APPENDIX H

Surface Geophysical Survey Report
(Note – Report attachments provided on disc only)

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GREENSTAR
Environmental Solutions, LLC

Greenstar Environmental Solutions, LLC
6 Gellatly Drive
Wappingers Falls, NY 12590

30 November 2012

Mr. Jeff Donovan
Senior Environmental Scientist
ECC
33 Boston Post Road West-Suite 420
Marlborough, MA 01752

RE: Summary Report for Ground Penetrating Radar Survey at RV-4/RV-87, RV-41, RV-46, RV-86, RV-88, and RV-89, Ravenna Army Ammunition Plant, Ravenna, Ohio.

Dear Mr. Donovan:

This letter report provides a summary of the geophysical scanning survey at RV-4/RV-87, RV-41, RV-46, RV-86, RV-88, and RV-89, Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio.

1.0 SITE AND PROJECT DESCRIPTION

1.1 Introduction

Greenstar Environmental Solutions LLC (Greenstar) was contracted by ECC to conduct a geophysical survey at the Ravenna Army Ammunition Plant. The survey was completed between 5 and 7 November 2012 by Greenstar staff overseen by ECC personnel. The objective of the survey was to identify whether underground storage tanks (UST) were present in seven areas located by ECC personnel.

The seven areas which were scanned comprised an area of approximately 7,275 square feet (sq ft). Two types of geophysical survey techniques were used including Ground Penetrating Radar (GPR) and Electro-magnetic (EM) survey. The GPR survey was completed using a GSSI SIR-3000 with a 400 mHz antenna. GPR surveying is a nonintrusive, subsurface geophysical investigation technique that detects subsurface structures by transmitting electromagnetic waves from an antenna into the ground. The antenna then monitors the strength and time delay of the return signal. The return signal is then evaluated for any anomalies, which by their size, shape and orientation can be interpreted as voids, underground storage tanks, utility pipelines, soil-bedrock interface or areas of different sediment compaction. Penetration and quality of the return signal are both highly dependent on a tight coupling between the ground surface and the antenna and the composition of materials in the subsurface.

The EM survey was completed using an EM-61 Mark 2 (EM-61) with on-board logging computer. The EM-61 is a time-domain metal detector which detects both ferrous and non-ferrous metals. A powerful two-coil rectangular transmitter generates a pulsed primary magnetic field into the earth, which induces eddy currents in nearby metallic objects. The eddy current decay produces a secondary magnetic field measured by the receiver coil and digitally recorded with an onboard field computer. The EM-61 can detect buried metal beyond four feet into the subsurface depending on the size of the item and the contrast between the geology and the item. Additionally, the EM-61 response is focused directly below the coils, minimizing the interference from nearby metal structures.

1.2 Method

Prior to mobilization, historical data and site maps provided by ECC were reviewed by Greenstar for planning the geophysical survey and identifying field conditions and grid extents. Both the GPR and EM-61 were calibrated prior to their use. The GPR survey wheel was calibrated to ensure accurate location of targets. In addition, antenna connections were checked, and a test scan of the area was completed to ensure the antenna was properly transmitting and receiving a signal. Where possible, the GPR scanned an area over a known target (pipe or manhole) to ensure proper response. The EM-61 transmitter was calibrated using the onboard computer to ensure proper antenna response. After calibration, the EM-61 was tested using a known metallic object prior to use.

Prior to initiating each survey, a survey grid was marked at each area to facilitate data collection over the presumed tank location. The gird was marked out in the X (vertical) and Y (horizontal) direction with two feet between each adjacent survey line, ensuring full coverage of the survey area. The EM-61 was used to scan survey lines in the X direction. After the EM-61 scanning was completed the grid area was surveyed with the GPR. Targets located during the survey were marked in the field with paint and/or stakes.

Digital data was recorded for the EM and GPR surveys. The survey grid was located relative to stationary objects (i.e., building corners or other site features) and GPS coordinates recorded using a GPS receiver. The data collected from the GPR and EM-61 were processed in the field for each survey grid. Raw and processed EM and GPR data is provided on the attached CD for each of the six survey areas. Data is organized by individual folders labeled with the individual UST designation. Individual processed orthoreferenced grid anomaly maps (.tiff) that are ESRI GIS compatible are also included in the individual UST folders. An orthoreferenced final overall geophysical grid mosaic is included in Figures 1 through 12 which summarize EM-61 and GPR results at each UST location.

1.3 Processing

The data was processed in the field for use in interpretation and final figure generation. RADAN 7 was the primary software used for processing data collected from the GPR. Time delay, background removal and migration processing was used to correct for time discrepancies, reduce background noise and prepare the data for 3-D modeling. Gain controls were used to ensure all relevant features were visible for the figure generation.

Geotonics software was used to import the EM data. Contouring of EM data was performed using the geostatistical tools available within Groundwater Modeling System 6.0 software. Kriging methods were employed to generate the EM contouring data.

Attachment 1 (on attached CD) provides the EM-61 and GPR raw and processed data files, GIS shapefiles containing the EM-61 and GPR grids and contoured results, the Greenstar field notebook, and photos of the EM-61 and GPR survey areas. Results are projected in feet in Ohio State Plane, North FIPS 3401.

2.0 INTERPRETATION AND RESULTS

2.1 RV-4/RV-87

At RV-4/RV-86 a total area of 2,484 sq ft was scanned in an attempt to identify two co-located USTs on the northeast side of Building 1026. One UST was 100 gallons in capacity and the other co-located UST dimensions are unknown. Two potential vent pipes were identified adjacent to the building.

Due to a chain link fence obstructing the survey area, the survey area was separated into two grids. The first survey grid (labeled RV-4) was completed outside the chain link fence furthest away from the building and had a total area of 1,500 sq ft (20 ft by 75 ft). Surface conditions consisted of cut grass on even terrain that enabled a good coupling between the ground and the GPR antenna.

The results of the EM survey indicated there were no magnetic anomalies identified with the exception of increased return near the chain link fence boundary. The results of the GPR survey found one non-metallic conduit within the survey grid. One area of increased return seen in the final processed GPR scan was investigated further and interpreted to be a noise anomaly. The results of the EM and GPR survey are provided in Figures 1 and 2, respectively.

The second grid (labeled RV-87) was completed inside the chain linked fenced directly adjacent to Building 1026, had a total area of 912 sq ft (12 ft by 76 ft). Surface conditions were a combination of patchy tall grass and uneven terrain which did not yield a good coupling between the GPR antenna and the ground surface.

