Geophysical Investigations of Chalmette Battlefield and National Cemetery, Jean Lafitte National Historical Park and Preserve, St. Bernard Parish, Louisiana, Part I: Rodriguez Plantation and Cemetery Sections 131 & 132

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Abstract

The Louisiana Geological Survey conducted a series of geophysical investigations at archaeological sites within the Jean Lafitte National Historical Park and Preserve, Chalmette Battlefield and National Cemetery units, between Nov. 01 and Nov. 10, 2016. Magnetic field gradient anomalies over an 18 meter by 32 meter grid near the Visitor Center resolved buried features that are interpreted as remnants of the 18th - 19th century Rodriguez Plantation. Magnetic gradient and electrical resistivity measurements within the National Cemetery resolved burial patterns and their relationships to standing gravestones. The results encourage continued use of these geophysical techniques in the search and analysis of archaeological features within these National Park Service units.

Introduction

The Louisiana Geological Survey was enlisted by the Office of Resource Management at Jean Lafitte National Historic Park & Preserve to conduct a preliminary geophysical study of selected sites within the Chalmette Battlefield and Chalmette National Cemetery units located in St. Bernard Parish, Louisiana (Figure 1). The purpose of the study was to test geophysical techniques of magnetometry and electrometry in resolving archaeologically and historically important features within the park. One area of interest is a portion of the battlefield known as Rodriguez Plantation, a farmstead that was occupied during the Battle of New Orleans of January 8, 1815. A second study area lies within the National Cemetery where the configuration of a single gravestone row is inconsistent with the overall gravestone pattern within the cemetery.

Geophysical measurements (described below) were performed over 5 days' time between November 01 and 10, 2016. The field data were processed using appropriate computer software as a basis for interpretations within an archaeological context, with model results and interpretations presented here along with recommendations for future archaeological and geophysical investigations.

Previous Studies

A small number of archaeological and historical studies of the Chalmette Battlefield & National Cemetery units have been conducted over the previous decade. One study (Birkedal, 2009) presents details of the geographic and political history of the area, analysis of human artifacts found in the area, and a comprehensive narrative of the 1815 Battle of New Orleans. A second study (Cornelison and Cooper, 2002) reconstructs troop movements and engagements during the battle by analysis of concentrations of battlefield artifacts.

Both studies incorporated data from geophysical techniques, including magnetometry, metal detection, and ground radar, as a basis for excavation strategy. Birkedal (2009) limited geophysical investigation to total field magnetometry primarily within 60 meters of the modern-day left bank levee of the Mississippi River. Cornelison and Cooper (2002) applied ground-penetrating radar (GPR) and metal detector techniques. Metal detection was primarily limited to the battle field, producing a bounty of battle-related artifacts. GPR measurements were conducted at a number of selected sites, including a portion of the National Cemetery and the Rodriguez Plantation. The GPR models resolved a number of graves within the cemetery but failed to resolve remnant features of the Rodriguez Plantation.

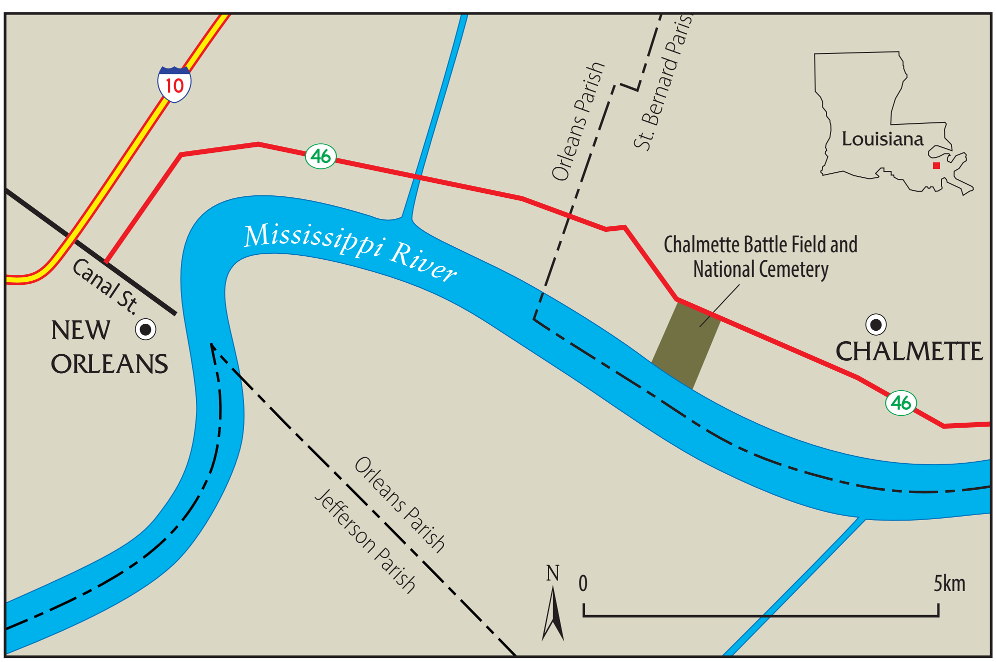


Figure 1. Location of Chalmette Battlefield and National Cemetery, St. Bernard Parish.

The present study attempts resolution of archaeological features associated with the battlefield and burials within the cemetery by measurement of Earth's magnetic field (magnetometry) and electrical properties of the soil (geo-electrometry). These techniques are briefly described in the next section.

Geophysical Techniques

Magnetometry

Magnetometry is the geophysical technique of measuring Earth's magnetic field over an area of interest and interpreting the results in terms of geological or anthropogenic features in the subsurface. Attention is typically focused on resolution and interpretation of local deviations ('anomalies') from an ideally uniform magnetic field. Archeological geophysics in particular seeks magnetic field anomalies that can be related to anthropogenic features concealed in the subsurface, providing a guide for subsequent excavations (Telford et al., 1990; Gaffney and Gater, 2003; Milson and Eriksen, 2011; Reynolds, 2011).

Magnetic field measurements are made using a magnetometer – an instrument specialized along various designs to resolve the magnetic field direction, components, and magnitude over a continuous or discretized geometric grid of the study site. This study used a proton precession magnetometer (Figure 2), a versatile and reliable instrument for measuring magnetic field magnitude. The instrument incorporates two sensors in order to measure the magnetic field gradient, providing better resolution of weak magnetic signatures than is available from total field measurement (Hood and McClure, 1965; Breiner, 1999). Iron-bearing material, such as steel, cast iron, and fired brick, has greater magnetic susceptibility than does typical soil and hence locally concentrates the magnetic field, producing a dipolar anomaly of positive and negative gradient values. The instrument cannot, however, discriminate between shape, origin, or age of a buried magnetic object, leaving it to interpretation to distinguish between historic relicts vs modern rubbish.

A two-dimensional rendering of the data set, or 'anomaly map', serves as a basis for recognizing and interpreting anomaly patterns in context of the investigation. Qualitative interpretation of anomaly patterns is ordinarily adequate for archeological purposes as magnetic evidence of human activity is typically in the form of either small isolated anomalies related to individual objects, or multi-anomaly patterns consistent with the tendency of humans to place or construct features along simple geometric shapes: straight lines, triangles, rectangles, circles, etc. One-dimensional profiles through select anomalies can be matched with theoretical models in order to estimate the size and depth of an individual subterranean object causing a specific anomaly (Telford et al., 1990; Breiner, 1999).

a

b

Figure 2. Magnetic gradiometer (a) and electrometer (b) in field use.

