to be used at Firing Position 2 include 4.2-inch mortars, 120mm mortars, and 175mm and 8-inch projectiles.

Investigation Activities

The investigation at Landfill Firing Position 2 was conducted in accordance with the *Site Specific Work Plan Addendum for Focused Preliminary Assessment/Site Inspection, Former Firing Position 2* (CH2M HILL, 2008). Field activities included land surveying, vegetation clearing, buried utility locating, digital geophysical mapping (DGM), and collection of surface soil, subsurface soil, and groundwater samples.

In order to facilitate DGM and sampling activities, the site boundary was surveyed and the site was cleared of standing vegetation less than three inches in diameter. DGM surveys were performed across the entire site, with the exception of areas that could not be accessed because of terrain, trees, or construction debris (concertina wire), using a single coil EM61-MK2¹, linked to a robotic total station (RTS) system. The purpose of the DGM survey was to identify geophysical anomalies that could potentially represent subsurface MEC. Following review of the DGM data, subsurface sampling locations were selected near, but for safety purposes not directly within, high anomaly density areas. Also for safety, buried utility clearance was performed within a 20-foot radius of each sampling location prior to sampling.

Environmental media sampling was conducted from October 6 through October 9, 2008, and included the collection and analysis of surface soil, subsurface soil, and groundwater samples for perchlorate by Method 6850, Resource Conservation and Recovery Act (RCRA) metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) by Method 6010B/7000, and explosives residues by Method 8330. Specific sampling procedures are detailed in the Site Specific Work Plan Addendum.

The environmental investigation included collection of the following samples:

- Three composite surface soil samples were collected from each of three decision units² for a total of nine samples (designated as ASR2.212-FP2-DU01-SS[01,02,03] through ASR2.212-FP2-DU03-SS[01,02,03]). The surface soil samples were collected from a depth of zero to two inches using the multi-increment (MI) sampling procedure; this approach is described in the *Systematic Random Multi-Increment Sampling* standard operating procedure (SOP) in the *Munitions Response Program Master Project Plans* (CH2M HILL, 2008).
- Four subsurface soil samples (designated as ASR2.212-FP2-IS01 through ASR2.212-FP2-IS04) were collected via direct push technology (DPT) from immediately above the water table, at depths ranging from three to seven ft below ground surface (bgs).
- Four groundwater samples (designated as ASR2.212-FP2-TW01 through ASR2.212-FP2-TW04) were collected from temporary monitoring wells. The screened interval of each temporary monitoring well ranged from four to 16 feet bgs.

The analytical results presented in this technical memorandum are preliminary data and have not been validated, and are therefore subject to change.

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.

² Decision units are sample areas that can range in size from 10m x 10m to 100m x 100m

Preliminary Findings

Digital Geophysical Mapping

Figure 2 provides a graphical representation of the EM61-MK2 survey data, and shows the presence of numerous geophysical anomalies. The DGM activities resulted in the discovery of a total of 1,310 geophysical anomalies representing potential subsurface MEC.

Saturated response areas (SRA's) were polygoned with a total of 21 SRA's at the site. The berm and mound areas contain the highest concentration of anomalies, especially in grids F5D6E2, F5D6F2, F5D6F2, and F5D6F2. Some anomalies were large in both response amplitude and size, indicating large pieces of metal close to the surface. Reinforced concrete and metal debris were observed on the surface in these areas, which may indicate the presence of similar construction related debris in the subsurface.

Surface Soil

Each composite surface soil sample consisted of a minimum of 30 sample increments collected from an individual decision unit, using the previously referenced MI sampling procedure. The nine surface soil samples (three from each of the three decision units) were analyzed for explosives residues, perchlorate, and RCRA metals.

Surface soil concentrations were screened against the USEPA industrial and residential regional screening levels (RSLs), and the North Carolina (NC) soil screening levels (SSLs). In addition, surface soil concentrations were also compared to two times the mean Base background concentrations. Surface soil analytical results are as follows:

- Explosives residues and perchlorate were not detected in any of the surface soil samples.
- Lead and chromium were detected at concentrations below the background criteria, USEPA industrial and residential RSLs, and NC SSLs in all surface soil samples.