The results of the EM-61 survey showed three significant responses adjacent to the building. Due to their small footprint and location relative to surface features, these responses were interpreted to be the two vent pipes in place from the former USTs and a drain gutter. No other anomalies were noted during the EM-61 survey. The GPR survey found several non-metallic conduits trending across the survey area, but no tank sized targets were identified. The results of the EM and GPR survey are provided in Figures 1 and 2, respectively. An attempt to trace the vent pipes was made using radio line locator but results were inconclusive. The lines were either cut below grade or extend below the range of the radio line detector.

RV-4/RV-87 Findings: The survey at RV-4/RV-87 finished with no conclusive evidence of USTs in place within the survey area. Potential vent pipes within the survey area could not be traced and may be cut below grade.

2.2 RV-41

A total area of 1,084 sq ft was to be survey for one 6,000 gallon UST adjacent to the southwest side of former Building 2F-11. The survey grid (labeled RV-4) was completed and had a survey area of 2,500 sq ft (50 ft by 50 ft), more than double the size of the originally requested area. Surface conditions were poor. The terrain was highly uneven, with patches of tall grass covering the survey area which did not

yield a good coupling between the GPR antenna and ground surface. Standing water was also present across a limited portion of the survey area.

The results of the EM-61 survey identified a small metallic object and a linear metallic feature, but no anomaly was present at the scale of a UST. The results of the GPR confirmed this interpretation and provided no additional evidence of a 6,000 gallon UST. The data collected was further examined for the presence of a UST excavation, but no UST excavation could be interpreted from the survey data. The results of the EM and GPR survey can be found in Figure 3 and Figure 4 respectively.

RV-41 Findings: The survey at RV-41 was completed with no conclusive evidence of a UST in place within the survey area.

2.3 RV-46

A total area of 263 sq ft was to be surveyed for one 1,500 gallon tank adjacent to the north side of former Building EE-102. The survey grid (labeled RV-46) was completed and had a survey area of 324 sq ft (18 ft by 18 ft), more than the area originally requested. Surface conditions were varied, but for the most part poor. The majority of the survey was conducted over uneven terrain that was obstructed with small bushes and debris resulting in a poor coupling between the GPR antenna and ground surface.

The results of the EM-61 survey indicated there was a large magnetic anomaly, approximately 2 ft by 3 ft, within the northeastern portion of the survey gird. The GPR survey confirmed this anomaly was an object in place, but due to its irregular surface it could not be confirmed as a UST. Another feature was identified during the GPR survey that had proper dimensions and features of a UST, but did not have any magnetic return. This feature was interpreted as a concrete UST approximately 7.5 ft in width and 8.8 ft in length. The extent of the UST extends partially beyond the survey grid due to obstructions that shortened the survey grid. The location of the tank was marked out on the ground, and its corners pinned to concrete stairs adjacent to the former building foundation for future locating. The results of the EM-61 and GPR survey can be found in Figure 5 and Figure 6 respectively.

RV-46 Findings: The survey was completed with a concrete UST located in place. An additional object was located within the survey area, but its identity could not be confirmed as a UST.

2.4 RV-86

A total of 633 sq ft was to be surveyed for one UST with unknown dimensions north of Building 1026. The survey grid (labeled RV-86) was completed and had a survey area of 900 sq ft (30 ft by 30 ft), more than the area originally requested. Surface conditions were good and consisted of cut grass and fairly even terrain.

The results of the EM-61 survey identified one small metallic object, but no magnetic anomalies of UST scale. The GPR survey confirmed these findings with no additional evidence of a UST in place. Two sides of a UST excavation were inferred from the GPR data. The bounds of the excavation were marked on the ground surface, with the remaining two sides extrapolated from the orientation of the two inferred

UST excavation boundaries. The excavation was approximately 14.3 ft. in length by 8.5 ft. in width. The area of the UST excavation correlated with a large depression on the ground surface, also possibly suggesting the presence of a former UST. The results of the EM-61 and GPR survey can be found in Figure 7 and Figure 8 respectively.

RV-86 Findings: The survey was completed with no conclusive evidence of a UST in place within the survey area. Two sides of an excavation were interpreted from the survey data and were marked out within the survey area.

2.5 RV-88

A total of 321 sq ft was to be surveyed for one UST with unknown dimensions located west of former Building 1103. The survey grid (labeled RV-88) was completed with a survey area of 900 sq ft (30 ft x 30 ft), more than double the area originally requested. Surface conditions were poor with protruding rubble and uneven terrain throughout the survey area.

The results of the EM-61 survey identified several small metallic objects, but no magnetic anomalies of UST scale. The GPR survey confirmed this finding with no additional evidence of a UST within the survey area. The larger magnetic anomaly on the eastern boundary of the survey area was investigated to the east of the original survey grid. Its source was a traced to a bank of metallic conduits. The data collected was further examined for the presence of a UST excavation, but no UST excavation could be interpreted from the survey data. The results of the EM-61 and GPR survey can be found in Figure 9 and Figure 10 respectively.

RV-88 Findings: The survey at RV-88 finished with no conclusive evidence of a UST in place within the survey area.

2.6 RV-89

A total of 115 sq ft was to be surveyed for one UST with unknown dimensions east of the chlorine building. The survey grid (labeled RV-89) was completed and had a survey area of 242 sq ft (11 ft x 22 ft), more than double the area originally requested. Surface conditions were poor with tall grass and uneven terrain throughout the surface area. A vent pipe was located adjacent to the eastern boundary of the building.

The results of the EM-61 survey identified a large magnetic anomaly on the southeastern boundary of the survey area adjacent to a partially backfilled chlorine AST sump. The GPR survey did not identify a UST in place within the survey area. While a survey could not be conducted over the chlorine AST sump, the EM-61 was lifted over this basin, yielding a strong return indicating this was the likely source of the magnetic anomaly. Copper lines were observed coming out of this feature. An attempt to trace the vent pipes was made using radio line locator but results were inconclusive. The lines were either cut below grade or extend below the range of the radio line detector. The data collected was further examined for the presence of a UST excavation, but no UST excavation was visible in the survey data. The results of the EM-61 and GPR survey can be found in Figure 11 and Figure 12 respectively.

RV-89 Findings: The survey at RV-89 was completed with no conclusive evidence of a UST in place within the survey area. A potential vent pipe was located but could not be traced and may be cut below grade.