Electrometry

An electrical survey maps geo-spatial variations of electrical resistivity (reciprocal of conductivity) and induction of electrical polarization. In this technique a pair of electrodes that carry electrical current and a second pair that measure electrical potential are positioned along a geometric configuration (Figure 2b) so that at a position within the electrode array, electrical resistivity and induction are related to the injected current, current phase shift, and voltage differential (Telford et al., 1990; Gaffney and Gater, 2003; Milson and Eriksen, 2011; Reynolds, 2011). Although measurements can be performed with electrodes positioned arbitrarily, model equations ordinarily assume co-linear arrangement with specific relative positions dictated by the goal(s) of the investigation. A suitable electrode array is deployed over the study site to yield either a two-dimensional map of electrical anomalies due to variations over a range of depths, a two-dimensional cross-section similar to a geologic cross-section, or a three-dimensional representation, all of which can be related to geologic or anthropogenic features in the subsurface (Van Nostrand and Cook, 1966; Telford et al., 1990).

Depending upon the survey format, viz. 2-D map vs. cross section or 3-D imagery, effective interpretation of the data may require numerical modeling and processing. Model inversion, the approach most commonly used for electrical profiling and 3-D rendering, attempts to fit a 2-D or 3-D subterranean model with ideal electrical properties to measurements made at the surface (Loke, 2014).

Geophysical Surveys at Chalmette

CHAL-01: Magnetometry Survey, Rodriguez Plantation Area

A small area of the Rodriguez Plantation (*CHAL-01, Figure 3)* near the Chalmette Battlefield Visitor Center was selected to test magnetometry for identifying archaeological features. Previous archaeological and historical studies indicate that the plantation comprised at least one house and a number of outbuildings, some or all of which were occupied during the Battle of New Orleans (Birkedal, 2009). The plantation structures were subsequently razed leaving no immediately visible suggestion of their original shapes, sizes, and positions.

Magnetic gradient measurements were performed over a descretized rectangular grid of dimensions 32.0 meters SSW – NNE by 18.0 meters WNW – ESE with grid points, or 'stations', spaced 0.5 meters. The two gradiometer sensors were positioned at 0.30 and 0.60 meters height above the ground so that sensor proximity to the ground would enhance detection of magnetic signatures of small and/or weakly susceptible objects.

Malus-Beauregard House

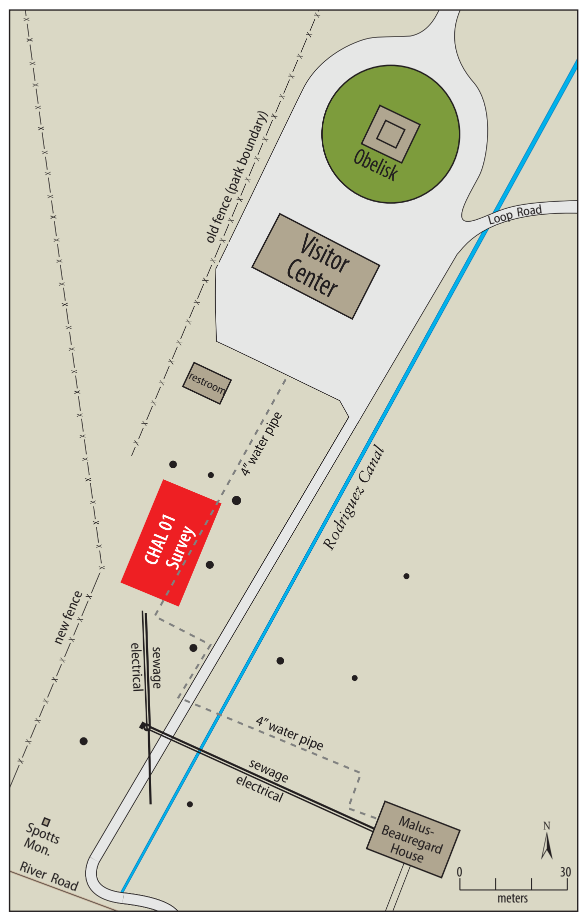


Figure 3. Location of CHAL-01 survey area plotted relative to park landmarks. Trees are represented by solid dots sized according to trunk diameter. Utilities are shown according to Lenstra and Robertson (1983).

CHAL-01: Results and Summary

The results of magnetic gradient measurement over the CHAL-01 survey are shown in Figure 4. Contour shades of pink – red represent areas of positive magnetic gradient, purple – blue represent negative magnetic gradient, and yellow-green corresponds to zero gradient. Magnetic gradient anomalies are recognized in context of anthropogenesis in the form of geometric patterns and isolated anomalies that are not likely to be of geologic origin. Recognition of an anomaly as being isolated vs. part of a pattern is somewhat subjective, but depends upon its distance from other anomalies of similar strength and whether the anomaly and its neighbors appear to form a discernible pattern. Weak anomalies, despite being isolated, may result from measurement noise either from the instrument or from fluctuations in Earth's magnetic field. Such artificial anomalies can be recognized by their low magnitude and lack of paired positive and negative values.

A few isolated anomalies and anomaly patterns in the CHAL-01 survey are mapped in Figure 5. Strong individual anomalies (red and blue) of large areal extent are produced by a buried pipeline along the southeastern margin of the survey (cf. Figure 3), and demonstrate the tendency for a continuous object of steel to produce a segmented anomaly pattern. Other anomaly patterns interpreted as possibly having archaeological significance are numbered 1 – 6 in Figure 5. Feature 1 is interpreted as an area of concentration of iron and/or brick objects due to the small breadth, moderate strength, and bi-polarity the anomalies. The lack of obvious pattern coherence within this area makes it difficult to determine if the pattern is related to objects more or less randomly strewn or to one or more structures larger than or extending beyond the limits of the survey area. In either case, the high concentration of equant and somewhat singular anomalies suggests this area has a history of intense human activity that includes deposition of iron-bearing objects.

Features 2 and 3 map apparent linear distributions of anomalies, suggesting these patterns could correspond to one or more rectilinear features, such as remnants of pen fencing or foundational elements of some type of rectangular structure. The NE-SW swath of high magnetic gradient at the northern end of area 2 (pink-red) could, however, be produced by the buried pipeline.

Pattern area 4 is another NW-SE linear cluster of anomalies that parallels anomaly area 3, suggesting a possible relationship between the two. Unfortunately, the intersection of the pipeline and the spatial limit of the survey make it difficult to determine if these two areas actually represent a single feature. Feature 5 is a set of somewhat weak anomalies that appear to be arranged in an arcuate pattern, although archival depictions of the Rodriguez property indicate only rectangular structures occupied the site through its history (Cornelison and Cooper, 2002; Birkedal, 2009).

