

Wood Environment & Infrastructure Solutions, Inc. 2801 Yorkmont Road, Suite 100 Charlotte, North Carolina 2820 Licensures: NC Engineering F-1253, Geology C-2478 T: 704-357-8600 www.woodplc.com

November 5, 2021

Dr. Dennis Li, LG GeoEnvironmental Project Manager Geotechnical Engineering Unit North Carolina Department of Transportation 1589 Mail Service Center Raleigh, NC 27699-1589

Subject: Report of UXO/MEC Investigation Parcel 218 – Sharon Bullard Property 6485 Aberdeen Road Raeford, North Carolina

> State Project: R-5709 WBS Element: 50205.1.1 County: Hoke Wood Project: 20478R5709

Dear Dr. Li:

Wood Environment and Infrastructure Solutions, Inc. (Wood) is pleased to submit this report for the investigation of possible buried unexploded ordnance (UXO) or munitions and explosives of concern (MEC) at the above referenced Site. During correspondence between the parcel owner and the North Carolina Department of Transportation (NCDOT), the parcel owner noted the possibility of UXO and/or MEC buried at the Site. In response, the NCDOT requested a geophysical survey and a UXO/MEC intrusive investigation be performed at the Site within areas that will be affected by the proposed widening of NC 211 Hwy from US 15-501 in Aberdeen, North Carolina to SR 1244 (West Palmer Street)/SR 1311 (Mockingbird Hill Road) in Raeford, North Carolina. The Site location and vicinity are presented in **Figure 1**. The following report describes the geophysical survey and UXO/MEC investigation at Parcel 218.

Project Information

Parcel 218 is identified as the Sharon Bullard property in the NCDOT MicroStation survey file and is located at 6485 Aberdeen Road. Currently, the Site is occupied by remnants of a brick garage and residential structures. Remaining portions of the Site consist of grass-covered and wooded areas. The Site layout is shown on **Figure 2**. During correspondence between the parcel owner and the NCDOT, the parcel owner noted the possibility of UXO or MEC buried on Site. The NCDOT requested a geophysical



survey be performed at the parcel to identify buried metallic object in areas to be affected by construction activities. Based on the results of the geophysical survey, a limited UXO/MEC intrusive investigation was performed.

Field Activities

Prior to commencing field activities at the Site, several tasks were accomplished in preparation for the subsurface investigation. A Health and Safety Plan (HASP) was created with the Site-specific health and safety information necessary for the field activities, including protocol for COVID-19. In addition, a Work Plan (dated October 4, 2021) was submitted to the NCDOT. The Work Plan included a description of the proposed staffing, planning and preparations for the fieldwork, UXO/MEC intrusive investigation and removal activities, the disposition of UXO/MEC, munition debris, and/or scrap metal, and Site restoration activities. North Carolina 811 was contacted on September 28, 2021, for the parcel.

Geophysical Survey Results

Wood personnel and our geophysical survey subcontractor Pyramid Geophysical Services (Pyramid) mobilized to the Site to conduct a geophysical investigation on August 11 and 12, 2021. Pyramid used electromagnetic (EM) induction-metal detection and ground penetrating radar (GPR) equipment to survey areas on the northern portion of the parcel that will be affected by the proposed widening of NC 211 Hwy. Four EM anomalies were identified within the area surveyed. Pyramid designated the anomalies #1 to #4. EM anomalies #2, #3, and #4 were attributed to a sign, a buried utility, and building ruins, respectively. Anomaly #1 was comprised of ten EM features, P218-A to P218-J. The ten EM features were identified as possible buried UXO or metallic debris. The estimated depth to the top of the features ranged from 0.5 to 4 feet below the ground surface. The locations of EM features P218-A to P218-J are shown on Figure 2. The geophysical survey did not identify evidence of USTs within the area surveyed. The complete Pyramid geophysics report is included as an attachment.

Vegetation Clearing and Utility Locating

The vegetation clearing was performed by Wood personnel on October 4, 2021. Wood used a push lawn mower and string trimmer to mow the tall grass at the parcel. After the vegetation was cleared, Wood personnel used a hand-held geographic positioning system (GPS) unit to locate and mark the ten EM features identified by Pyramid. Each location was marked with a flag with the feature's ID letter displayed on the flag.

Utility locating was performed by Pyramid personnel on October 5, 2021. The utility locating effort identified several buried fiber optic telephone and communication lines along the northwestern and northeastern parcel boundaries. Two of the buried fiber optic lines located along the northwestern parcel



boundary were observed to be in close proximity to EM feature P218-A. In addition, a buried telephone line was observed extending from the northern corner of the parcel to the residential structure remnants.