Thank you for allowing Greenstar to assist ECC with this project. If you have any questions, please do not hesitate to contact me at (917) 655-5123 or via email at pnimmer@greenstarsolutions.com.

Sincerely,

GREENSTAR ENVIRONMENTAL SOLUTIONS, LLC

Peter L. Nimmer, P.G., L.S.R.P.
Senior Geologist

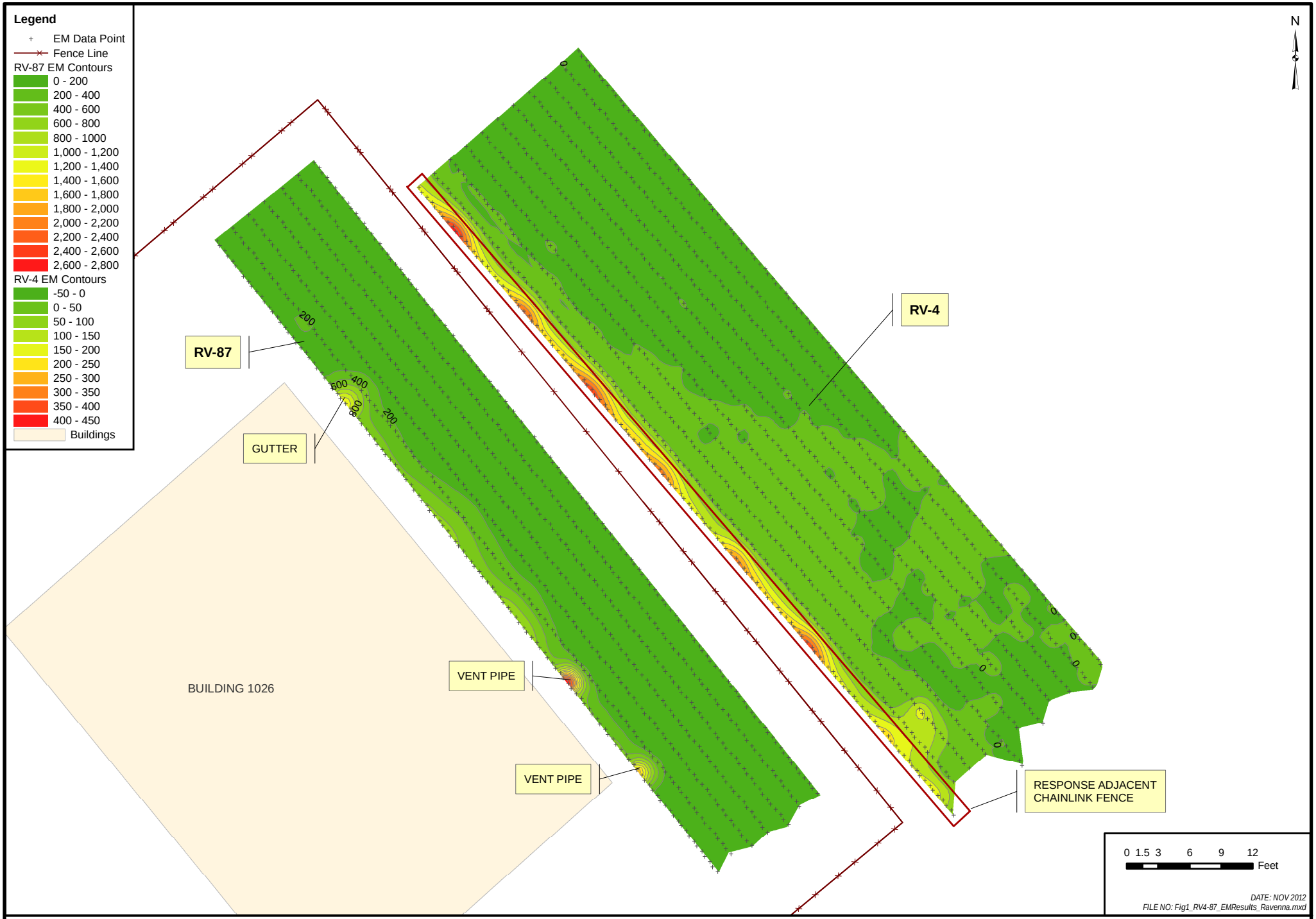

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FIGURE 1
RV-4/87 EM SURVEY RESULTS

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FIGURE 2
RV-4/87 GPR SURVEY RESULTS

