ENVIROSCAN, INC.

June 10, 2003

Mr. Douglas Guenther
US Army, Fort Monmouth
Director of Public Works
ATTN: SELFM-PW-EV-Building 173
Fort Monmouth, NJ 07703

RE: Geophysical Survey
Buried Construction Debris and UST Detection/Delineation
33-Acre Area
Fort Monmouth, NJ
Enviroscan Project Number 030301

Dear Mr. Guenther:

Pursuant to our proposal dated March 4, 2003, Enviroscan, Inc. (Enviroscan) has completed a geophysical survey of the above-referenced site. The methods and results of the survey are described below. Fieldwork was completed on May 22, 2003.

Survey Purpose and Site Description

The purpose of the survey was to detect and delineate possible buried materials, including areas of construction debris, piping, utilities, and underground storage tanks (USTs). The first component of the field effort involved an electromagnetic (EM) terrain conductivity survey of the entire site. Ground penetrating radar scanning was then performed in order to further characterize specific targets identified in the EM survey.

The area surveyed (Figure 1) consisted of 33 acres, located in and around the 800 Area of the Main Post. The designated area of concern comprised open grass-covered areas, asphalt-covered parking lots, buildings, and a football field. The chain link fence and bleachers surrounding the football field, picnic tables and benches located at Buildings 822 and 836, automobiles in parking lots, and overhead power lines are examples of cultural interference or surficial debris which were present at the time the survey was completed and may preclude detection of buried materials in their immediate vicinity.

Survey Methods

For the first part of the geophysical survey, Enviroscan conducted electromagnetic (EM) terrain conductivity scanning over the survey area. EM instruments employ an electromagnetic transmitter coil to induce an electric current in the earth. This current creates a secondary electromagnetic field that is measured by a receiver coil, and has strength proportional to the bulk electrical conductivity or terrain conductivity of the subsurface materials. The subsurface terrain conductivity measured by an EM instrument is primarily sensitive to two parameters: the relative proportions of conductive soil and non-conductive rock within the effective survey depth, and the moisture content of the soil mantle.

In addition, some EM instruments can record the amplitude ratio between the primary (transmitted) electromagnetic field and the secondary field from electrical currents in the subsurface. These inphase data are a measure of the metallic content of the materials in the vicinity of the instrument. Therefore, where interference from metallic structures or debris (e.g. buildings, utilities, fences, etc.) is expected, simultaneous recording of terrain conductivities and inphase data allows identification of stations where the terrain conductivity reflects the presence of metallic interference rather than soil or rock conditions or features.

A Geonics, Ltd. EM-31 terrain conductivity meter with vertical dipole coil orientation was used to collect terrain conductivity readings at approximately 5-foot stationing along EM survey profiles spaced approximately 10 feet apart (see Figure 1). At each survey station, terrain conductivity (in millimhos/meter or mmho/m) and inphase response (in parts per thousand or ppt) were automatically digitally recorded using an Omnidata Polycorder. The vertical dipole EM-31 instrument was employed since it is sensitive to conductivity anomalies to depths of approximately 25 feet, with peak sensitivity between 4 and 12 feet (see e.g. McNeill, 1980a and Appendix A).

The actual location of each EM measurement station was digitally recorded using a backpack-mounted Trimble Pathfinder global positioning system (GPS) receiver in contact with four to seven position-fixing satellites. The GPS positions were differentially corrected using data from a community base station in Trenton, NJ. The resulting differential GPS (DGPS) positions have a nominal accuracy of better than 3 feet (+/-). Base map information was obtained from an AUTOCAD (.dxf format) map provided by the U.S. Army. Enviroscan also DGPS-surveyed the locations of additional features not located on the provided base map.

The EM inphase and terrain conductivity data were contoured using the statistical kriging routine in SURFER for WINDOWS by Golden Software. The terrain conductivity and inphase response contours are depicted in Figures 2 and 3, respectively.

Each anomaly indicated by the EM-31 was then scanned with the Fisher TW-6 EM pipe and cable locator/tracer to more accurately define its location. In pipe and cable search mode, the TW-6 is essentially a deep-sensing metal detector that detects any highly electrically conductive materials (e.g. metals) by creating an electromagnetic field with a transmitting coil. A receiving coil at a fixed separation from the transmitter measures the field strength. As the instrument is swept along the ground surface, subsurface metallic bodies distort the transmitted field. The change in field strength/orientation is sensed by the receiver, setting off an audible alarm and/or causing deflection of an analog meter. The TW-6 can nominally detect a 2-inch metal pipe to a depth of 8 feet and a 10-inch metal pipe to a depth of 14 feet. In some locations the presence of subsurface metal, such as concrete reinforcing, metallic fill, and/or nearby utilities saturated the TW-6, rendering it ineffective.