UXO/MEC Intrusive Investigation

The UXO/MEC investigation was performed by Wood personnel on October 6, 2021. Prior to beginning the intrusive activities, a safety tailgate meeting was held to discuss the proposed scope of work, the Site-specific HASP, and to identify an exclusion zone for non-UXO Wood personnel and Site visitors. The exclusion zone was determined based upon the munitions with the greatest fragmentation distance (MGFD) and lacking information on MGFD for the parcel, an exclusion zone of approximately 200 feet was set. Non-UXO Wood personnel and Site visitors remained near the southwestern parcel corner along Montrose Road while the intrusive activities were performed.

Following the safety tailgate meeting, the two Wood UXO technicians began the intrusive activities. Due to the close proximity of buried fiber optic lines, EM feature P218-A was not investigated by the UXO technicians. At EM features P218-B to P218-J, the technicians began the intrusive activities by confirming the presence of a buried metal object using a Schonstedt magnetic locator. The technicians then manually uncovered and exposed the metal object(s). After determining it was safe, the technicians removed the metal object from the hand-dug hole. After the object was removed, the hole was scanned with the Schonstedt to confirm no metal objects remained buried at the location. Once the location was cleared by the technicians, the non-UXO Wood personnel were allowed to approach the location to document and photograph the metal object.

Buried UXO/MEC or munition debris were not encountered at Parcel 218 during the intrusive investigation activities. The buried metallic objects encountered at EM features P218-B to P218-J were determined to be scrap metal and included objects such as a metal pipe, a lawn mower blade, and a grate. A summary of the objects with their approximate size and the approximate depths is included in the attached Table. Photographs of the objects are included in the attached Photolog. Since the metallic objects were determined to be scrap metal and not UXO/MEC or munition debris, they were placed on an existing debris pile at the parcel and the holes were backfilled.



Closing

Wood appreciates this opportunity to assist you on this project and recommends no further action at Parcel 218. Should you have any questions or need additional information, please do not hesitate to contact the undersigned.

Sincerely,

Wood Environment & Infrastructure Solutions, Inc.

ah. 1Fmt

Andrew J. Frantz, REM Senior Scientist

Helen Cally

Helen P. Corley, LG, BCES Principal Hydrogeologist

Attachments

FIGURES





TABLE

Table 1: Summary of EM Features R-5709, Parcel 218 - Sharon Bullard Property Raeford, North Carolina Wood Project: 20478R5709

Feature ID	Object Encountered at Feature Location	Approximate Size of Object	Approximate Depth to Top of Object (feet)
P218-A	Not invest	tigated due to nearby buried fiber c	pptic lines
P218-B	Small scrap metal and lawn mower blade	Small scrap - 6-inches long Blade 15-inches long	0.33
P218-C	Debris pile at surface	1.5-feet long by 2-feet wide	0.00
P218-D	Metal pipe	24-inches long	0.25
P218-E	3 pieces of scrap metal	Scrap 1 - 3-inches long Scrap 2 - 3-inches long Scrap 3 - Undetermined, to big too remove	2.00
P218-F	Small piece of a magnet	1-inch long	0.16
P218-G	Lawn mower blade	15 inches long	0.16
P218-H		i s-incries long	0.10
P218-I	Small scrap metal	3-inches long	0.16
P218-J	Metal grate	15-inches long	0.08

Notes:

1. Features investigated on October 6, 2021

PHOTOLOG









Photograph 2: Investigation area following mowing activities, facing southeast.





Photograph 3: Investigation area following mowing activities, facing northwest.



Photograph 4:

Area outside of exclusion zone near southwest parcel corner, facing southwest.



wood.

Photograph 5:

Location of P218-A and paint markings indicating buried utilities (fiber optic lines), facing northwest.



Photograph 6:

Location of P218-A and paint markings indicating buried utilities (fiber optic lines), facing northeast.





Photograph 7:

Location of P218-A and paint marking indicating buried utility (fiber optic line) beneath flag location.



Photograph 8:

Scrap metal and lawn mower blade at location P218-B. Glove for scale.





Photograph 9: Debris pile located at location P128-C.



Photograph 10: Metal pipe located at location P218-D.



Photograph 11: Scrap metal at location P218-E.





Photograph 12: Scrap metal at location P218-E. Boot for scale.





Photograph 13: Piece of magnet at location P218-F.



Photograph 14: Lawn mower blade at locations P218-G and P218-H.