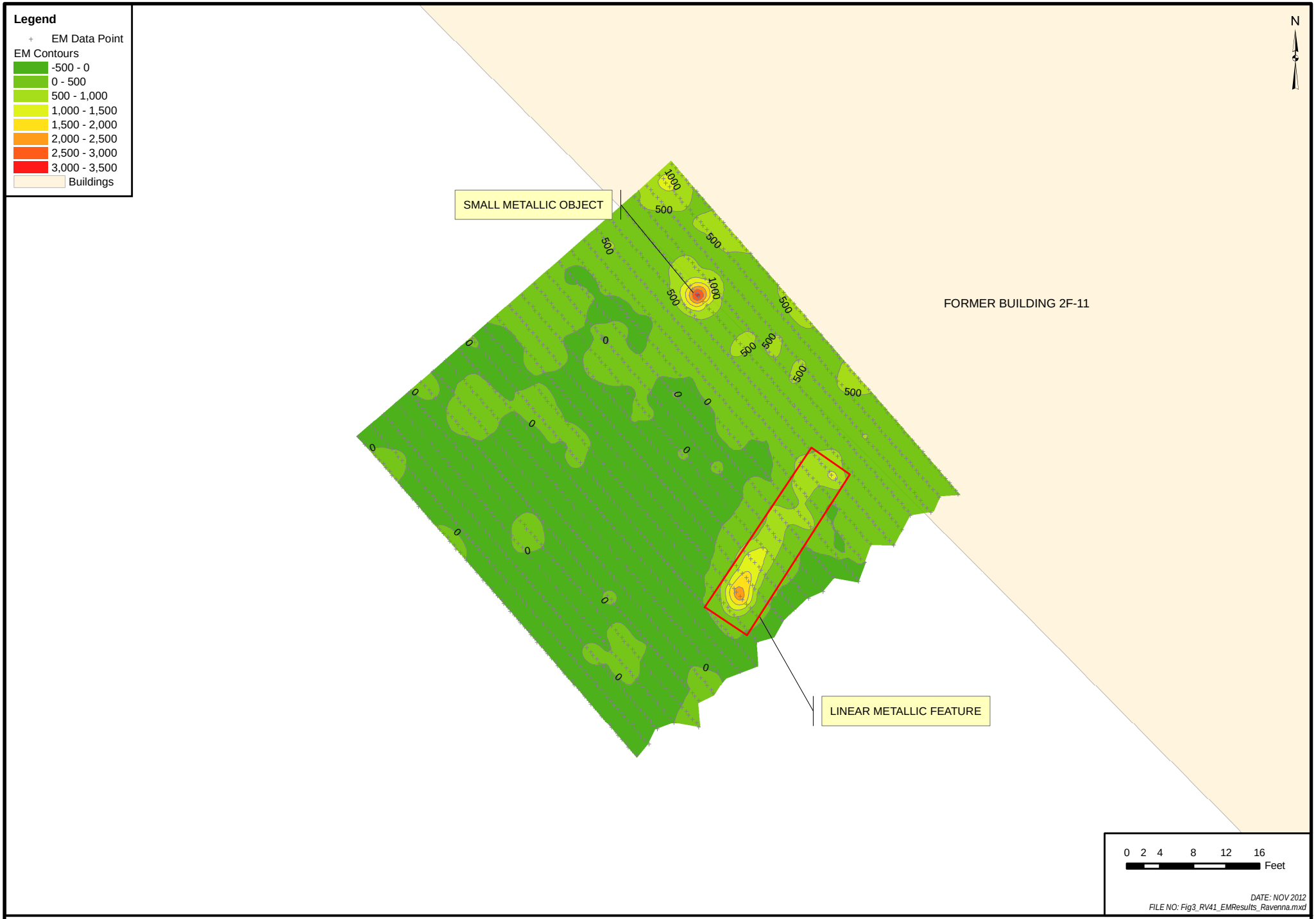

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FIGURE 3
RV-41 EM SURVEY RESULTS

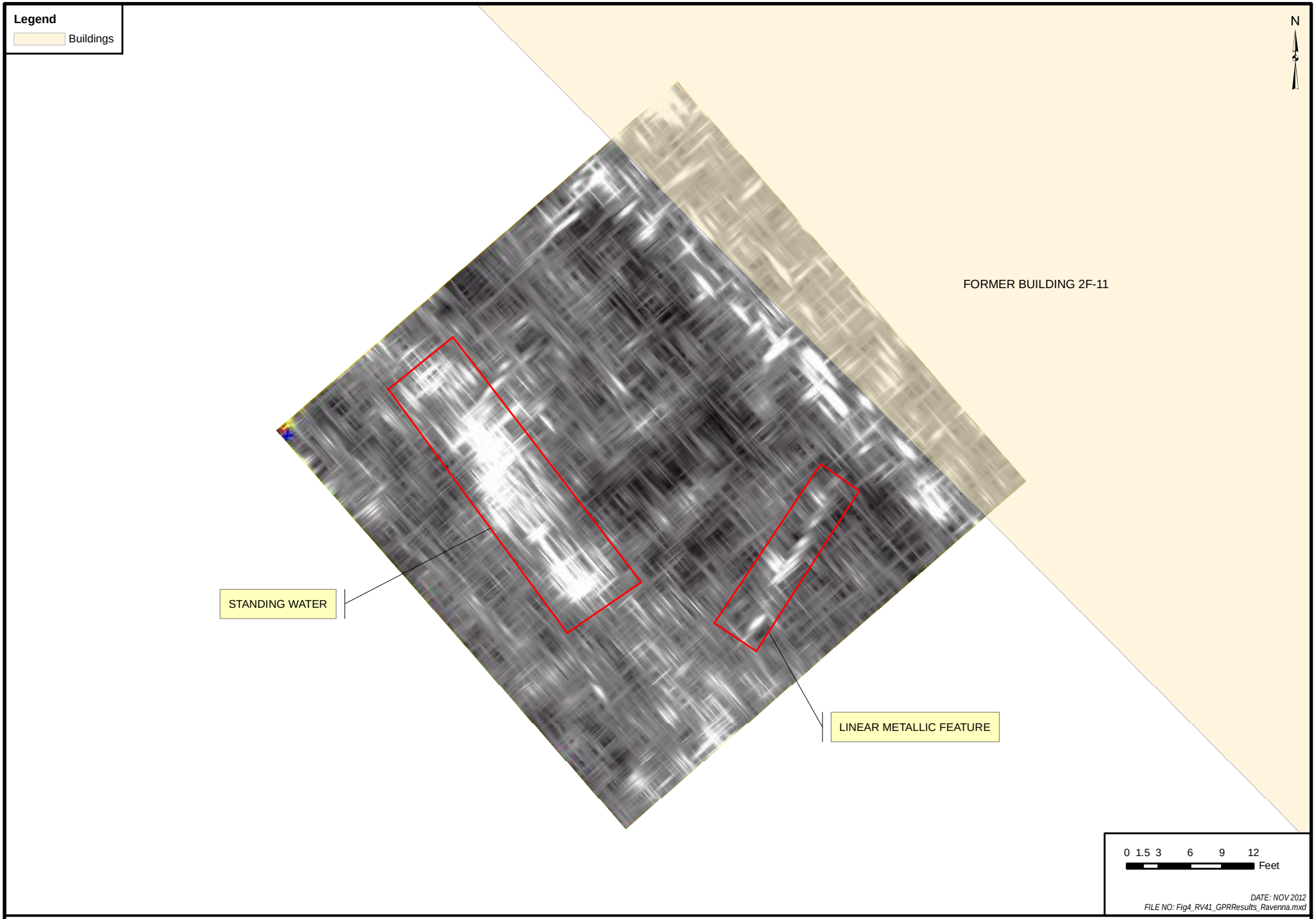

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FIGURE 4
RV-41 GPR SURVEY RESULTS

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FIGURE 5
RV-46 EM SURVEY RESULTS