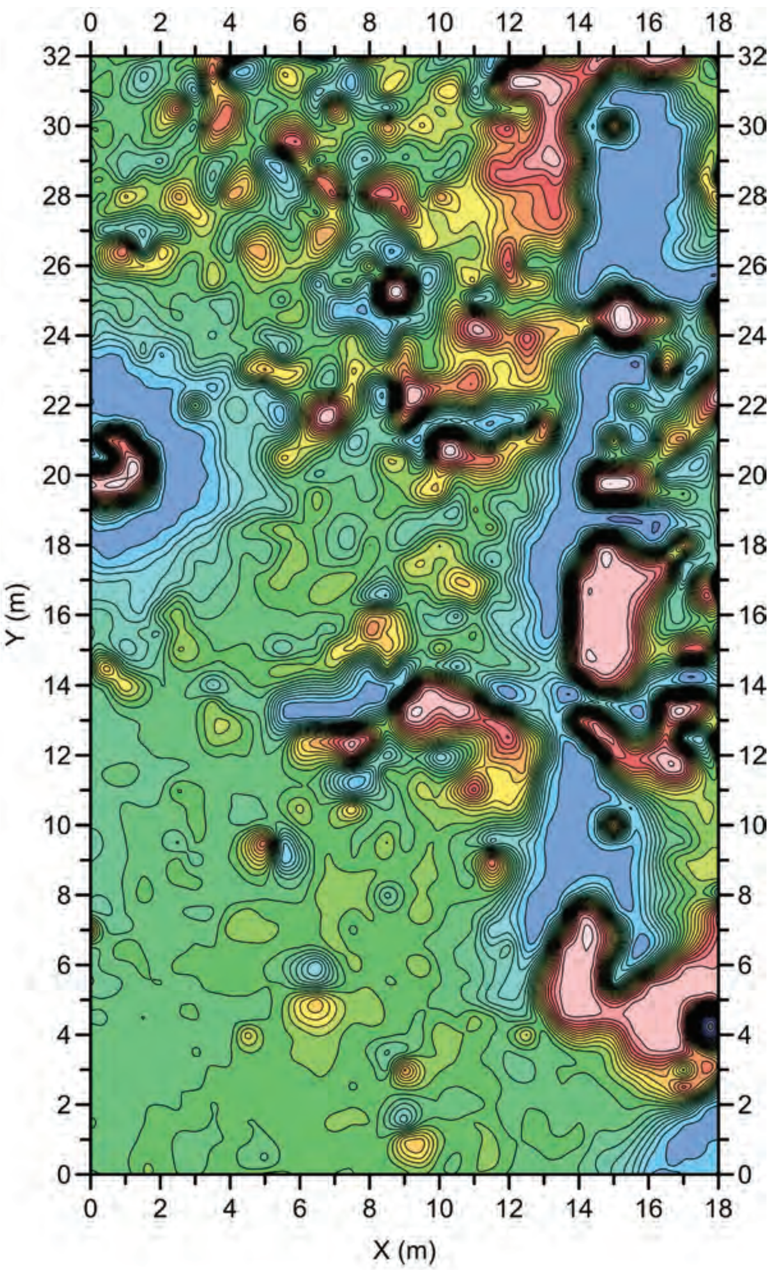


Figure 4. Magnetic gradient anomaly map of survey CHAL-01, Rodriguez Plantation area.

Area 6 appears to be free of all but a few isolated anomalies of moderate to low strength, which is remarkable considering the long history of human occupation of the site (cf. area 1). The anomalies are dipolar with axes divergent from current-day magnetic North. The divergent orientations, relatively low strength, and small breadth of the anomalies suggest relatively small, polarized iron or brick objects situated within a few decimeters depth. The relative paucity of magnetically susceptible objects in this area suggests that during human occupation the area may have been protected from strewn objects by some structure, such as a floored residence.

Two isolated anomalies of high magnetic gradient, marked 'X' at coordinates (1.0, 20.0) and (8.7, 25.5), represent objects of high magnetic susceptibility and remanent magnetic polarity probably at shallow depth. The object within area 1 is the smaller of the two and its location within the concentration of magnetic objects (area 1) suggests a relationship to the others and hence may be of historic significance. The second of the strongly magnetic objects, situated near coordinate (1.0, 20.0), appears relatively large and mostly intact. The breadth, strength, and sharpness of this anomaly indicate a relatively massive iron or brick object at shallow depth.

Assuming survey CHAL-01 is positioned over a portion of the Rodriguez Plantation footprint, magnetic gradient anomalies seem to indicate residual features of that establishment. In particular, the data indicate isolated magnetically susceptible (steel, possibly brick) items, structural remnants in geometric shapes, and a concentration of strewn steel and brick objects suggesting an area of concentrated human activity. Interpretation of anomaly patterns is hindered by the magnetic signal of a modern burial pipeline along the southeastern margin of the survey and by the limited areal extent of the survey itself. While removal of the magnetic effects of the pipeline is impractical, extension of the survey area well beyond the pipeline should improve definition of anomaly patterns. Moreover, the extents and forms of all of the features will be better resolved by measurements over adjacent areas, effectively expanding the coverage of survey CHAL-01.

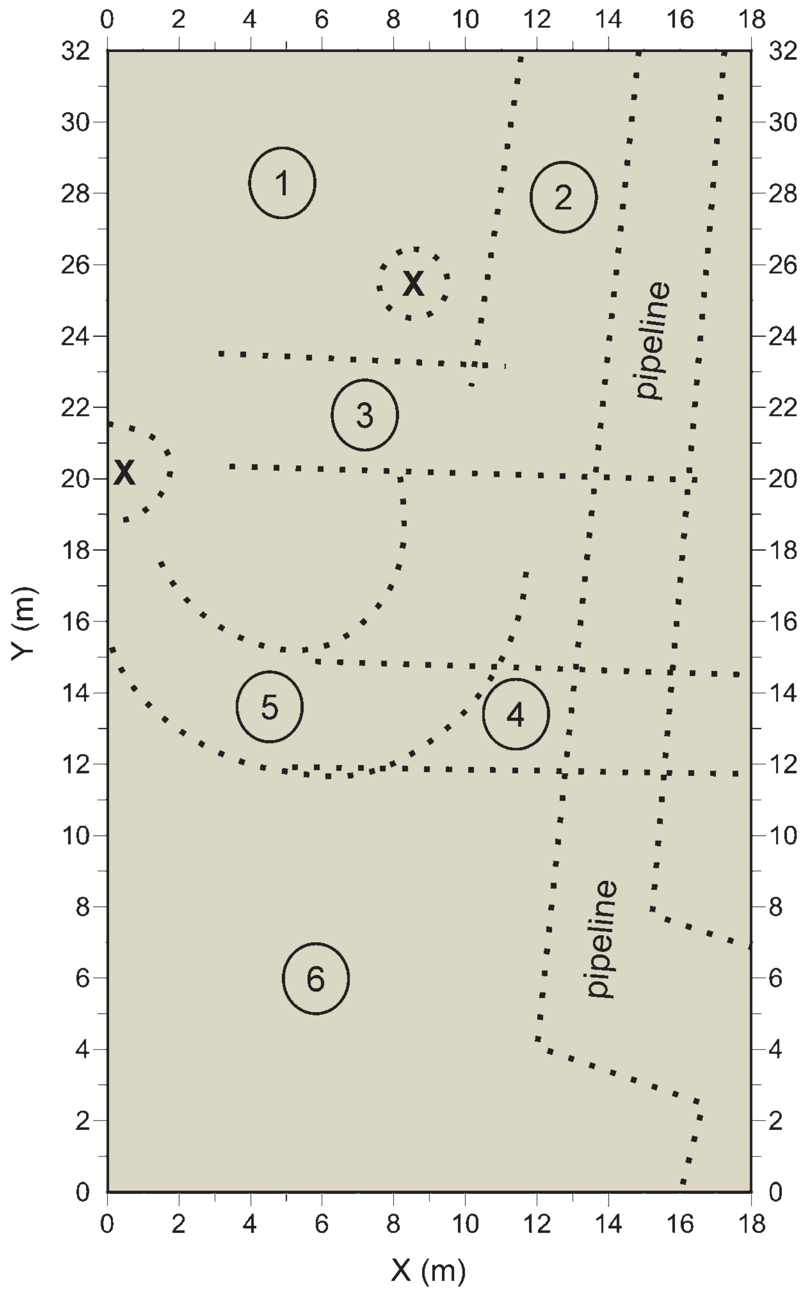
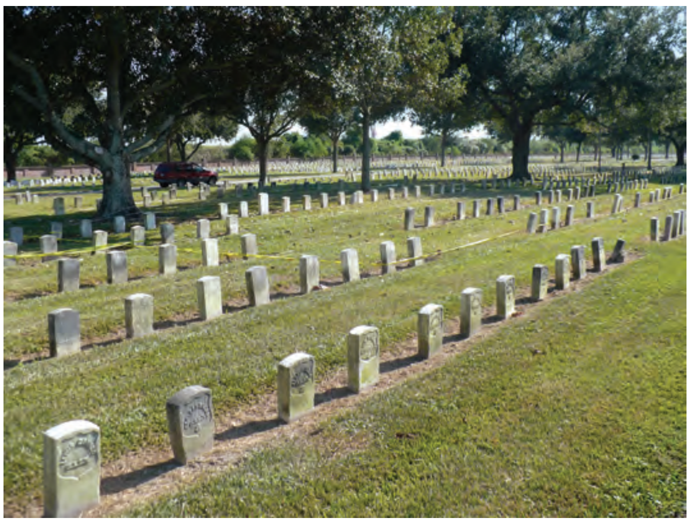