Photograph 15: Scrap metal at location P218-I.



Photograph 16: Grate at location P218-J.

PYRAMID GEOPHYSICAL REPORT



PYRAMID GEOPHYSICAL SERVICES (PROJECT 2021-201)

GEOPHYSICAL SURVEY

INVESTIGATION OF BURIED METAL OBJECTS: PARCEL 218 NCDOT PROJECT R-5709 (50205.1.1)

6485 NC-211, RAEFORD, NC

August 18, 2021

Report prepared for:

Helen P. Corley, LG, RSM, BCES Wood, PLC 2801 Yorkmont Road #100 Charlotte, NC 28208

Prepared by:

Eric C. Cross, P.G. NC License #2181

Doug Canavello

Reviewed by:

Douglas A. Canavello, P.G. NC License #1066

503 INDUSTRIAL AVENUE, GREENSBORO, NC 27406 P: 336.335.3174 F: 336.691.0648 C257: GEOLOGY C1251: ENGINEERING

GEOPHYSICAL INVESTIGATION REPORT Parcel 218 - 6485 NC-211 Raeford, Hoke County, North Carolina

Table of Contents

Executive Summary	. 1
Introduction	3
Field Methodology	3
Discussion of Results	5
Discussion of EM Results	5
Discussion of GPR Results	5
Summary & Conclusions	6
Limitations	7

Figures

Figure 1 – Parcel 218 - Geophysical Survey Boundaries and Site Photographs
Figure 2 – Parcel 218 - EM61 Metal Detection Contour Map
Figure 3 – Parcel 218 - GPR Transect Locations and Select Images
Figure 4 – Overlay of Metal Detection Results on NCDOT Engineering Plans

Appendices

Appendix A – GPR Transect Images

LIST OF ACRONYMS

CADD	Computer Assisted Drafting and Design
DF	Dual Frequency
EM	Electromagnetic
GPR	Ground Penetrating Radar
GPS	Global Positioning System
NCDOT	North Carolina Department of Transportation
ROW	Right-of-Way
UST	Underground Storage Tank

EXECUTIVE SUMMARY

Project Description: Pyramid Environmental (Pyramid) conducted a geophysical investigation for Wood, PLC (Wood) at Parcel 218, located at 6485 NC-211, in Raeford, NC. The survey was part of a North Carolina Department of Transportation (NCDOT) Right-of-Way (ROW) investigation (NCDOT Project R-5709). The survey area was indicated to Pyramid by a Wood staff member on-site at the time of data collection. It was Pyramid's understanding that site research and property owner interviews conducted by Wood suggested a possibility that the site may contain buried unexploded ordinance (UXO). Conducted on August 11-12, 2021, the geophysical investigation was performed to determine if unknown, metallic underground storage tanks (USTs) were present beneath the survey area and to identify any possible UXO or other buried metallic debris.

Geophysical Results: The geophysical investigation consisted of electromagnetic (EM) induction-metal detection and ground penetrating radar (GPR) surveys. It was Pyramid's understanding that site research and property owner interviews conducted by Wood suggested a possibility that the site may contain buried UXO. This survey was designed to investigate the site both for USTs as well as smaller buried metallic anomalies that may be associated with UXO. A total of four EM anomalies were identified. Analysis of the metal detection survey indicated that some of the EM anomalies were directly attributed to visible cultural features at the ground surface.

Typically, the EM survey utilizes differential data from the top and bottom coils of the instrument to identify larger metallic objects such as USTs. To identify potential UXO, this survey utilized bottom coil data to emphasize the responses resulting from smaller metallic objects. Evidence of multiple smaller buried metallic objects was identified during the survey. GPR surveys across the minor metallic features indicated they were present at depths ranging from 0.5-4.0 feet below the ground surface.

Collectively, the geophysical data <u>recorded no evidence of metallic USTs at Parcel 218</u>. The survey did record evidence of a total of ten minor buried metal anomalies. These features may be associated with UXO or other minor metallic debris. If the nature of the buried metal anomalies is to be determined, Pyramid recommends excavation and physical sampling at these ten locations to verify the cause of each metallic feature. A contractor with experience in dealing with UXO should likely be consulted to determine proper excavation procedures.