Surface soil sampling locations are shown in **Figure 3**. Surface soil analytical results are presented in **Table 1**.

Subsurface Soil

Four subsurface soil samples (IS01 through IS04) were collected and analyzed for explosives residues, perchlorate, and RCRA metals. Subsurface soil concentrations were screened against the USEPA industrial and residential RSLs and the NC SSLs. In addition, subsurface soil concentrations were also compared to two times the mean Base background concentrations. Subsurface soil analytical results are as follows:

- Explosives residues and perchlorate were not detected at any of the subsurface soil samples locations.
- Lead and chromium were detected at concentrations below the background criteria, USEPA industrial and residential RSLs, and NC SSLs in all subsurface soil samples.

Subsurface soil sampling locations are shown in **Figure 3**. Subsurface soil analytical results are presented in **Table 2**.

Groundwater

Four groundwater samples (TW01 through TW04) were collected and analyzed for explosives residues, perchlorate, and total RCRA metals. Groundwater samples were screened against USEPA tap water RSLs adjusted for groundwater and NC2L groundwater quality standards (NC2LGW). In addition, groundwater samples were also compared to two times the mean Base background concentrations. Groundwater analytical results are as follows:

- Explosives residues were not detected at any of the sample locations.
- Lead, selenium, and chromium were detected at concentrations above the background criteria in at least one groundwater sample.
- Lead, chromium, and selenium were not detected at concentrations above the adjusted tap water RSLs or NC2LGWs in any groundwater samples.
- Perchlorate was detected at one sample location with concentrations below the adjusted tap water RSL.

Groundwater sampling locations and screening criteria exceedances are shown in **Figure 4**. Groundwater analytical results are presented in **Table 3**.

Follow-on Activities

The raw laboratory analytical data summarized in this correspondence will be validated, and human health and ecological risk screenings will be conducted. An intrusive investigation of select geophysical anomalies will be conducted to evaluate the potential for subsurface MEC to be present at the site. Intrusive investigation with handheld metal detectors should also be conducted in areas where DGM cannot be completed (e.g., trenches). Mechanized equipment may be used for removal of the buried construction debris. The conclusions and recommendations will be documented in an Environmental Investigation Report.

References

United States Army Corps of Engineers (USACE). 2001. *Final Range Identification and Preliminary Range Assessment, Marine Corps Base Camp Lejeune, Onslow, North Carolina*. St. Louis District. December.

CH2M HILL. 2008. Site Specific Work Plan Addendum for Focused Preliminary Assessment/Site Inspection, Former Firing Position 2, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.

Tables

Table 1
Preliminary Surface Soil Exceedances
 Landfill Firing Position 2
 MCB Camp Lejeune
 North Carolina

Sample ID	RSL's Industrial Soil Adjusted	RSL's Residential Soil Adjusted	NCSSL (May 2005)	Camp Lejeune Background SS 2X Mean	Decision Unit 1		
					ASR2.212-FP2-DU01-SS01	ASR2.212-FP2-DU01-SS02	ASR2.212-FP2-DU01-SS03
Sample Date					10/6/08	10/6/08	10/6/08
Chemical Name							
Explosives (mg/kg)							
No Exceedances							
Total Metals (mg/kg)							
Chromium	1400	280	27.2	6.05	2.6	2.8	2.5
Lead	800	400	270	12.3	4.6	4.3	4.1

Notes:

Data report is unvalidated

B - Analyte not detected above the level reported in blanks

BN* - Below detection limit; spiked sample recovery was not within control limits

mg/kg - milligrams per kilogram

N* - Spiked sample recovery was not within control limits

NA - Not analyzed

U - The material was analyzed for, but not detected

UN* - Not Detected; spiked sample recovery was not within control limits

Shading exceeds RSL

Bold box exceeds NC SSLs

Bold text exceeds Background

Table 1
Preliminary Surface Soil Exceedances
 Landfill Firing Position 2
 MCB Camp Lejeune
 North Carolina