In order to further characterize any field-identified EM anomalies, Enviroscan mobilized a ground penetrating radar (GPR) system. GPR systems produce cross-sectional images of subsurface features and layers by continuously emitting pulses of radar frequency energy from a scanning antenna as it is towed along a survey profile. The radar pulses are reflected by interfaces between materials with differing dielectric properties. The reflections return to the antenna and are displayed on a video monitor as a continuous cross section in real time. Since the electrical properties of metallic tanks, pipes, and wastes are often distinctly different from soil and backfill materials, metallic targets produce dramatic and characteristic reflections. Fiberglass, plastic, concrete, and terra-cotta targets as well as subsurface voids, rock surfaces, soil type changes, and concentrations of many types of non-metallic wastes also produce recognizable, but less dramatic reflections. In cases where the TW-6 could not be used due to abundant subsurface metal, GPR was used to scan along profiles defining a rough 5-foot grid in order to locate any anomalies indicative of a metallic UST.

Results

The results of the EM survey are shown in Figures 2 and 3. Figure 2 presents the terrain conductivity data and Figure 3 presents the inphase data.

In the terrain conductivity data (Figure 2), high levels of metallic interference are common throughout the site. The areas bordering Husky Brook Lake, on the western edge of the survey area, display evidence of deep or wet soils. North of Building 814 the levels are more indicative of metallic interference, possibly due to contaminated fill material. Linear features identified in the western portion of the designated area of concern correspond with mapped utilities, according to information provided by the Director of Public Works, U.S. Army. Scanning beneath asphalt-paved parking lots in the areas of Buildings 822, 826, 899, 1006 and 1075 (Medical Center to the southeast – not shown) also showed levels of metallic interference, which may be caused by fill material.

The inphase data (Figure 3) indicate multiple targets with high metallic response. After accounting for surficial metal, cultural interference, and linear features caused by utility lines, there were a total of 24 anomalous targets. These targets are delineated and numbered on Figures 2 and 3, and summarized in Appendix B, with coordinates corresponding to the approximate center of each target.

GPR scanning to further characterize targets in the parking lots of Buildings 814, 1006, and 1075 was not possible, due to signal attenuation. This may be a result of disturbed soils or the high level of conductivity in the soils. Targets described as high-amplitude parabolic reflectors in the following chart may be indicative of USTs or other buried material. Reinforced concrete structures are indicated as targets in the cases where metallic reinforcing led to both saturation of the TW-6 and GPR signal attenuation. In these cases, it was not possible to determine if there was any metallic or otherwise anomalous response from below the concrete slab.

Limitations

The geophysical survey described above was completed using standard and/or routinely accepted practices of the geophysical industry and equipment representing the best available technology. Enviroscan does not accept responsibility for survey limitations due to inherent technological limitations or site-specific conditions. However, we make every effort to identify and notify the client of such limitations or conditions.

We have appreciated this opportunity to work with you. If you have any questions, please do not hesitate to contact the undersigned.

Sincerely,
Enviroscan, Inc.

Mark J. Villa
Project Geophysicist

Technical Review By:
Enviroscan, Inc.

Felicia Kegel Bechtel, M.Sc., P.G.
President

enc.: Figure 1: Geophysical Survey EM-31 Data Coverage
Figure 2: EM-31 Terrain Conductivity Contours
Figure 3: EM-31 Inphase Response Data Contours
Appendix A: EM-31 Vertical Dipole Mode Depth Response
Appendix B: GPR Survey Results
References

Notes:

Coordinates in New Jersey State Plane Grid, NAD-27 geodetic datum.

Survey station locations from DGPS survey by Enviroscan, Inc.

Base map features from information provided by Director of Public Works, U.S. Army.

Every second survey station is shown for clarity.