INTRODUCTION

Pyramid Environmental conducted a geophysical investigation for Wood, PLC at Parcel 218, located at 6485 NC-211, in Raeford, NC. The survey was part of a North Carolina Department of Transportation (NCDOT) Right-of-Way (ROW) investigation (NCDOT Project R-5709). The survey area was indicated to Pyramid by a Wood staff member onsite at the time of data collection. It was Pyramid's understanding that site research and property owner interviews conducted by Wood suggested a possibility that the site may contain buried UXO. Conducted on August 11-12, 2021, the geophysical investigation was performed to determine if unknown, metallic underground storage tanks (USTs) were present beneath the survey area and to identify any possible UXO or other buried metallic debris.

The site consisted of an abandoned building and grass surfaces. An aerial photograph showing the survey area boundaries and ground-level photographs are shown in **Figure 1**.

FIELD METHODOLOGY

The geophysical investigation consisted of electromagnetic (EM) induction-metal detection and ground penetrating radar (GPR) surveys. Pyramid collected the EM data using a Geonics EM61-MK2 (EM61) metal detector integrated with a Geode External GPS/GLONASS receiver. The integrated GPS system allows the location of the instrument to be recorded in real-time during data collection, resulting in an EM data set that is geo-referenced and can be overlain on aerial photographs and CADD drawings. A boundary grid was established around the perimeter of the site with marks every 10 feet to maintain orientation of the instrument throughout the survey and assure complete coverage of the area.

According to the instrument specifications, the EM61 can detect a metal drum down to a maximum depth of approximately 8 feet. Smaller objects (1-foot or less in size) can be detected to a maximum depth of 4 to 5 feet. Objects associated with UXO typically fall

into the smaller range of buried metal, and, therefore, are usually analyzed in the EM results using the bottom coil dataset, which helps to visualize all metal identified during the survey within the instrument's capabilities. The EM61 data were digitally collected at approximately 0.8-foot intervals along north-south trending or east-west trending, generally parallel survey lines, spaced five feet apart. The data were downloaded to a computer and reviewed in the field and office using the Geonics NAV61 and Surfer for Windows Version 15.0 software programs.

GPR data were acquired across select EM anomalies on August 12, 2021, using a Geophysical Survey Systems, Inc. (GSSI) SIR 4000 control unit coupled to a 350 MHz HS antenna. Data were collected both in reconnaissance fashion as well as along formal transect lines across EM features. The GPR data were viewed in real-time using a vertical scan of 512 samples, at a rate of 48 scans per second. GPR data were viewed down to a maximum depth of approximately 6 feet, based on dielectric constants calculated by the SIR 4000 unit in the field during the reconnaissance scans. GPR transects across specific anomalies were saved to the hard drive of the DF unit for post-processing and figure generation.

Pyramid's classifications of USTs for the purposes of this report are based directly on the geophysical UST ratings provided by the NCDOT. These ratings are as follows:

	Geophysical Surveys for on NCE	Underground Stora	ge Tanks
High Confidence	Intermediate Confidence	Low Confidence	No Confidence
Known UST Active tank - spatial location, orientation, and approximate depth determined by geophysics.	Probable UST Sufficient geophysical data from both magnetic and radar surveys that is characteristic of a tank. Interpretation may be supported by physical evidence such as fill/vent pipe, metal cover plate, asphal/concrete patch, etc.	Possible UST Sufficient geophysical data from either magnetic or radar surveys that is characteristic of a tank. Additional data is not sufficient enough to confirm or deny the presence of a UST.	Anomaly noted but not characteristic of a UST. Should be noted in the text and may be called out in the figures at the geophysicist's discretion.

DISCUSSION OF RESULTS

Discussion of EM Results

A contour plot of the EM61 results obtained across the survey area at the property is presented in **Figure 2**. Each EM anomaly is numbered for reference in the figure. The following table presents the list of EM anomalies and the cause of the metallic response, if known:

Metallic Anomaly #	Cause of Anomaly	Investigated with GPR
1A-J	Possible UXO or Metallic Debris	✓
2	Sign	
3	Utility	
4	Building	

LIST OF METALLIC ANOMALIES IDENTIFIED BY EM SURVEY

Some of the EM anomalies were directly attributed to visible cultural features at the ground surface, including a sign, a utility, and a building. Typically, the EM survey utilizes differential data from the top and bottom coils of the instrument to identify larger metallic objects such as USTs. As mentioned above, UXO may not manifest itself in the differential dataset. To identify potential UXO, this survey utilized bottom coil data to emphasize the responses resulting from smaller metallic objects. EM Anomalies 1A-J were investigated with GPR to further examine the size, depth, and nature of these features.

Discussion of GPR Results

Figure 3 presents the locations of the formal GPR transects performed at the property as well as select transect images. All of the transect images are included in **Appendix A**. A total of fifteen formal GPR transects were performed at the site. These transects were performed across all locations containing metallic anomalies not associated with known visible cultural features at the ground surface. The following table contains depth to the possible targets identified during the survey.