Sample ID	RSL's Industrial Soil Adjusted	RSL's Residential Soil Adjusted	NCSSL (May 2005)	Camp Lejeune Background SS 2X Mean	Decision Unit 2			
					ASR2.212-FP2-DU02-SS01	ASR2.212-FP2-DU02-SS01D	ASR2.212-FP2-DU02-SS02	ASR2.212-FP2-DU02-SS03
Sample Date					10/6/08	10/6/08	10/6/08	10/6/08
Chemical Name								
Explosives (mg/kg)								
No Exceedances								
Total Metals (mg/kg)								
Chromium	1400	280	27.2	6.05	3.8	3.8	4.3	3.8
Lead	800	400	270	12.3	6.6	6.6	7.2	6

Notes:

Data report is unvalidated

B - Analyte not detected above the level reported in blanks

BN* - Below detection limit; spiked sample recovery was not within control limits

mg/kg - milligrams per kilogram

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Shading exceeds RSL

Bold box exceeds NC SSLs

Bold text exceeds Background

Table 1
Preliminary Surface Soil Exceedances
 Landfill Firing Position 2
 MCB Camp Lejeune
 North Carolina

Sample ID	RSL's Industrial Soil Adjusted	RSL's Residential Soil Adjusted	NCSSL (May 2005)	Camp Lejeune Background SS 2X Mean	Decision Unit 3		
					ASR2.212-FP2-DU03-SS01	ASR2.212-FP2-DU03-SS02	ASR2.212-FP2-DU03-SS03
Sample Date					10/6/08	10/6/08	10/6/08
Chemical Name							
Explosives (mg/kg)							
No Exceedances							
Total Metals (mg/kg)							
Chromium	1400	280	27.2	6.05	4.5	4.3	4.7
Lead	800	400	270	12.3	6	5.4	6.7

Notes:

Data report is unvalidated

B - Analyte not detected above the level reported in blanks

BN* - Below detection limit; spiked sample recovery was not within control limits

mg/kg - milligrams per kilogram

N* - Spiked sample recovery was not within control limits

NA - Not analyzed

U - The material was analyzed for, but not detected

UN* - Not Detected; spiked sample recovery was not within control limits

Shading exceeds RSL

Bold box exceeds NC SSLs

Bold text exceeds Background

Table 2
Preliminary Subsurface Soil Exceedances
 Landfill Firing Position 2
 MCB Camp Lejeune
 North Carolina

Sample ID	RSL's Industrial Soil Adjusted	RSL's Residential Soil Adjusted	NCSSL (May 2005)	2x Average Base-Wide Background Subsurface Soil	ASR2.212-FP2-IS01-3-5	ASR2.212-FP2-IS01D-3-5	ASR2.212-FP2-IS02-4-6	ASR2.212-FP2-IS03-5-7	ASR2.212-FP2-IS04-5-7
Sample Date					10/7/08	10/7/08	10/7/08	10/7/08	10/7/08
Chemical Name									
Explosives (mg/kg)									
No Exceedances									
Total Metals (mg/kg)									
Chromium	1400	280	27.2	14.5	2.5	7.7	2.3	12.4	3.3
Lead	800	400	270	8.49	2.3	3.1	2.6	6.1	2.4

Notes:

Data report is unvalidated

B - Analyte not detected above the level reported in blanks

mg/kg - milligrams per kilogram

NA - Not analyzed

U - The material was analyzed for, but not detected

UN - Not detected; spiked sample recovery was not within control limits

Shading exceeds RSL

Bold box exceeds NC SSLs

Bold text exceeds Background

Table 3
Preliminary Groundwater Exceedances
 Landfill Firing Position 2
 MCB Camp Lejeune
 North Carolina