LEGEND

+ Survey Data Point

Figure 1

Geophysical Survey
EM-31 Data Coverage

US Army
Fort Monmouth, NJ

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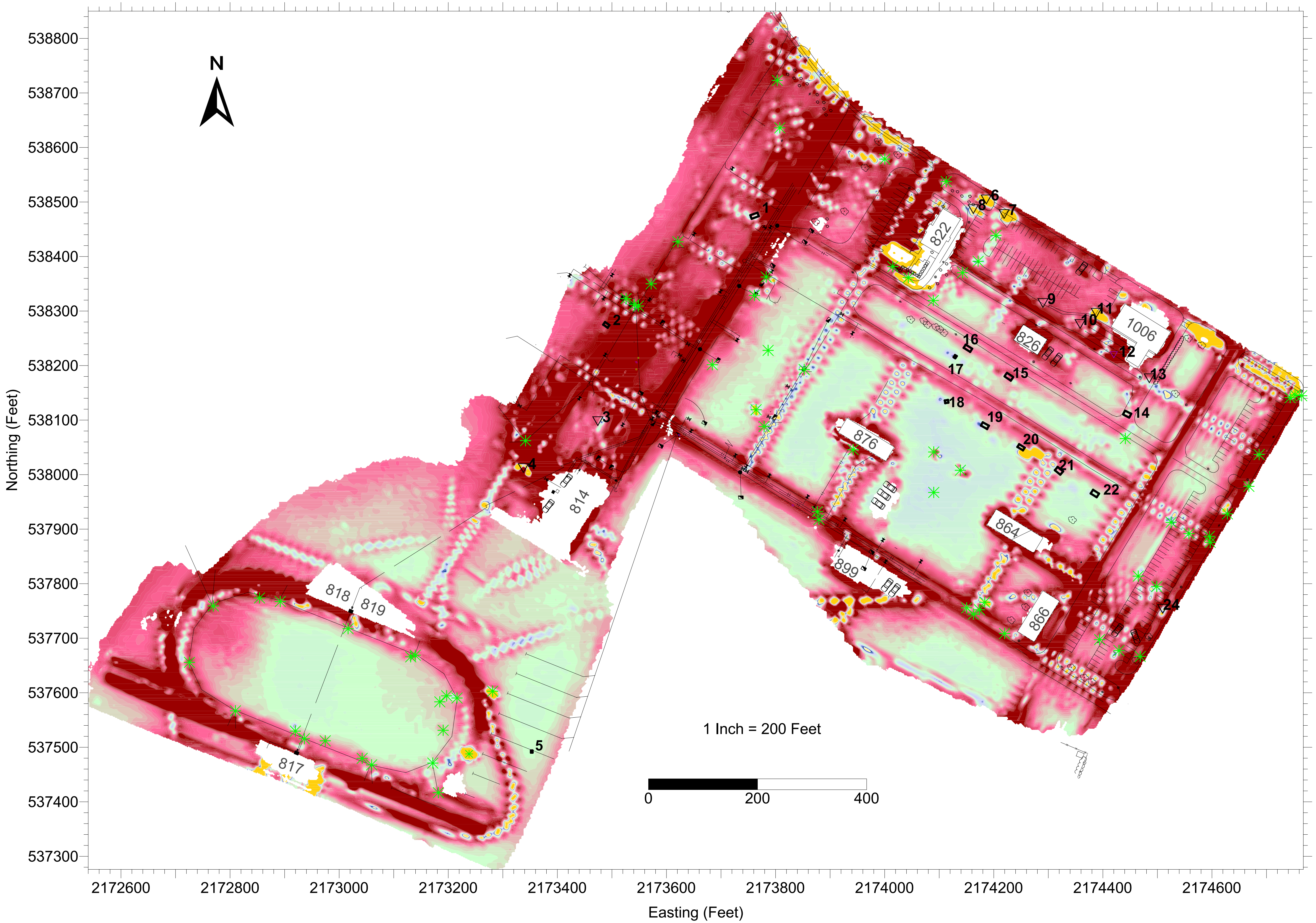

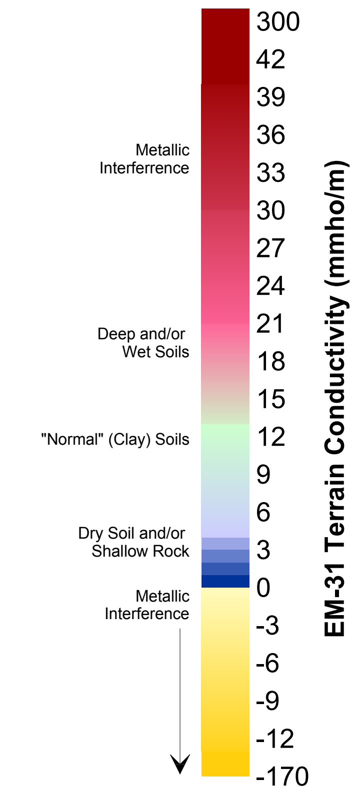

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Coordinates in New Jersey State Plane Grid, NAD-27 geodetic datum.

