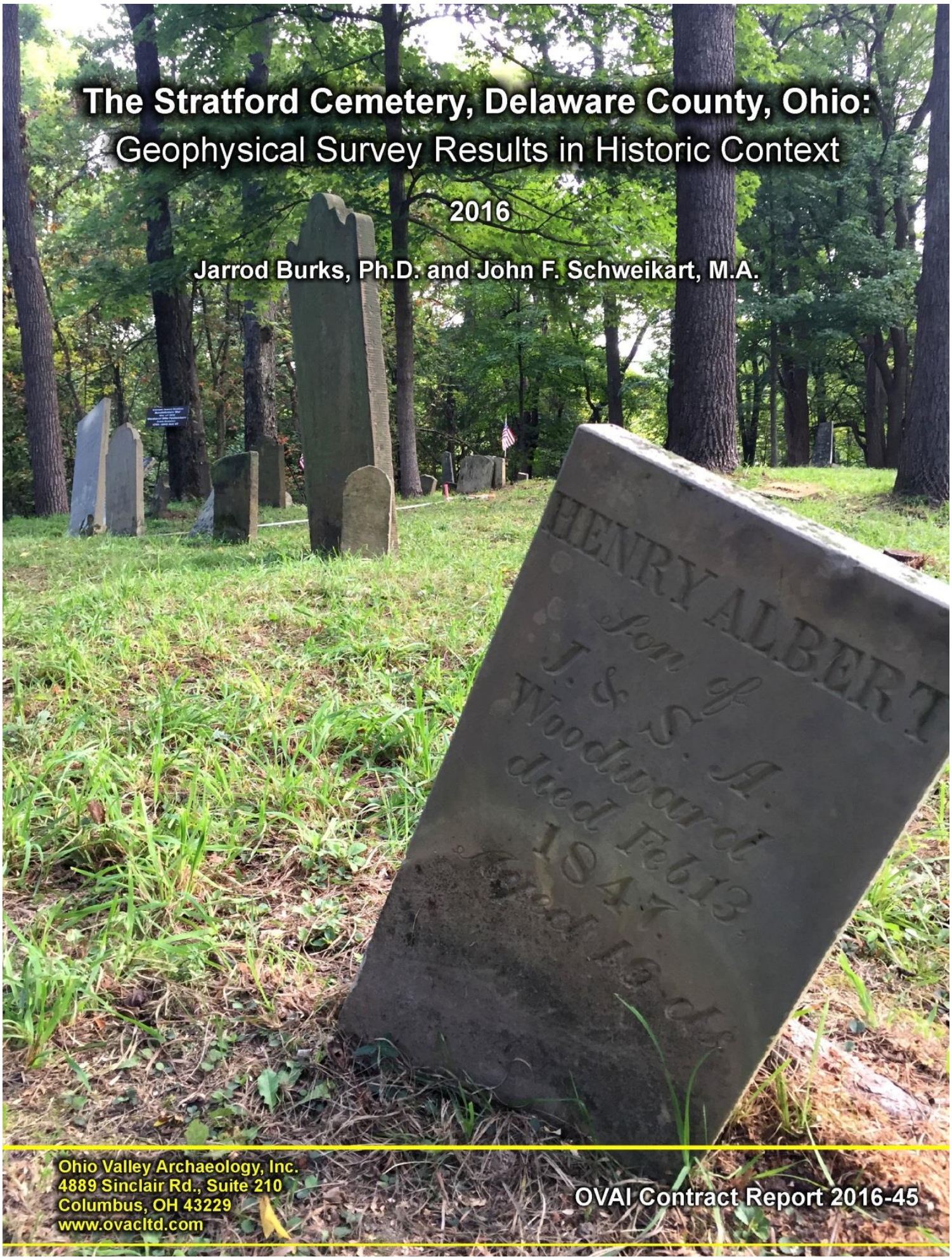
The Stratford Cemetery, Delaware County, Ohio:
Geophysical Survey Results in Historic Context

2016

Jarrod Burks, Ph.D. and John F. Schweikart, M.A.



Ohio Valley Archaeology, Inc.
4889 Sinclair Rd., Suite 210
Columbus, OH 43229
www.ovacltd.com

OVAI Contract Report 2016-45

OVAI Contract Report #2016-45

The Stratford Cemetery, Delaware County, Ohio: Geophysical Survey Results in Historic Context

by

Jarrod Burks, Ph.D.
and
John F. Schweikart, MA

Prepared for:

Stratford Ecological Center
3083 Liberty Road
Delaware, Ohio 43015

Prepared by:

Ohio Valley Archaeology, Inc.
4889 Sinclair Rd., Suite 210
Columbus, Ohio 43229
(614) 436-6926

2016

Executive Summary

On August 30th and 31st, 2016 Ohio Valley Archaeology, Inc. conducted mapping and geophysical surveys at the Stratford Cemetery, a small nineteenth-century burial ground in southern Delaware County that historically was on private land and was started as a family cemetery. This project, performed on behalf of the Stratford Ecological Center, aimed to locate marked and unmarked graves, as well as other possible cemetery features, and it is being done as part of a larger cemetery restoration project.