GPR Transect(s)	Anomaly #	Depth of Target (ft.)
1-2	1A	0.5-2.5
3-5	1E & 1F	1-2
6-7	1J	0-1
8-9	1H	1-2
10	1G	0-1
11	1I	0-1
12	1B	0-3
13-15	1C & 1D	2-4

Collectively, the geophysical data <u>recorded no evidence of metallic USTs at Parcel 218</u>. The survey did record evidence of a total of ten minor buried metal anomalies, ranging in depth from 0.5-4.0 feet below the ground surface. These features may be associated with UXO or other minor metallic debris. **Figure 4** provides an overlay of the metal detection results on the NCDOT engineering plans for reference.

SUMMARY & CONCLUSIONS

Pyramid's evaluation of the EM61 and GPR data collected at Parcel 218 in Raeford, North Carolina, provides the following summary and conclusions:

- It was Pyramid's understanding that site research and property owner interviews conducted by Wood suggested a possibility that the site may contain buried UXO.
- This survey was designed to investigate the site both for USTs as well as smaller buried metallic anomalies that may be associated with UXO.
- Analysis of the metal detection survey indicated that some of the EM anomalies were directly attributed to visible cultural features at the ground surface.
- Typically, the EM survey utilizes differential data from the top and bottom coils of the instrument to identify larger metallic objects such as USTs. To identify potential UXO, this survey utilized bottom coil data to emphasize the responses resulting from smaller metallic objects. Evidence of multiple smaller buried metallic objects was identified during the survey.
- GPR surveys across the minor metallic features indicated they were present at

depths ranging from 0.5-4.0 feet below the ground surface.

- Collectively, the geophysical data recorded no evidence of metallic USTs at Parcel 218. The survey did record evidence of ten minor buried metal anomalies. These features may be associated with UXO or other minor metallic debris.
- If the nature of the buried metal anomalies is to be determined, Pyramid recommends excavation and physical sampling at these ten locations to verify the cause of each metallic feature. A contractor with experience in dealing with UXO should likely be consulted to determine proper excavation procedures.

LIMITATIONS

Geophysical surveys have been performed and this report was prepared for Wood, PLC in accordance with generally accepted guidelines for EM61 and GPR surveys. It is generally recognized that the results of the EM61 and GPR surveys are non-unique and may not represent actual subsurface conditions. The EM61 and GPR results obtained for this project have not conclusively determined the definitive presence or absence of metallic USTs, but the evidence collected is sufficient to result in the conclusions made in this report. Additionally, it should be understood that areas containing extensive vegetation, reinforced concrete, or other restrictions to the accessibility of the geophysical instruments could not be fully investigated.



APPROXIMATE BOUNDARIES OF GEOPHYSICAL SURVEY AREA



View of Survey Area (Facing Approximately Northeast)



View of Survey Area (Facing Approximately South)

DATE	8/16/2021	CLIENT Wood, PLC
PYRAMID PROJECT #:	2021-201	FIGURE 1

Ν



NO EVIDENCE OF METALLIC USTs WAS OBSERVED.

The contour plot shows the bottom coil results of the EM61 instrument in millivolts (mV). The bottom coil presents a higher-amplitude response to any metal identified by the instrument. Differential data (difference between top and bottom coils) were not used for this parcel in order to focus on smaller buried metallic objects. The EM data were collected on August 11, 2021, using a Geonics EM61-MK2 instrument. Verification GPR data were collected using a GSSI SIR 4000 controller equipped with a 350 MHz HS antenna on August 12, 2021.





DATE	8/16/2021	CLIENT	Wood, PLC
PYRAMID PROJECT #:	2021-201		FIGURE 2



BURIED METAI	LLIC DEBRIS		BURIED META	LLIC DEBRIS
GPR TRANSE	CT 1 (T1)	(GPR TRANSEC	CT 4 (T4)
Postarua observed by the second secon	CANT ES ED CT 5 (T5)	(BURIED METAL	LIC DEBRIS
BURIED META	LLIC DEBRIS	GI	BURIED METAI	LLIC DEBRIS
	DATE	8/16/2021	CLIENT	Wood. PLC
		0001.001		



Appendix A – GPR Transect Images





GPR TRANSECT 2



GPR TRANSECT 3









GPR TRANSECT 7







GPR TRANSECT 10



GPR TRANSECT 11









GPR TRANSECT 15