Survey station locations from DGPS survey by Enviroscan, Inc.

Base map features from information provided by Director of Public Works, U.S. Army.

Data from Geonics, Ltd. EM-31 instrument, vertical dipole mode.

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- ▽ TW-6 Target
- ▭ GPR Target
- ✳ Surface Metal

Figure 2

EM-31 Terrain Conductivity Data Contours

US Army Fort Monmouth, NJ

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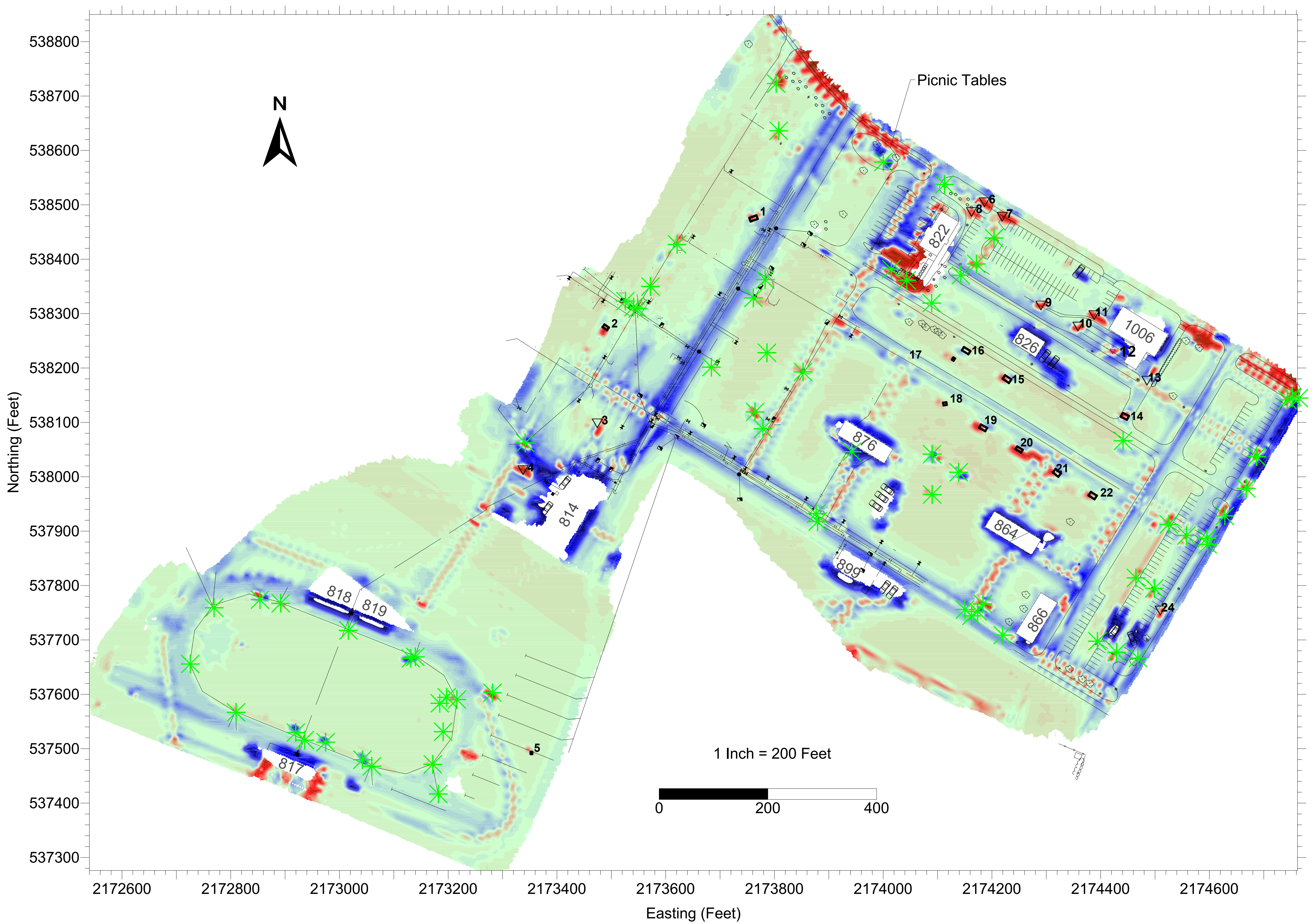