The mapping work was performed with a laser transit and 3D models generated from drone-based and on-the-ground photographs. A total of 118 stones were mapped, along with 15 surface depressions that could be subsided graves. A magnetometer and a ground-penetrating radar were used for the geophysical survey work. The magnetometer located the buried remains of a wire perimeter fence surrounding the cemetery, as well as 25 possible graves; three clusters of magnetic anomalies that could be graves, debris, or other buried features; and three possible precontact period American Indian pit-type features. The radar survey data were dominated by tree roots, but 19 possible buried stones and 18 possible graves were detected.

Combined, the geophysical survey and above-ground mapping work identified 90 marked and 18 possible unmarked graves, for a total of 108 graves. This estimate of the number of graves in the Stratford Cemetery is somewhat higher than most previous estimates for the cemetery, which are based on stone readings and archival work. Since the cemetery was used by a wide range of families and individuals in the local community, some of whom were only of modest means and may not have been able to afford large stone grave markers, there may be more unmarked or minimally marked graves in the cemetery than previously thought.

Table of Contents

Tables

Figures

Acknowledgements

Many thanks to the Stratford Ecological Center for helping this project come to fruition. The Center's director, Jeff Dickinson, is a real pleasure to work with. John Tetz has been one of the biggest advocates for the cemetery, both in cleaning it up and conducting research on its history. He is also a great promoter of the cemetery's importance. John is joined by many other hearty souls who give their time for the cause of history and caring for this place that matters.

Our field crew consisted of Jarrod Burks and Jamie Davis from Ohio Valley Archaeology, Inc. Stratford volunteer Bruce Renard helped out with the grave stone mapping and many others, especially Bill Swoager, put in a lot of time to clear the way for the survey work—removing brush, downed limbs, and select trees. It really does take a village to make these kinds of projects happen, so thanks to all who participated. Your efforts helped to insure a successful survey!

Introduction

Like many nineteenth century cemeteries in Ohio, the Stratford Cemetery in southern Delaware County is a long suffering, rural burial ground in need of TLC. It is the final resting place for some of Delaware County's earliest Euro-American settlers, but most of the families once associated with the nearby mills in the Village of Stratford have long-since moved out of the area. Though almost all of the mills are gone and the Village of Stratford has slowly been transformed by urban sprawl, the cemetery and the graves of the community's founders remain, hidden in the woods on a small ridge overlooking the Olentangy River bottoms below (Figure 1).

Ongoing work by volunteers from the Stratford Ecological Center (SEC), the cemetery's current owner, is bringing the cemetery back to life, so to speak. Overgrown brush has been removed, grave marker stones have been uncovered, and plans are in the works for repairing and resetting stones, as well as erecting a new boundary fence.

This report details the results of a mapping and geophysical survey project in the cemetery conducted on August 30th and 31st, 2016 to map visible marker stones and locate evidence for unmarked graves and other cemetery-related features. The project was funded by the Stratford Ecological Center with a grant received from Delaware County. Hearty volunteers, led by Bill Swoager, cleared the brush and select trees, preparing the area for the survey work. In the field, Ohio Valley Archaeology, Inc. (OVAI)