Sample ID	RSLs Tap for GW Adjusted	NC2LGW (Dec. 2005)	2x Base-Wide Background Groundwater	ASR2.212-FP2-TW01	ASR2.212-FP2-TW01D	ASR2.212-FP2-TW02	ASR2.212-FP2-TW03	ASR2.212-FP2-TW04
Sample Date				10/9/08	10/9/08	10/9/08	10/9/08	10/9/08
Chemical Name								
Explosives (µg/L)								
No exceedances								
Total Metals (µg/L)								
Chromium	11	50	3.13	10.4	3.6 B	5.1 B	0.8 U	2.2 B
Lead	--	15	2.8	4.1	2.8 U	2.8 U	2.8 U	2.8 U
Selenium	18	50	3.14	4.3 U	4.3 U	4.3 U	6.9	4.3 U
Wet Chemistry (µg/L)								
Perchlorate	2.6	--	--	0.2 U	0.2 U	0.2 U	0.2 U	0.47

Notes:

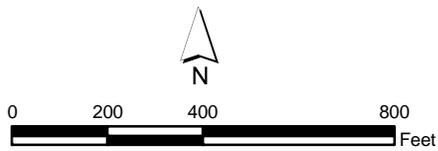
- Data report is unvalidated
- * - Duplicate analysis was not within control limits
- E - Estimated concentration due to interference
- B - Analyte not detected above the level reported in blanks
- N - Tentative Identification. Consider Present. Special methods may be needed to confirm its presence or absence in future sampling efforts
- NA - Not analyzed
- U - The material was analyzed for, but not detected
- PCT/REC - Percent recovery
- µg/L - micrograms per liter
- Shading exceeds RSL
- Bold box exceeds NCGWS**
- Bold text exceeds Background**

Figures



Legend

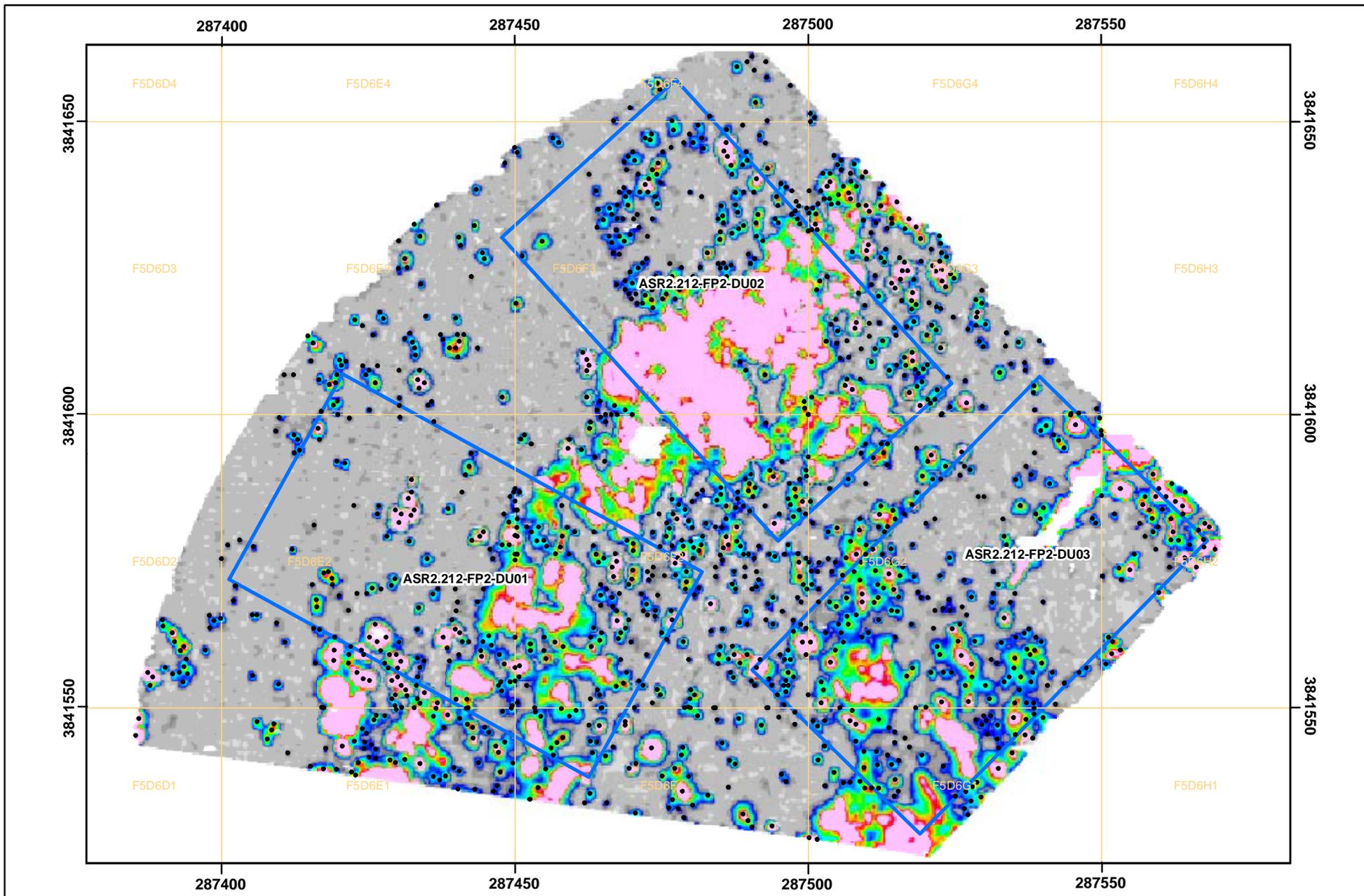
-  Focused PA/SI Investigation
-  ASR #2.212 Area
-  Base Boundary