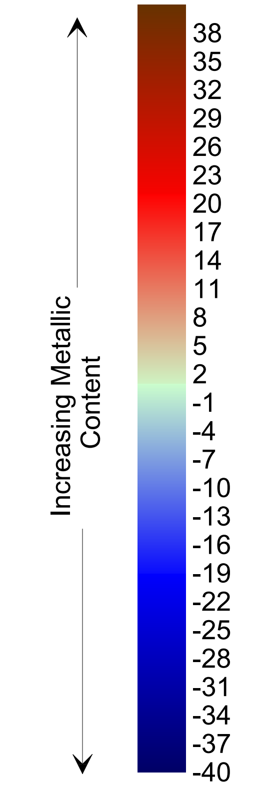

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Survey station locations from DGPS survey by Enviroscan, Inc.

Base map features from information provided by Director of Public Works, U.S. Army.

Data from Geonics, Ltd. EM-31 instrument, vertical dipole mode.

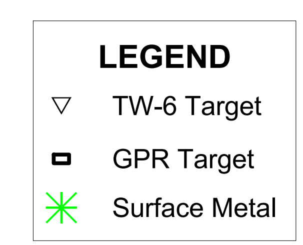

Figure 3

EM-31 Inphase Response Data Contours

US Army Fort Monmouth, NJ

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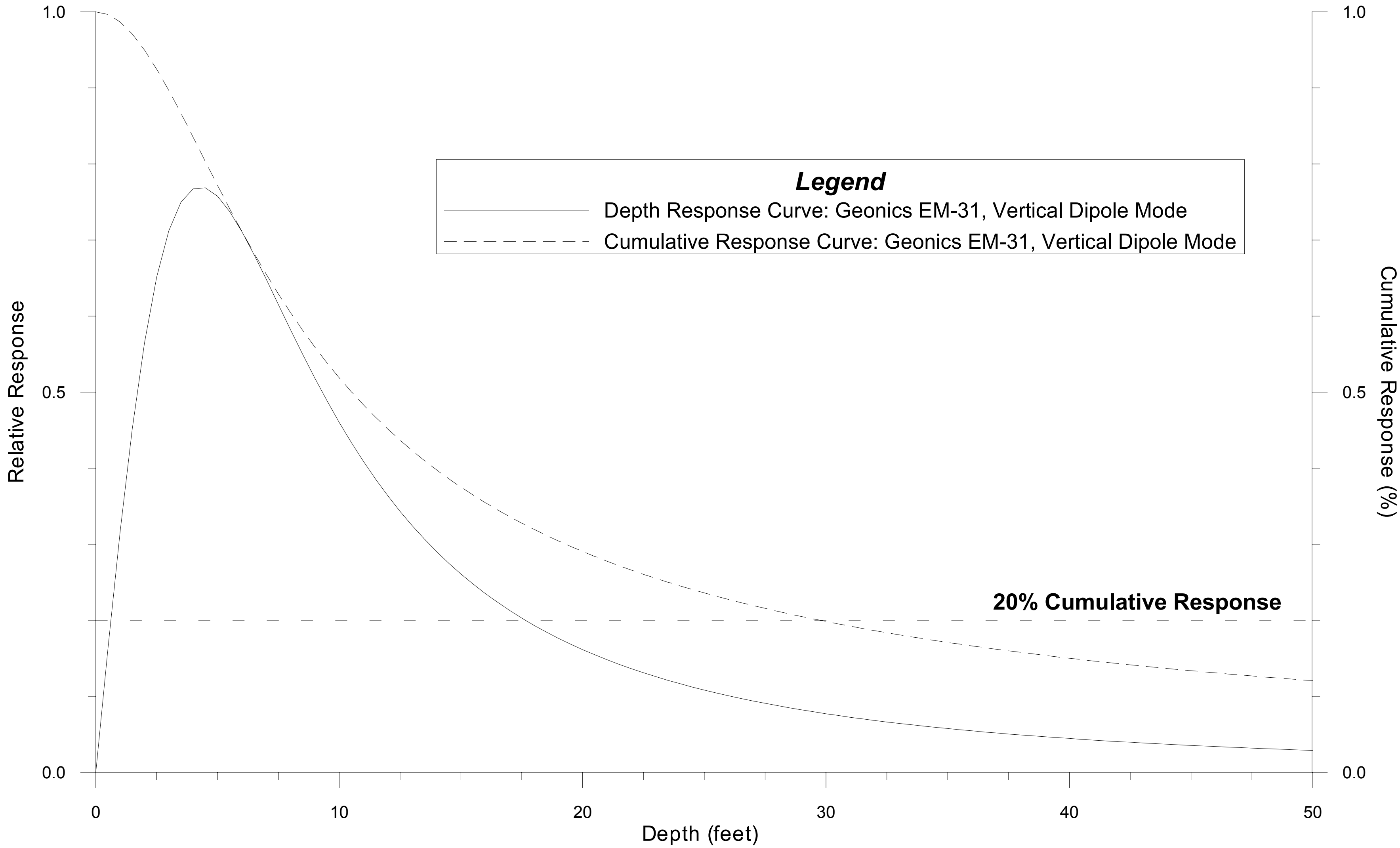
Appendix A