Figure 5. Map of interpretations of magnetic gradient anomalies, survey CHAL-01. Geometric patterns of possible anthropogenic origin are shown outlined and numbered, and are discussed in the text. Strong anomalies, 'X', correspond to isolated and relatively massive iron or brick objects at shallow depth.

CHAL-02: Magnetometry, Chalmette National Cemetery

The research question for the cemetery site, CHAL-02 (Figure 6), concerns detection and mapping of burials in order to verify their relationship(s) to standing gravestones. Some gravestone rows within the cemetery have inconsistently spaced gaps of length equivalent to several (10 or more) gravestones, raising the question whether burials are situated along these gaps that either were never marked with gravestones or were once marked but the gravestones have since been removed. Alternatively, remains were never interred where the gaps now occur, in discord with burial patterns indicated by gravestone row continuity that is typical of the cemetery overall. Effectively addressing this question requires comparison of geophysical data over presumed burials (along a row of standing gravestones) with data over gravestone-free areas, such as alleyways for access and tree placement. Both magnetometry and electrometry surveying have been successful in this purpose at other settings although site characteristics can effectively marginalize one technique vs. the other (eg., Horn and Gregory, 2015; Gregory et al., 2015). In this study results from both techniques address the question concerning burials within a gravestone row gap, but also raise additional questions and suggest enlightening hypotheses.



Survey area CHAL-02 is shown in Figure 7 with details of standing gravestones, alleyways, trees, and electrical profile lines of this study. The survey area was selected to encompass five rows of gravestones, 3, 2, 1, 6, and 5* shown in Figure 7, which presumably mark individual burials, as well as alleyways lacking gravestones (labeled 'walk alley' and 'tree alley') in order to collect geophysical data over both burial and non-burial areas. Gravestone row 2 is of specific interest in this study because of the lack of gravestones between the two walk alleys. (* A roster of gravestone inscriptions is provided in Appendix A-1. The numbering of sections, rows, columns, and burials is in accord with the National Park Service grid system for Chalmette National Cemetery (Appendix A-2).

As for survey CHAL-01, magnetic gradient measurements over CHAL-02 were performed on a 0.5 m x 0.5 m station grid with sensors positioned 0.30 m and 0.60 m above ground. The resultant magnetic gradient field is color contoured in Figure 8; orange-red-white shading represents positive magnetic gradient and green-blue-black shading represents negative gradient. Anomaly patterns interpreted to represent anthropogenic features are mapped in Figure 9.

Three isolated, relatively strong anomalies are marked 'X' at coordinates (1.5, 17.0), (8.0, 20.0), and (8.0, 7.5). The large magnitudes and breadths of these anomalies correspond to isolated objects of relatively high magnetic susceptibility and remanent polarity, i.e. iron or brick. No such objects were observed at the surface, hence the first two of these likely reside in the near subsurface, the third is either buried near the Red Oak tree or perhaps embedded within the tree.

Four areas of anomaly patterns are mapped in Figure 9 in context of the survey boundaries, standing gravestones, alleyways, and trees. Area 1 is dominated by a row of relatively low magnitude (yellow-orange), positive gradient, eccentrically shaped (1 m x 2 m) anomalies on roughly 1 meter spacing along Y with their long axes oriented perpendicular to the gravestone row. The shapes and spacing within this pattern and its position along a row of gravestones (row 3) is consistent with a row of burials (remains situated eastward of the gravestones, feet to the East), although matching of individual anomaly axes with individual gravestones is inconsistent. Positive magnetic gradient over a burial could be due to the inclusion of steel objects, such as components of military paraphernalia or encasement hardware (hinges, nails, wire, etc.) with the remains. The northeastward extent of this anomaly pattern is difficult to establish due to the strong anomaly at coordinate (1.5, 17.0).

A distinctive set of regular linear elements, or stripes, oriented roughly parallel and at ~45^{o} to the bearing of gravestone rows (patterns 2 & 4), is more consistent with an anthropogenic rather than geologic origin. Furthermore, the uniform 1.5 meter (~ 5 feet) spacing, apparent pairing, orientations, and position among gravestone rows suggest these anomalies could correspond to ruts of a wheeled vehicle, such as a wagon used at the time of interment or of service vehicles used in subsequent years.

Area 3 shows somewhat ambiguous patterning. Its position immediately eastward adjacent to a gravestone row (row 1) imply this should be an area of burials. However, the anomaly pattern lacks distinct oblong, roughly NW-SE oriented, positive gradient anomalies as appears in area 1. Moreover, roughly SW-NE oriented linear anomalies south of the Red Oak tree are more consistent with those in areas 2 and 4 interpreted as vehicle ruts. Unfortunately, the strength of the anomaly associated with the Red Oak tree obscures much of this area making it difficult to conclude from this data whether area 3 encompasses burials.

Figure 6. Location of survey CHAL-02 within Chalmette National Cemetery, along the eastern margin of Chalmette Battlefield park.