Legend

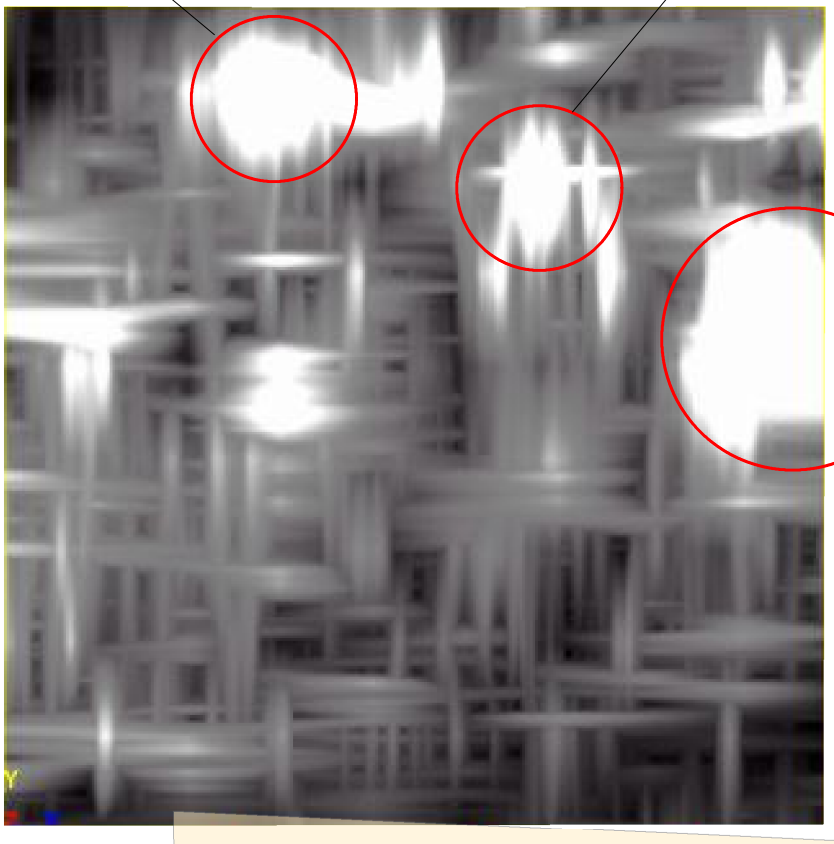
Buildings

N

NOISE ANOMALY

METALLIC OBJECT
2-FT BY 3-FT IN SIZE

CONCRETE UST



FORMER BUILDING EE-102

0 0.5 1 2 3 4
Feet

DATE: NOV 2012
FILE NO: Fig6_RV46_GPRResults_Ravenna.mxd

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FIGURE 6
RV-46 GPR SURVEY RESULTS

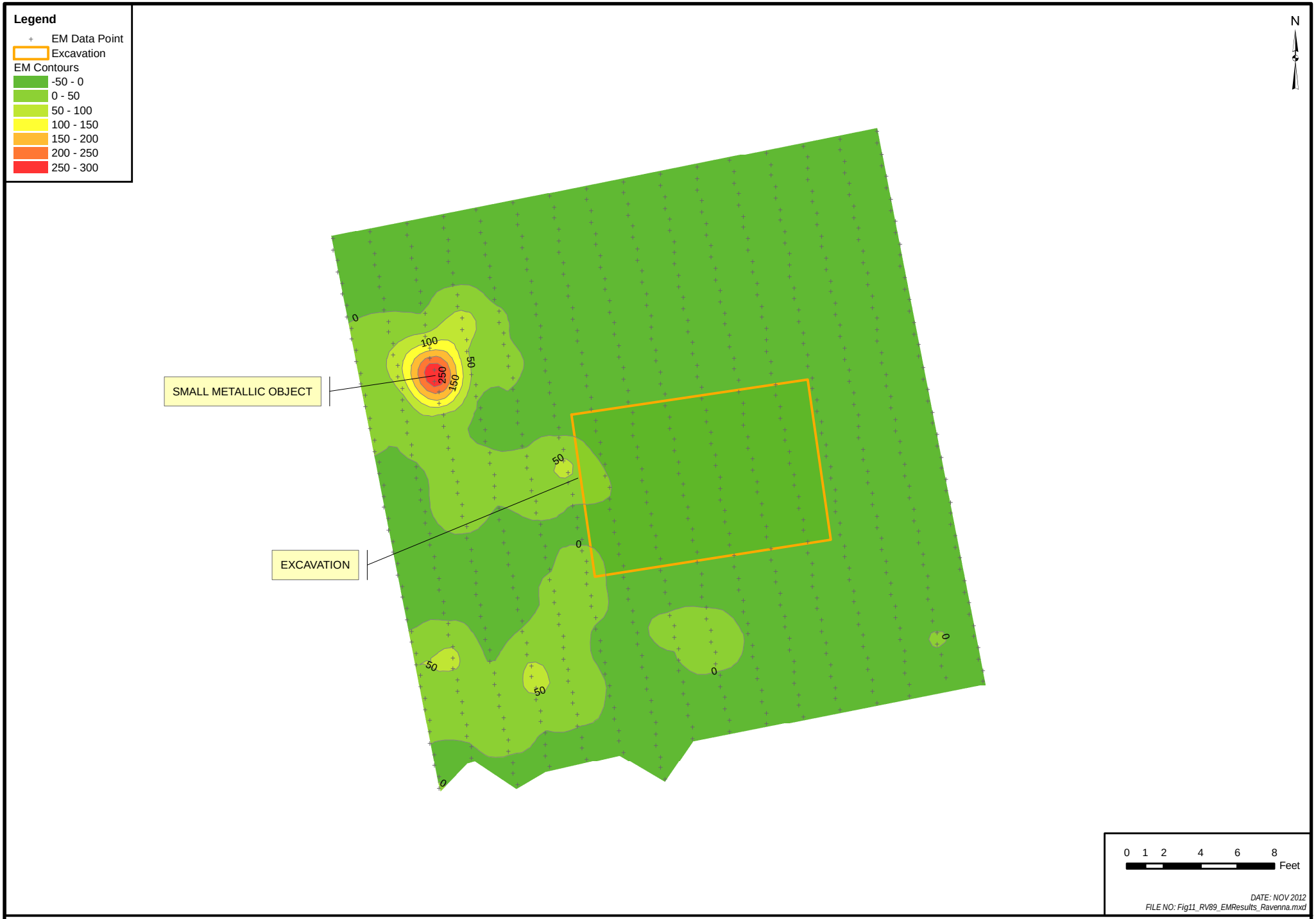

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FIGURE 7
RV-86 EM SURVEY RESULTS