EM-31 Vertical Dipole Mode Depth Response



EM-31 Vertical Dipole Mode Depth Response

Revised 01/2001

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Appendix B

GPR Survey Results

Project No. 030301, Fort Monmouth, NJ

TARGET NUMBER	EASTING	NORTHING	DESCRIPTION	METHOD
1	2173762.327	538474.106	7' x 14' High amplitude parabolic reflector	TW-6/GPR
2	2173489.047	538275.903	6' x 10' High amplitude parabolic reflector	TW-6/GPR
3	2173474.031	538098.7216	Multiple utility lines, poor signal penetration using GPR	TW-6/GPR
4	2173338.893	538014.6354	Linear anomaly from storm sewer line towards Building 814	TW-6
5	2173350.905	537492.1004	3' x 4' High amplitude parabolic reflector	TW-6/GPR
6	2174185.76	538504.1366	Reinforced concrete sidewalk, Poor signal penetration using GPR	TW-6/GPR
7	2174218.794	538480.112	Reinforced concrete sidewalk, Poor signal penetration using GPR	TW-6/GPR
8	2174161.736	538486.1182	Reinforced concrete sidewalk, Poor signal penetration using GPR	TW-6/GPR
9	2174290.868	538314.943	8' x 13' EM anomaly	TW-6

TARGET NUMBER	EASTING	NORTHING	DESCRIPTION	METHOD
10	2174356.935	538275.903	8' x 12' EM anomaly	TW-6
11	2174386.966	538296.9244	Reinforced Concrete Sidewalk	TW-6/GPR
12	2174419.548	538221.331	Multiple point target EM anomalies	TW-6
13	2174486.068	538176.8014	5' x 5' EM anomaly	TW-6
14	2174444.025	538107.7308	8' x 14' High amplitude parabolic reflector	TW-6/GPR
15	2174227.803	538176.8014	8' x 14' High amplitude parabolic reflector	TW-6/GPR
16	2174152.726	538230.8568	7' x 14' High amplitude parabolic reflector	TW-6/GPR
17	2174128.702	538215.8414	4' x 5' High amplitude parabolic reflector, near surface	TW-6/GPR
18	2174113.686	538131.7554	5' x 6' High amplitude parabolic reflector	TW-6/GPR
19	2174185.76	538089.7124	7' x 13' High amplitude parabolic reflector	TW-6/GPR
20	2174254.831	538047.6692	6' x 12' High amplitude parabolic reflector	TW-6/GPR
21	2174320.899	538002.6232	8' x 13' High amplitude parabolic reflector	TW-6/GPR
22	2174386.966	537963.5832	6' x 14' High amplitude parabolic reflector	TW-6/GPR
23	2174510.092	537756.371	Small metal tube at surface, no Subsurface target detected	TW-6/GPR
24	2174509.92368	537754.6006	Reinforced Concrete Sidewalk	TW-6/GPR

References

McNeill, J.D. (1980a) Electromagnetic Terrain Conductivity Measurement at Low Induction Numbers, Technical Note TN-6, Geonics, Ltd.