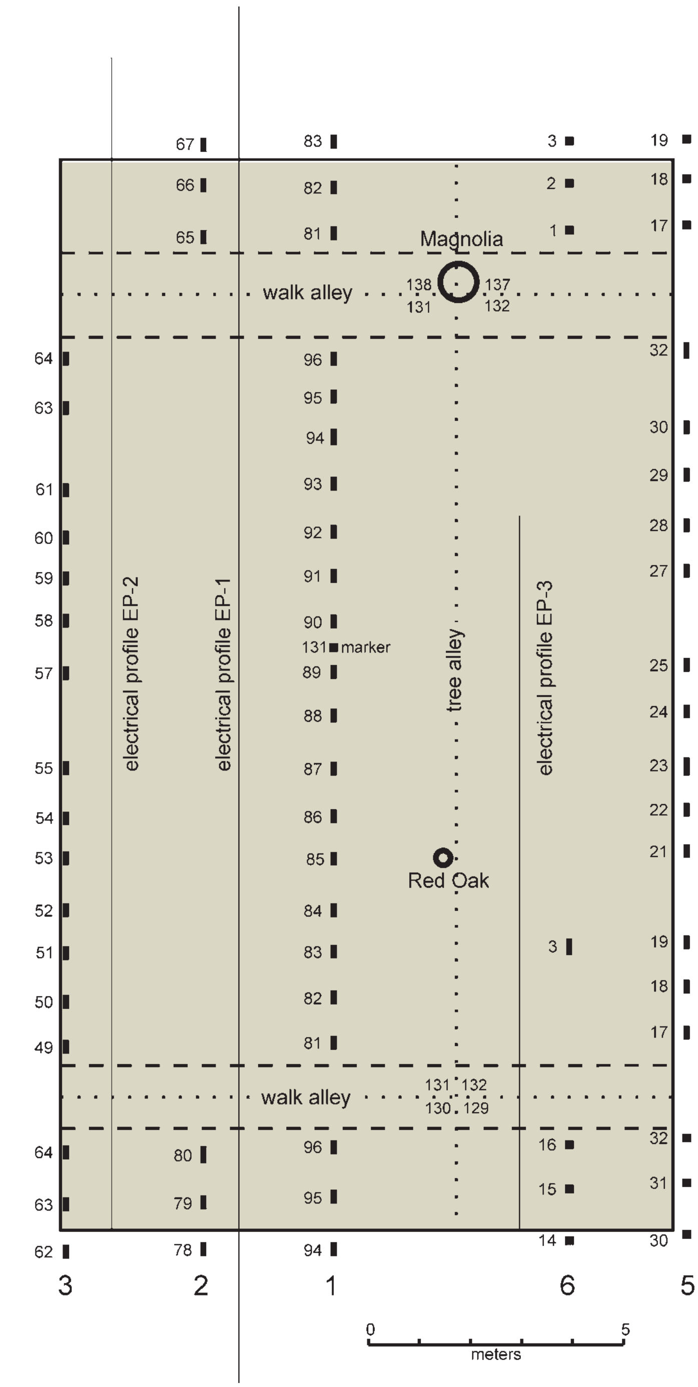


Figure 7. Map of CHAL-02 survey showing gravestone rows 3, 2, and 1 of sections 130, 131, and 138, rows 6 and 5 of sections 129, 132, and 137, alleyways (section boundaries), trees (circle diameter according to trunk diameter), and electrical profile lines (EP1 – EP3). Gravestone inscriptions are tabulated in Appendix A-1. Section, row, and gravestone numbering are according to the system used by the National Park Service (Appendix A-2). Northeast is to the top of the diagram (c.f. Figure 6).

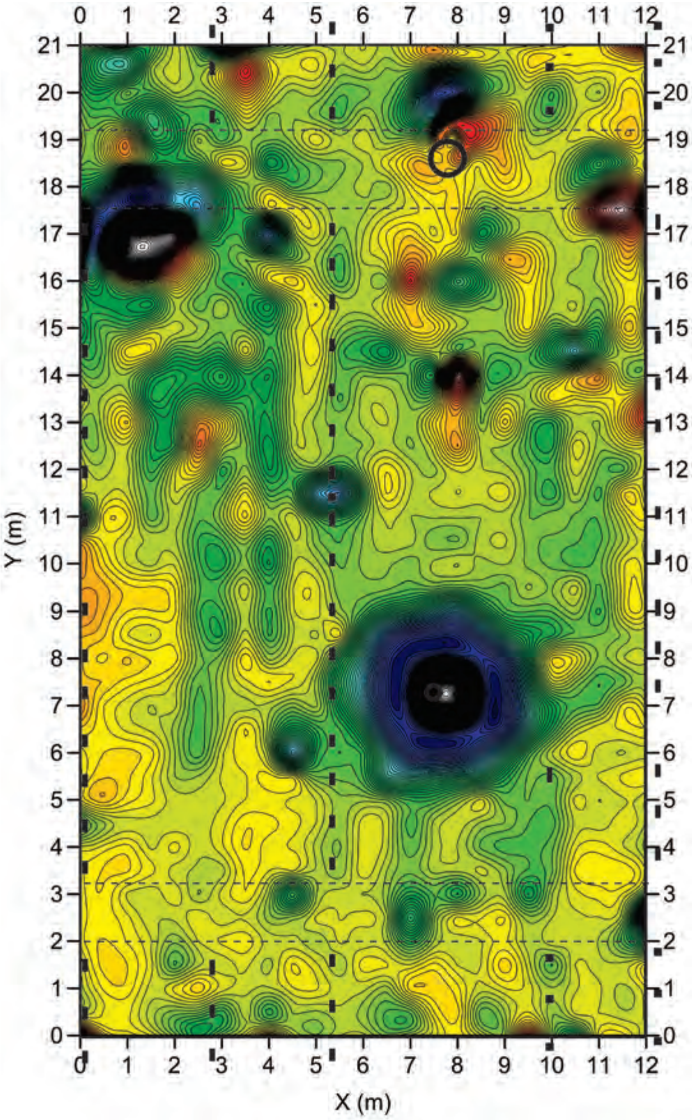


Figure 8. Magnetic gradient anomaly map for CHAL-02 with gravestones, alleyways, and trees shown for reference. Orange-red shading represents high magnitude positive magnetic gradient, yellow-green represents zero magnetic gradient, and dark blue – black represent high magnitude negative magnetic field gradient.