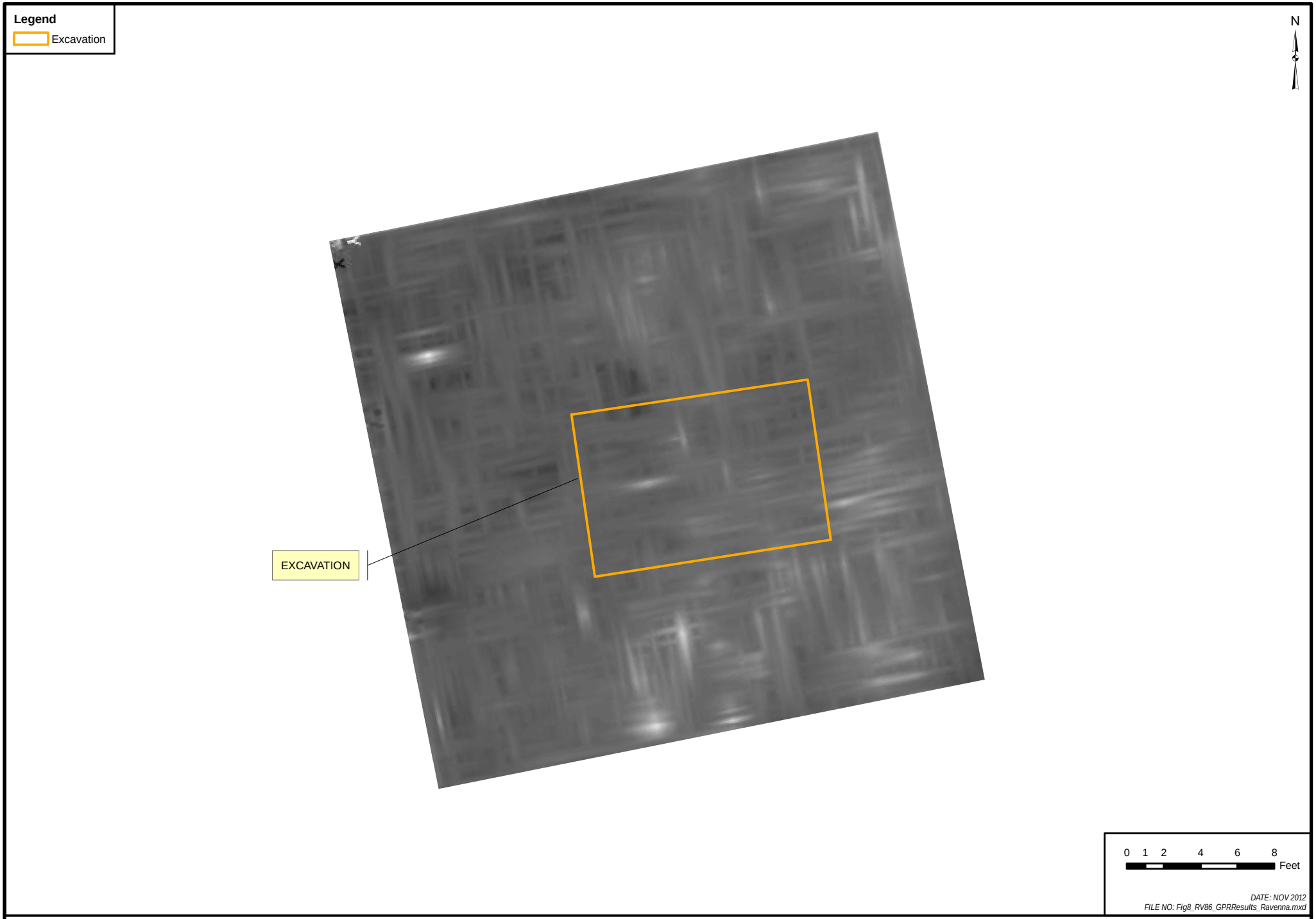

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FIGURE 8
RV-86 GPR SURVEY RESULTS