1 inch equals 400 feet

Figure 1
Site Location Map
Landfill Firing Position 2
MCB Camp Lejeune
North Carolina





- Legend**
- Geophysical Anomaly
 - ⊗ QC Seeds
 - Geophysical Investigation Grid
 - Decision Unit

Note: White spaces indicate areas where data could not be collected as a result of terrain, vegetation or construction debris.

Survey conducted in September 2008 using EM61-MK2.



mv
Channel 3

0 2 3 5 6 8 9 11 13 16 18 21 23 26 28 31 33 36 38 41 43 46 48

0 37.5 75 150
Feet

Figure 2
Geophysical Survey Data
Landfill Firing Position 2
MCB Camp Lejeune
North Carolina





Legend

-  Subsurface Sample Location
-  50x50 Meter Grid
-  Decision Units
-  Focused PA/SI Investigation
-  ASR #2.212 Area

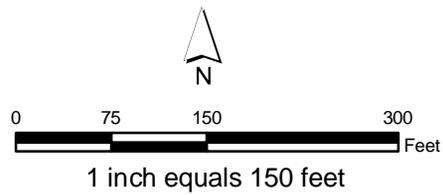
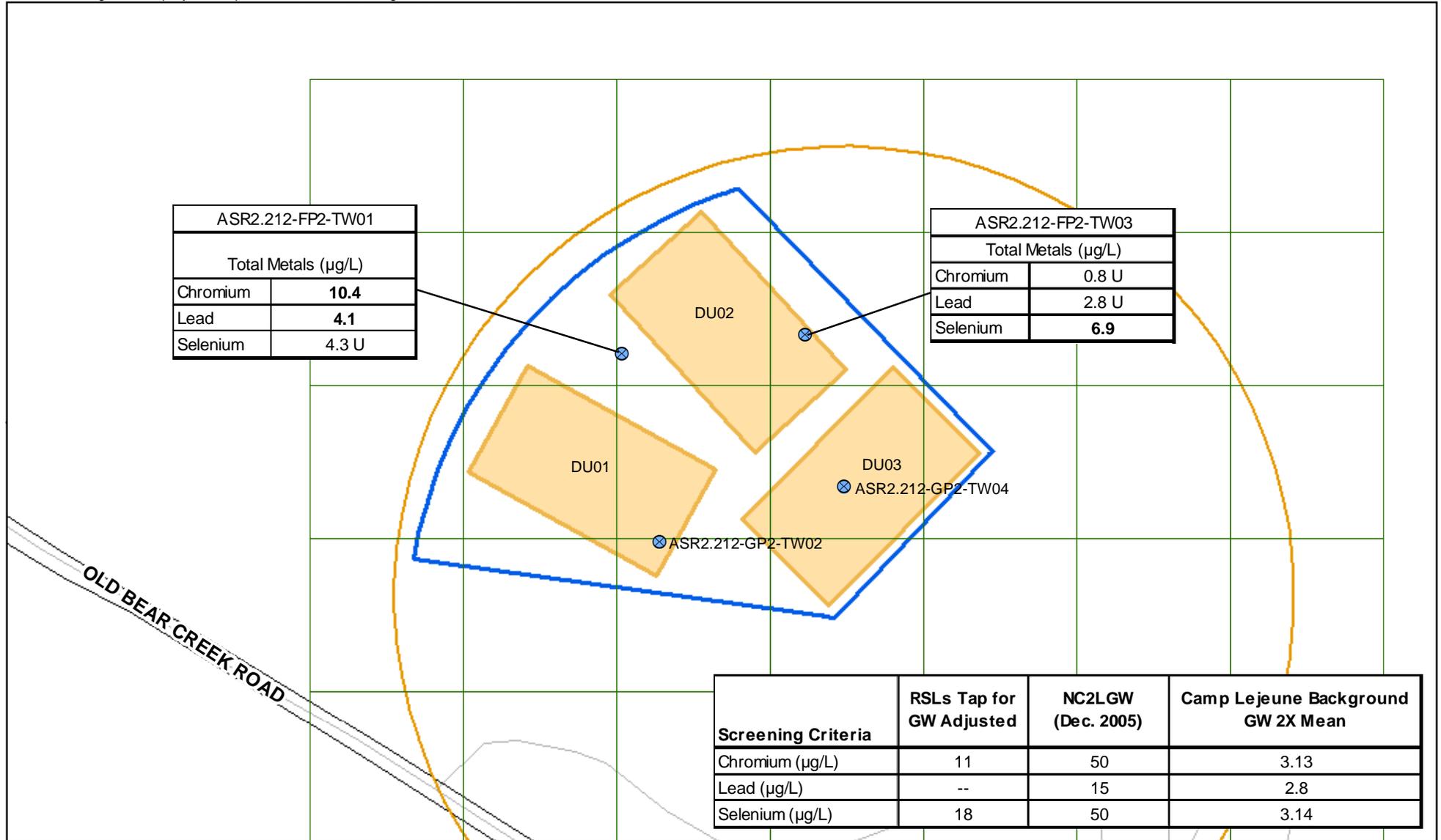


Figure 3
Surface and Subsurface Soil Sample Locations
Landfill Firing Position 2
MCB Camp Lejeune
North Carolina





- Legend**
- ⊗ Temporary Well Locations
 - 50x50 Meter Grid
 - Decision Units
 - Focused PA/SI Investigation
 - ASR #2.212 Area

Notes:
 1. Data report is unvalidated
 2. **Bold text exceeds twice mean background concentration**

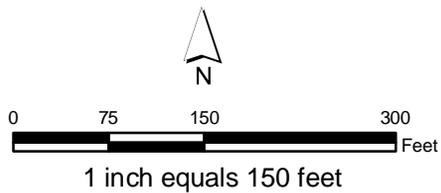


Figure 4
 Groundwater Exceedances
 Landfill Firing Position 2
 MCB Camp Lejeune
 North Carolina