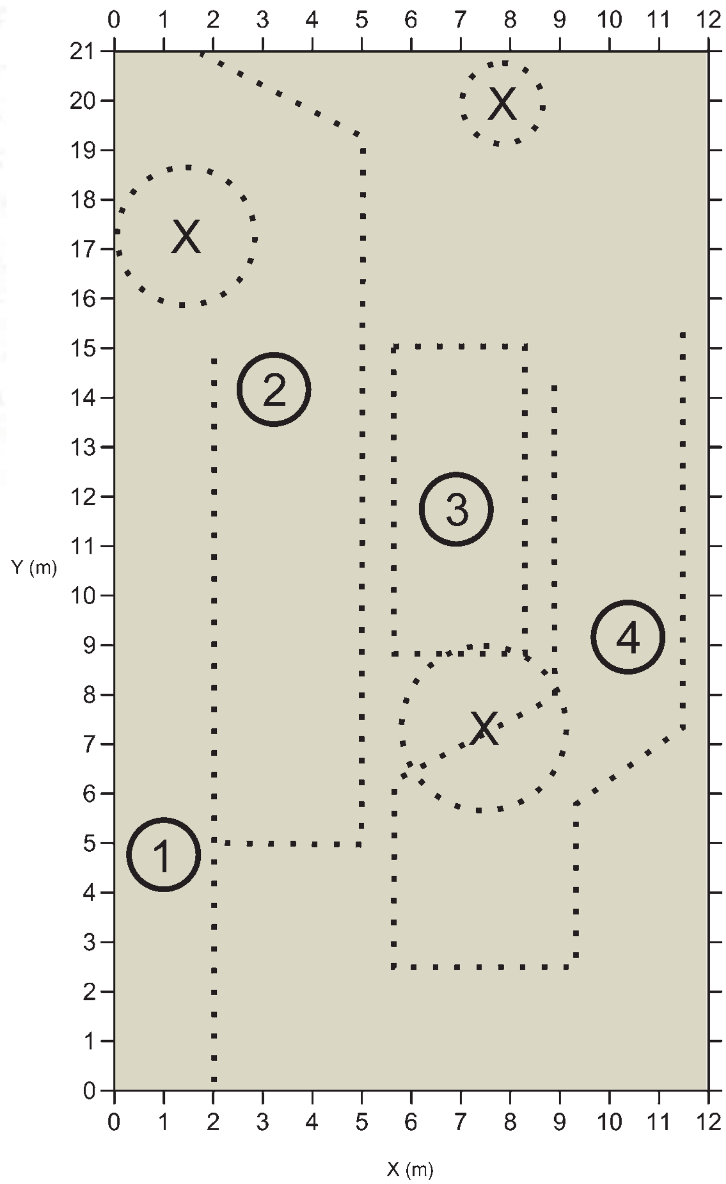


Figure 9. Map of interpretations of magnetic gradient anomalies, survey CHAL-02. Anomalies corresponding to massive objects made of iron or brick are marked 'X'.

CHAL-02: Electrical Resistivity Profiles, Chalmette National Cemetery

As a second approach in the search for burials, a set of three electrical resistivity profiles were performed in survey CHAL-02 along the strike of standing gravestones (Figure 7, electrical profiles 'EP-1', 'EP-2', and 'EP-3'). The three profiles were performed using a 4-electrode layout in a dipole-dipole array with a 0.5 m electrode spacing (Telford et al., 1990; Gaffney and Gater, 2003; Milson and Eriksen, 2011; Reynolds, 2011; Figure 2b). Profile EP-1 was positioned along X = 3.5 m of the magnetic survey grid and offset 0.6 meters eastward of gravestone row 2 to directly address the question of burials within the gravestone row gap. Profiles EP-2 and EP-3 were positioned along X = 1.0 m (0.83 meters eastward of gravestone row 3) and along X = 9.0 m (within the tree alley), respectively, as controls over presumed burials marked by gravestones (row 3) and an area lacking gravestones and, therefore, presumably burials (tree alley). Because profile EP-3 was assumed to traverse ground devoid of burials, its length was set shorter than for profiles EP-1 and EP-2 in order to conserve time.

The raw data were processed with computer software to produce an inversion model of electrical resistivity variation in the subsurface (Loke, 2014; Nero et al, 2016). The model results are plotted in Figure 10 in cross-section format so that the 'Y' coordinate corresponds to the Y coordinate of the survey grid and 'Z' represents depth. Base 10 logarithm values of model resistivity (ohm-m) are contoured and shaded so that dark gray – black represents relatively high electrical resistivity (<100 ohm-m) and light gray – white represents low resistivity (> 3 ohm-m). Positions of gravestones and alleys are indicated above each profile.

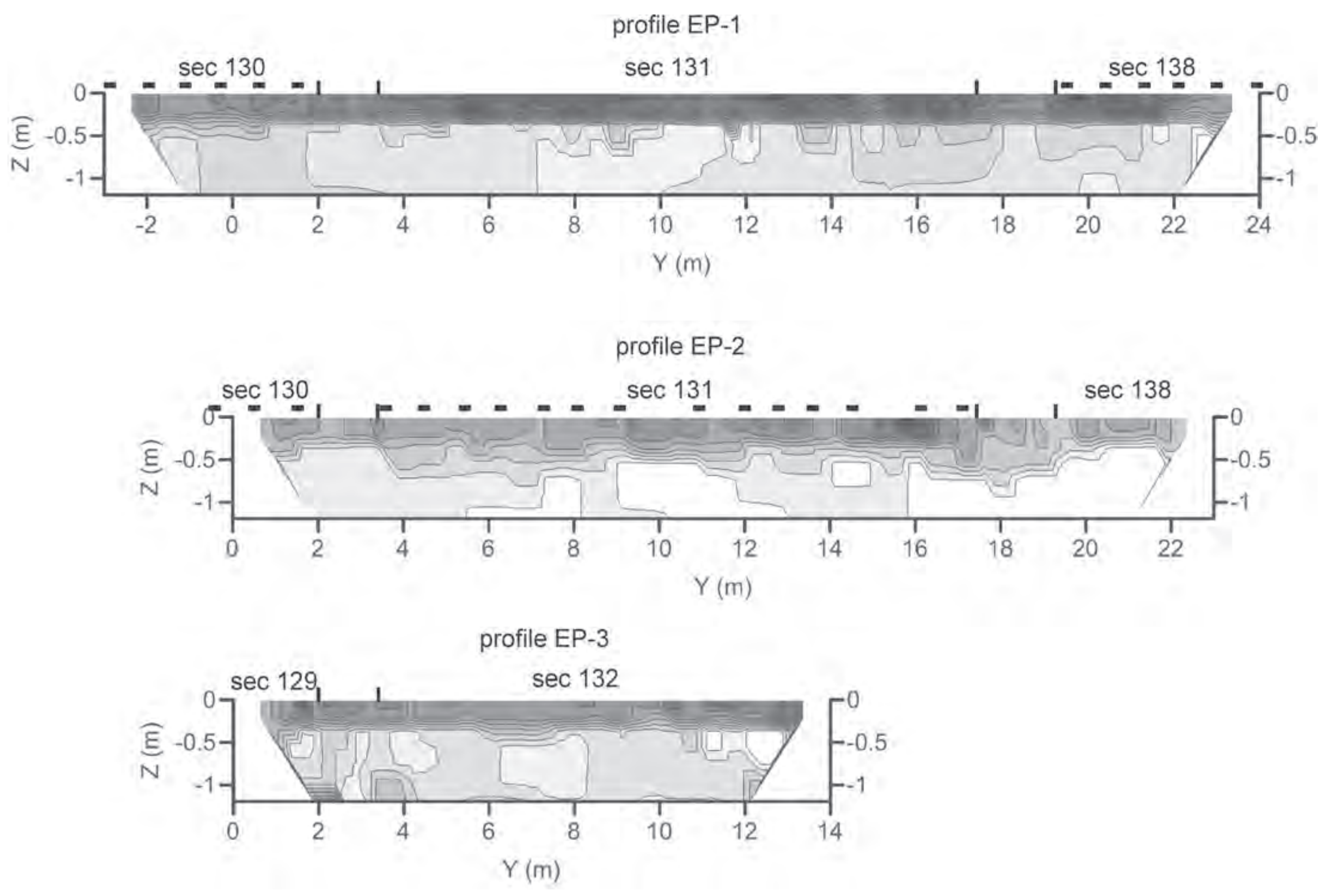


Figure 10. Inversion models of electrical resistivity profiles EP-1 – EP-3 in survey area CHAL-02. High resistivity areas are shaded dark gray – black, areas of low resistivity are shaded light gray – white. Gravestones (small rectangles), alleyways (vertical line segments), and cemetery section numbers are plotted above each profile. The Y coordinate in these profiles correlates to the Y coordinate of Figures 8 & 9. The model anomaly pattern of profiles EP-1 & 3 are interpreted to indicate lack of burials, profile model EP-2 indicates burials within 0.5 m depth.