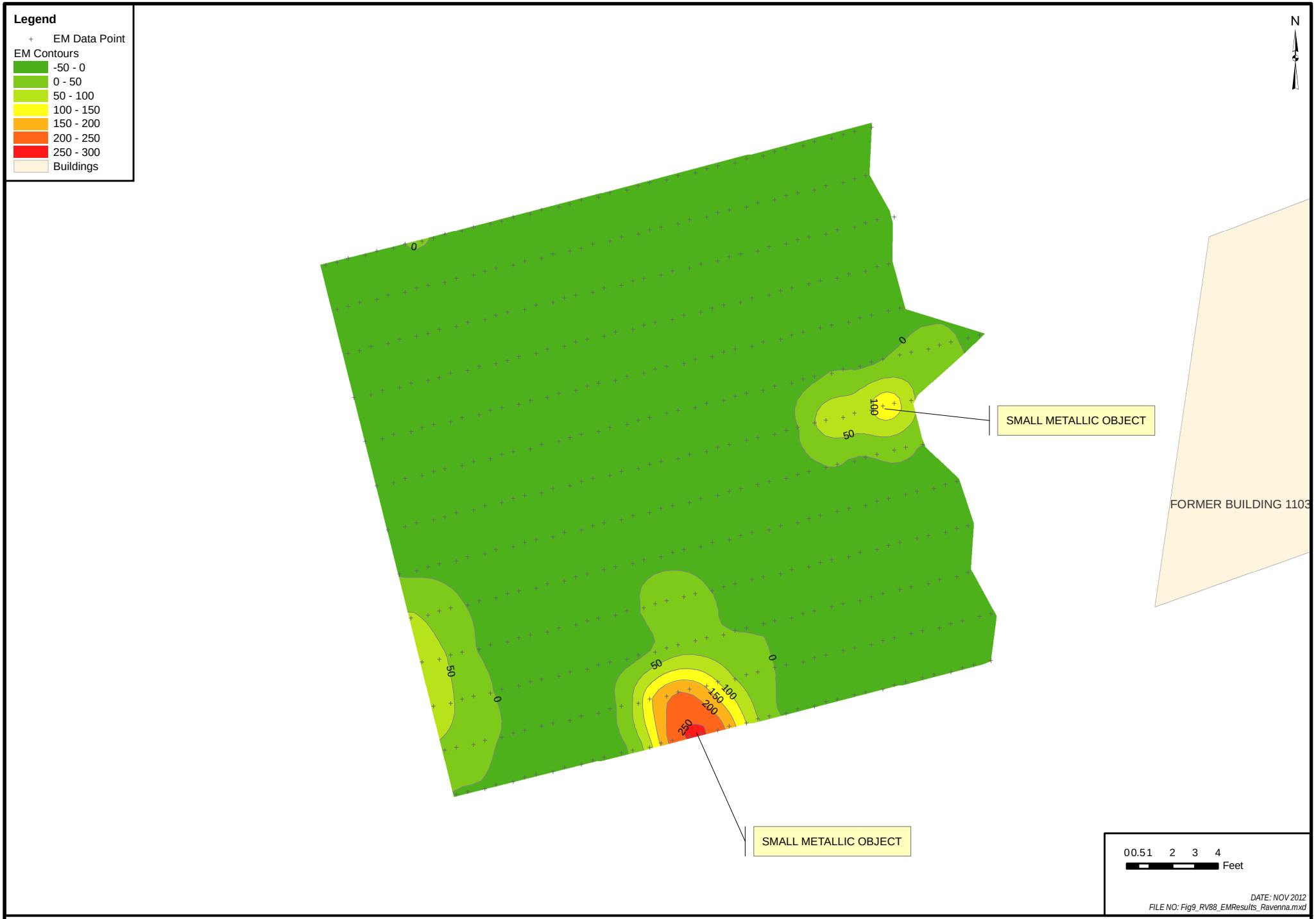

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FIGURE 9
RV-88 EM SURVEY RESULTS

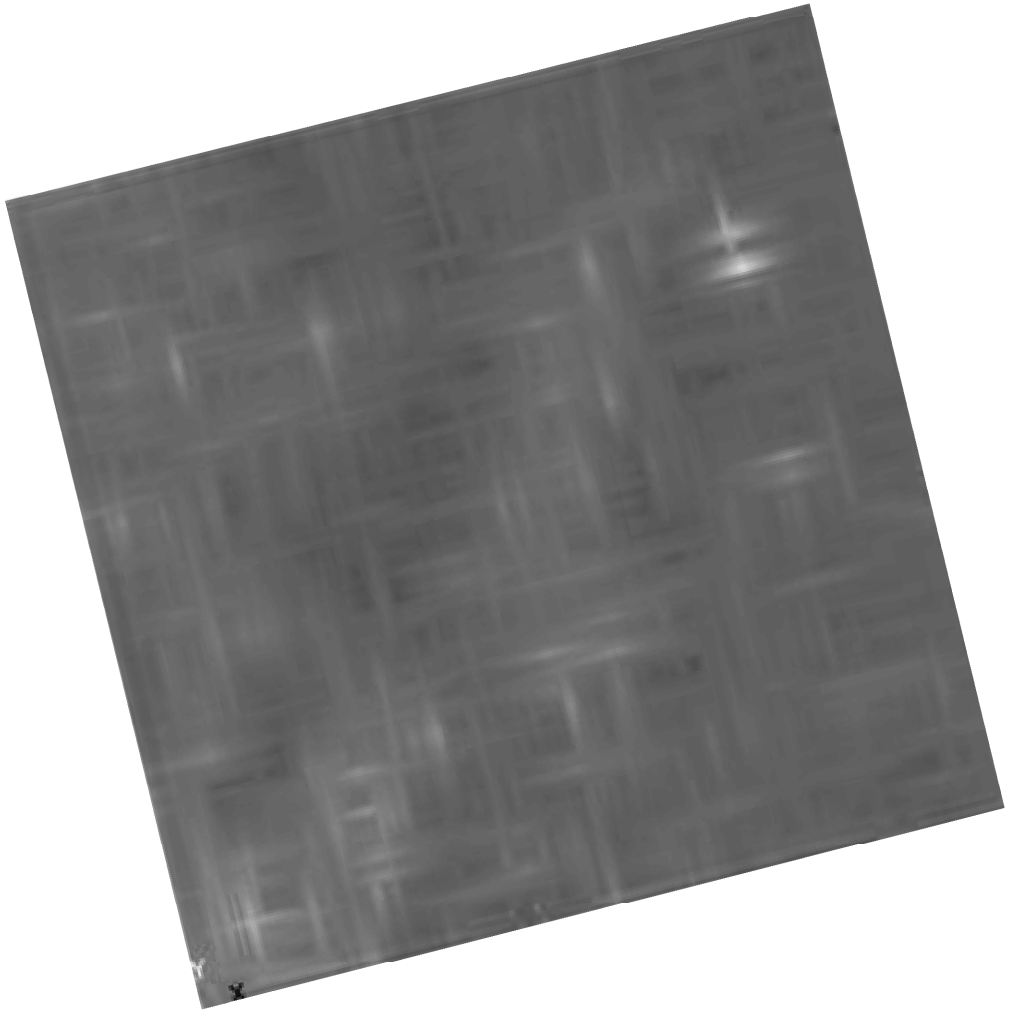

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FIGURE 10
RV-88 GPR SURVEY RESULTS