Profile EP-3 shows a relatively sharply defined pair of horizontal layers: an approximately 0.3 m thick resistive interval overlying a conductive half space. The sharp boundary is interpreted to separate an upper layer of relatively dry, and therefore resistant, soil layer from an underlying water-saturated conductive substrate, defining a water table surface at about 0.3 m depth. Because profile EP-3 is positioned within the tree alley (presumably) devoid of burials, it is concluded that the distinctly planar, sharply defined geometry of high vs. low resistivity layering represents naturally occurring undisturbed subsurface with a water table. (Isolated resistive anomalies at depth in profile EP-3 may represent either pockets of sand or silt or computational noise during model inversion.)

In contrast, model profile EP-2, adjacent to gravestone row 3, presumably over burials, shows a distinctly irregular and diffuse boundary between resistive (above) vs. conductive (beneath) layers, and is interpreted to represent a set of burials. Note also the sharp layer boundary within interval Y = 1.8 – 3.5 corresponding to the southern walk alley vs a downward extended anomaly situated beneath the northern walk alley (Y = 17.5 – 19.2 meters) indicating soil disturbance there.

The extension of resistive soil into the substrate in model profile EP-2 can be interpreted to result from a concentration of decomposition chemistry, and possibly bone, of the remains and its enclosure (wood or natural fabric, Seladji et al., 2010). Individual fluctuations in profile EP-2 may or may not correspond to individual burials (note plotted gravestone positions), however the diffuse subsurface distribution of electrical resistivity in model profile EP-2 is considered to be diagnostic of a row of buried remains while the more sharply defined resistivity layering of model profile EP-3 represents undisturbed subsurface, and hence a lack of burials (cf. Nero et al., 2016).

Turning to the question of burials within the gap of gravestone row 2, model profile EP-1 shows characteristics similar to both profiles EP-2 and EP-3, most strongly resembling the latter. The interval Y = -2.0 to 1.0 meters (profile EP-1) shows a somewhat diffuse layer boundary indicating burials associated with the gravestones immediately southwest of the walk alley (section 130). However, the majority of the transect (Y > 1.0 m) primarily shows the sharply defined layered character of undisturbed soil and water table as shown in model profile EP-3 including winthin the interval of gravestones along Y > 19.0 m. A few isolated intervals of diffuse and downward intrusive resistivity appear, such as at positions Y = 9.0, 12.0, and 14.0, and can be interpreted in a number of ways: soil disturbed by burial, soil disturbed by burrowing and nesting by ground-dwelling animals, such as ants, or artificial anomalies generated by computer modeling of 'noisy' data. However, only the anomaly at Y = 14.0 m is of breadth consistent with a burial (1.0 m). Furthermore, between Y = 1.0 to 23.0 m, the close spacing of contours indicates layered resistivity with a sharp boundary as appears in profile EP-3, interpreted as undisturbed soil. Hence this interval of the EP-1 transect, i.e. row 2, section 131 and row 2, columns 1-4, section 138 , is interpreted to host no burials.

As an aside, the resistivity model of profile EP-2 also indicates that burial depth may have been as much as about 0.5 meter, which is roughly 0.2 meter below the modern water table depth of 0.3 meter (profiles EP-1 and EP-3). Presumably, grave excavation would have stopped at the water table inasmuch as continued digging would have been onerous and honor protocol would discourage depositing remains in standing water. If so, the generally downward extension of resistivity shown in profile EP-2, compared with profile EP-3, could imply that at the time of burials, the water table stood at about 0.5 meter depth.

CHAL-02: Summary

Geophysical techniques appear to successfully discriminate between areas with burial vs. areas lacking burials within the CHAL-02 survey although individual burials are not plainly resolved. Interpretation of individual technique results includes a degree of uncertainty or ambiguity that is reduced by combination of the two data sets.
The combined model results indicate that buried remains are situated along gravestone row 1, but none occur between walk alleys along row 2 or within the tree alley. However, contrary to indication by the magnetic field data, electrical resistivity models indicate no burials beneath the southern walk-alley separating sections 130 and 131. In addition, there appear to be no burials along transect EP-1, corresponding to gravestones in plot row 2, columns 1 – 4 of section 138.

Individually strong, isolated magnetic field anomalies likely represent metallic iron or brick objects concealed in the subsurface, one perhaps embedded in the Red Oak tree. Of the three anomalies, the one at coordinate (1.5, 17.0) (northern walk alley, Figure 9) may be of historic importance as it correlates to an electrical resistance anomaly (profile EP-2) at the same location. The magnetic anomaly is consistent with a steel object of appreciable size at shallow depth and the electrical anomaly indicates soil disturbance. These two interpretations together suggest the remnant of a structure, such as a monument no longer standing, or possibly the site of rubbish burial, although the possibility of buried human remains at this location cannot be ruled out.

Conclusions and Recommendations

The results of the study show that the geophysical techniques of magnetometry and electrical profiling successfully address questions about archaeologically/historically significant features at the Chalmette Battlefield & National Cemetery study site. At survey CHAL-01 patterns of magnetic gradient anomalies indicate remnants of structures and human activity related to the Rodriguez Plantation. It is recommended that the interpretations presented here be considered for future archaeological excavation strategies. The geophysical study area at the Rodriguez Plantation site should be expanded; prior removal of the anomalous object at coordinate (1.0, 20.0) (Figure 5) will reduce interference with more subtle anomalies nearby. As an aside, although the anomaly pattern related to the buried pipe hinders interpretation of more subtle anthropogenically related patterns, the results demonstrate the effectiveness of magnetometry in searching and mapping the layout of buried utility pipelines.

The combination of the two geophysical techniques at CHAL-02 indicates that no human burials exist within the gap of gravestone row 2, section 131 (Figure 7). Furthermore, the data suggest the possibility that some standing gravestones may not mark actual burials. These conclusions motivate two immediate recommendations for this study area: (1) excavation for human remains at select positions among the three electrical profiles to test model interpretations, and (2) excavation in the immediate area of the magnetic anomaly at coordinate (1.5, 17.0) (Figure 9) to determine its identity and possible origin. It is also recommended that magnetometry and electrometry techniques, with prejudice toward the latter, be considered for future questions concerning cemetery features.

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APPENDIX A-1

Verbatim Roster of CHAL-02 gravestone inscriptions

No. (Fig. 7)	Inscription ('/' = line break, '(i)' = indiscernible)
Section 130	
62	SPENCER FLEMING / U.S.C.T.
63	JACOB DEMPSEY / U.S.N.
64	FREDI LEE / U.S.C.T.
78	GEO. CRAWLEY / U.S.C.T.
79	ROBT GAINES / U.S.C.T.
80	GEORGE OGLESBY / CPL / CO B / 67 REGT / US CLD TRPS / DEC 3 1864
94	RUSSELL FOLEY / U.S.C.T.
95	WM PADEN / U.S.C.T.
96	MORRIS PRATHER / U.S.C.T.
Section 131	
49	HENRI CALLES / U.S.C.T.
50	JEFFERSON FORD / U.S.C.T.
51	THOS / GREY / U.S.C.T.
52	FORMAN GARMOUCHE / U.S.C.T.
53	ISAAC BABCOCK / U.S.C.T.
54	(i) / HOLLAND / U.S.C.T.
55	J.W. COON / U.S.C.T.
57	PAUL HAWKINS / U.S.C.T.
58	ELIJAH GUY / U.S.C.T.
59	THOS GARRISON / U.S.C.T.
60	NELSON VALENTINE / U.S.C.T.
61	THOS HOLMES / U.S.C.T.
63	MILES CARTER / U.S.C.T.
64	JACOB DORSEY / U.S.C.T.
81	LOUIS SNEED / CORPL / U.S.C.T.
82	EPHN JONES / U.S.C.T.
83	GAY BENNETT / U.S.C.T.
84	GLEAN HILL / U.S.C.T.
85	JNO. WINES / U.S.C.T.
86	(i) SHERMAN / U.S.C.T.
87	HARRISON WOODS / U.S.C.T.
88	GEO. WALKER / U.S.C.T.
89	H.W. BURBRIDGE / U.S.C.T.
90	THOS WATSON / SGT / U.S.C.T.
91	FAUSTINE FAGO / U.S.C.T.
92	RICHD STEWART / U.S.C.T.
93	NELSON DUROB / U.S.C.T.

94	LEWIS BISHOP / U.S. / CLD. INF.
95	COFF. COOPER / U.S.C.T.
96	BEVERLY MITCHELL / U.S.C.T.

Section 138

65	C.H. LEONARD / SGT / U.S.C.T.
66	EDMUND JORDAN / U.S.C.T.
67	WM CLAY / U.S.C.T.
81	JNO. WATSON / U.S.C.T.
82	ALBT SMITH / U.S.C.T.
83	MICHL STEWART / U.S.C.T.

Section 129

14	10626
15	10627
16	10628
30	10642
31	10643
32	10644

Section 132

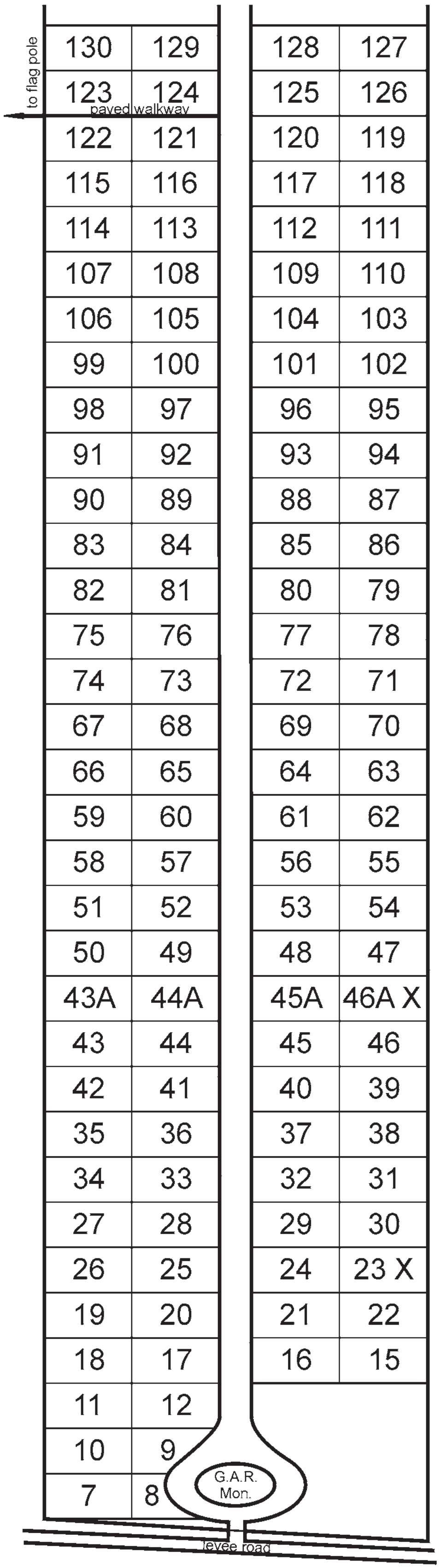
3	3 / EDW'D ROACH / EMPLOYEE / Q.M.D.
17	10864 / THOS N. MAFFET / U.S.A.
18	10865 / WM BROWER / U.S.A.
19	10866 / CARL KLAUS / U.S.A.
21	10867 / FRANK EDGERTON / U.S.A.
22	10868 / CHAS COLLINS / (i-ornament)
23	reverse: 10869 / obverse: (cross) / MICHAEL DANBITZER / MAY 24, 1873
24	10869 / A / MARTIN MAHER / U.S.A.
25	10869 / B / JNO. GRIFFIN / U.S.A.
27	10869 / C / CHAS BROOKS / U.S.A.
28	10869 / D / ARTHUR SIKIPPINGS / U.S.A.
29	10869 / E / CHRISTIAN DEALAM / U.S.A.
30	10869 / F / JNO. TIMMONEY / U.S.A.
32	reverse: 10869 / obverse: HENRY BORNEMAN / CO A / 3 REGT / US INF / JAN 9 1875

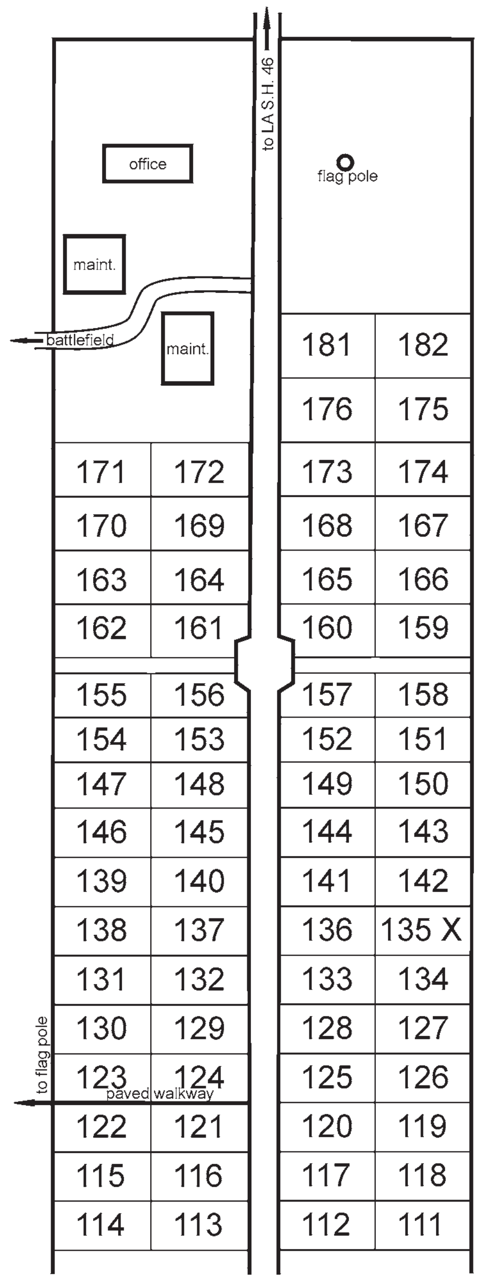
Section 137

1	110(i)
2	11100
3	11101
17	11115
18	11116
19	11117

Appendix A-2

Chalmette National Cemetery
Jean Lafitte Nat'l Hist. Park & Preserve
St. Bernard Parish, Louisiana
2017 Section and Plot Grid





brick wall

row																
6	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
5	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
4	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
3	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
2	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
1	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
column	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16