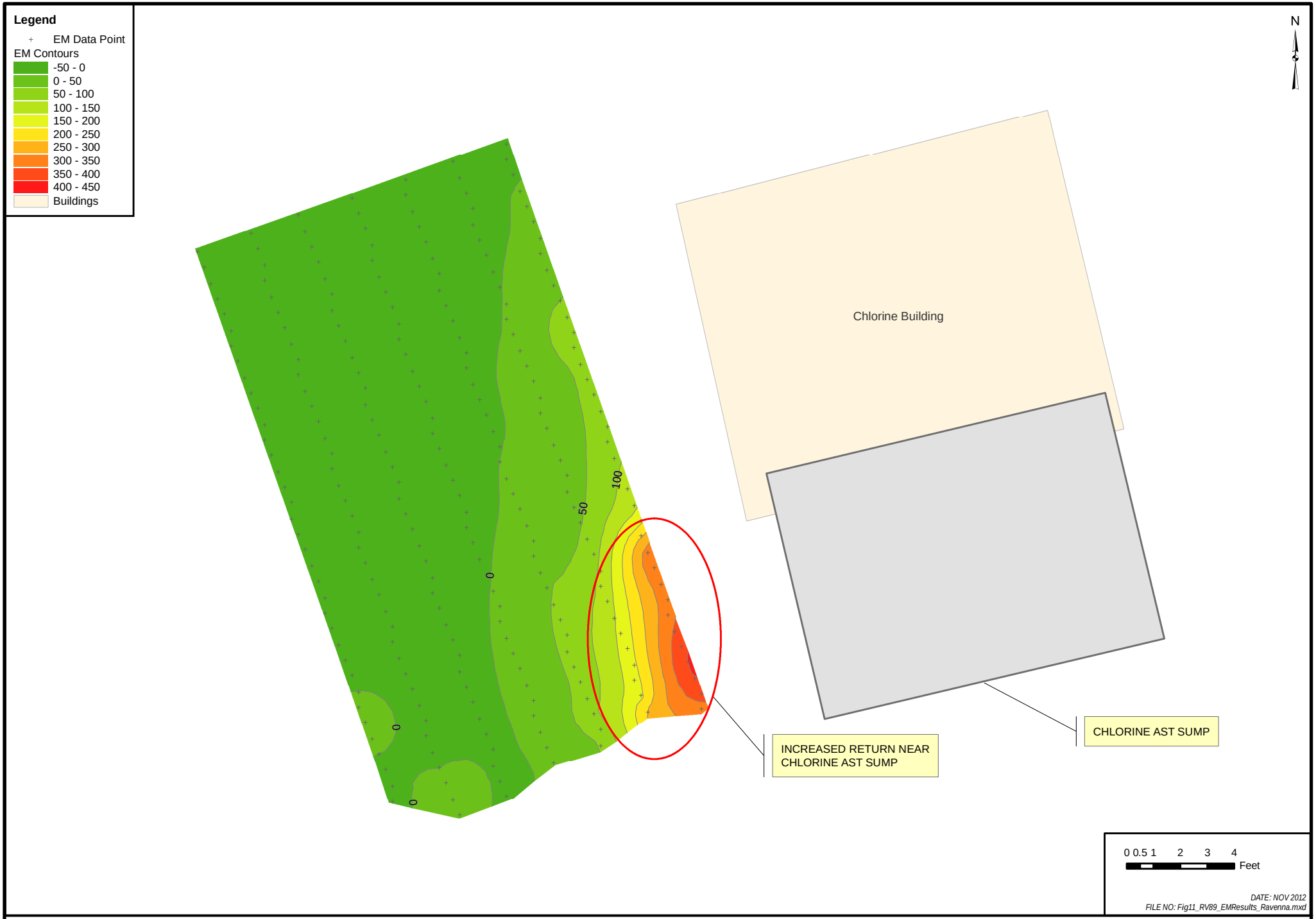

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FIGURE 11
RV-89 EM SURVEY RESULTS

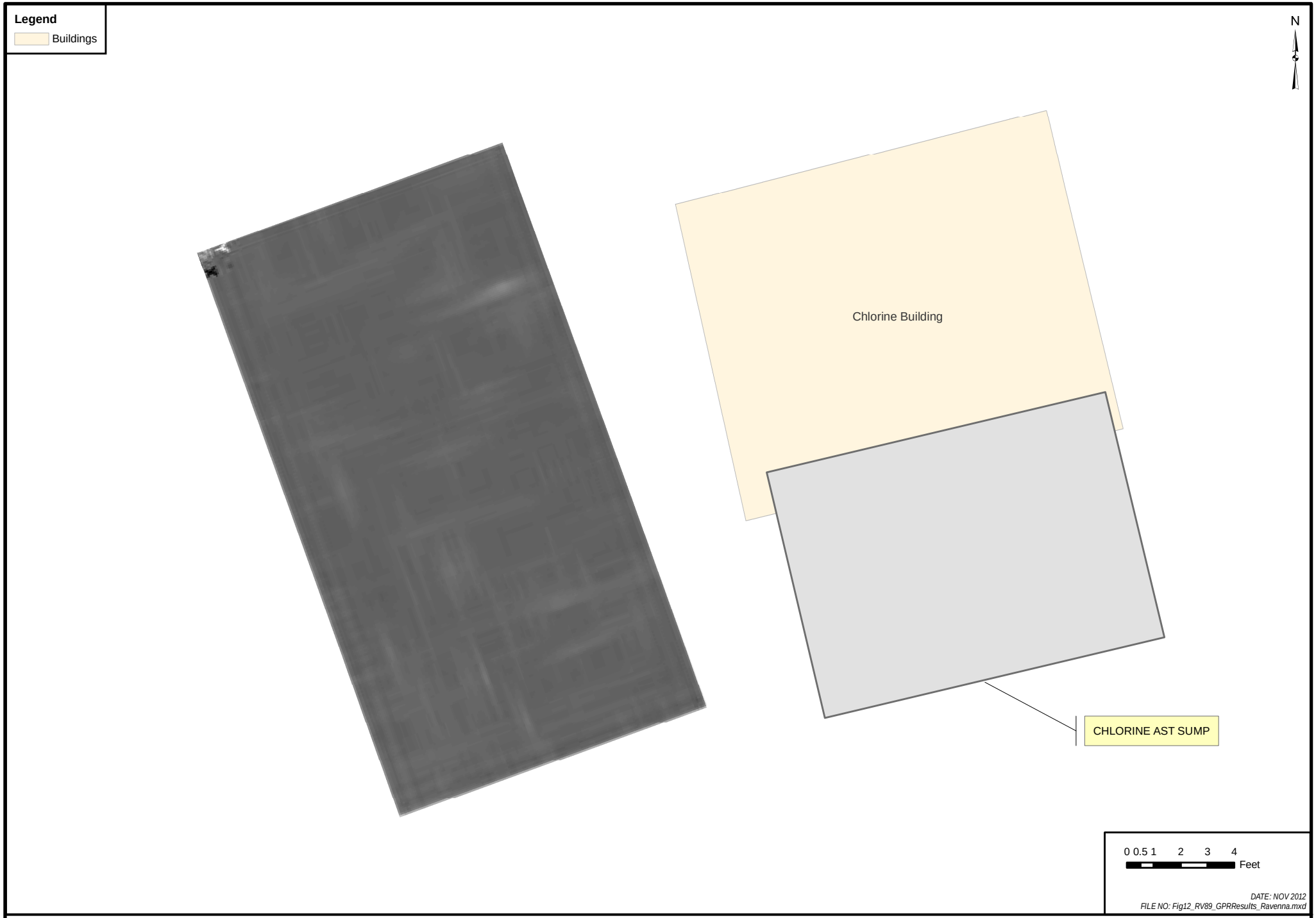

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FIGURE 12
RV-89 GPR SURVEY RESULTS

ATTACHMENT 1 (ON CD)

- **EM-61 AND GPR RAW AND PROCESSED DATA FOR RV-4/RV-87, RV-41, RV-46, RV-86, RV-88, RV-89**
- **GIS LAYERS OF EM-61 AND GPR RESULTS**
- **GREENSTAR FIELD NOTEBOOK**
- **PHOTOS OF EM-61 AND GPR SURVEY**

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