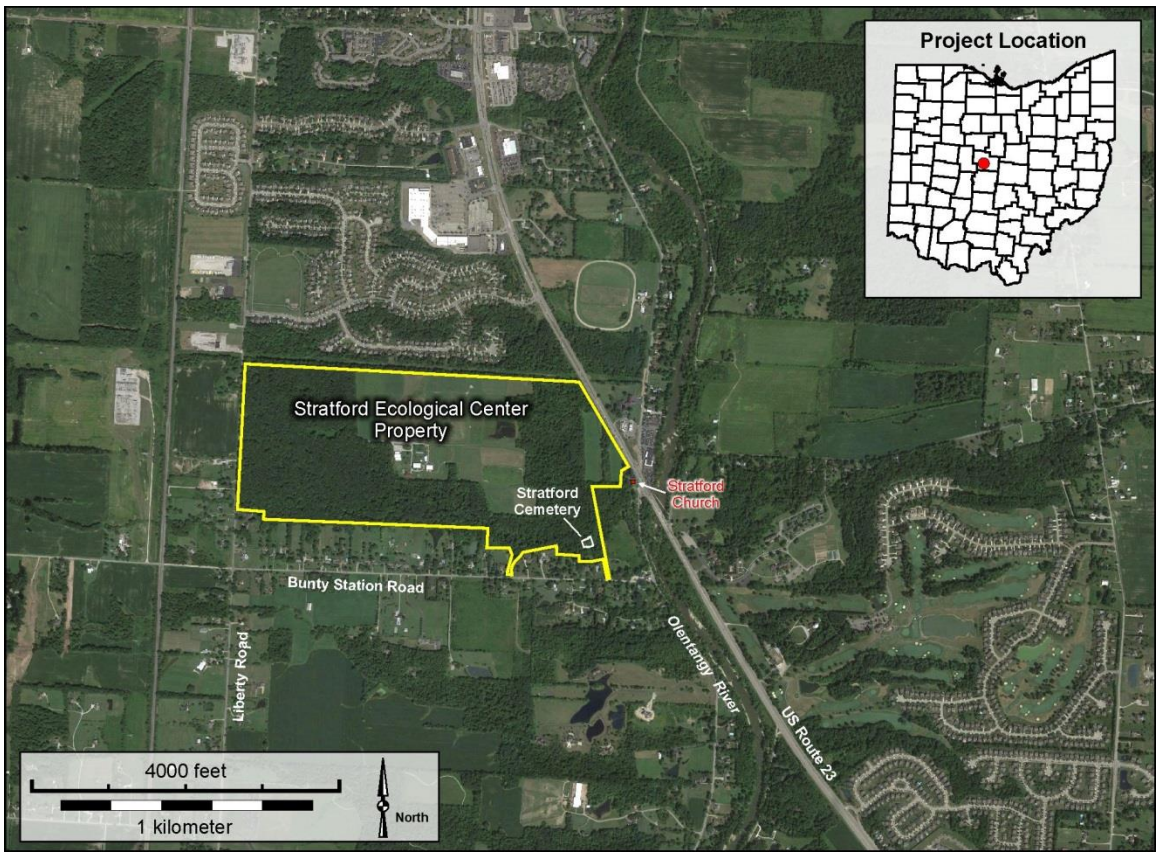


Figure 1. Project area location map on a 2015 aerial photograph.

archaeologist Jarrod Burks conducted the geophysical surveys while OVAI archaeologist Jamie Davis assisted and created a 3D model of the cemetery with imagery taken by a drone. SEC volunteer John Tetz coordinated the project and he and his team have conducted considerable historical research, some of which is compiled and added to here by OVAI archaeologist John Schweikart.

The following report is organized in several sections. It begins with a brief introduction to the cemetery's natural setting and a summary of the history of the Village of Stratford and the Stratford (a.k.a. Cole) Cemetery. Next, a methods section discusses graves and their detectability with geophysical survey instruments. The two kinds of instruments used in the survey, a magnetometer and a ground-penetrating radar, are then introduced. This is followed by a presentation of the mapping and geophysical survey results, with descriptions of the geophysical anomalies of interest that were detected. A final conclusion and recommendation section summarizes the project and provides several suggestions for next steps.

Natural Setting

The Stratford Cemetery is located at the edge of the west bluff overlooking the Olentangy River (Figure 2), just northwest of the intersection of Bunty Station Road and State Route 315 (Olentangy River Road). The Stratford church, now unused, sits on the flooplain about 1000 feet northeast of the cemetery. The bluffs and uplands in this area are covered by ground moraine deposits left behind by the last glaciers more than 14,000 years ago. Over the millennia since, the top several feet of the clayey, rocky sediment the glaciers left behind has developed into several different soil types in the area of the cemetery, including Glynwood clay loam (USDA 2007a) on the crest of the ridge and Lybrand silt loam (USDA 2007b) on the slopes to the north, east, and south. These soils formed under forested conditions (both are classified as hapludalfs by soil scientists) and have well developed A (topsoil) and B (clayey subsoil) horizons. Because of the elevated clay content in the soil, the flatter ground in the cemetery may not drain well in the wetter months. Clayey soil tends to be challenging for radar surveys since the clay quickly absorbs the radar energy. However, the ground was relatively dry at the time of the survey, so the wet clayey soil was not likely a limiting factor in the radar depth penetration.

The photograph in Figure 3 is looking roughly east and shows the eastern two thirds of the cemetery, with the ground sloping down to the left (north) and right (south). A variety of standing, fallen, and fragmented head- and footstones are readily visible in the cemetery; some are organized in rows while others appear to be randomly scattered about, leaning against trees, or are displaced in small piles. No perimeter fence is evident today. However, barbed wire was found sticking up out of the ground while clearing brush and collecting the geophysical data. Today, the cemetery is accessed along a mowed path from Bunty Station Road—likely close to its original access point—and a path that leads north down into a ravine and then west toward the Ecological Center's main building complex.

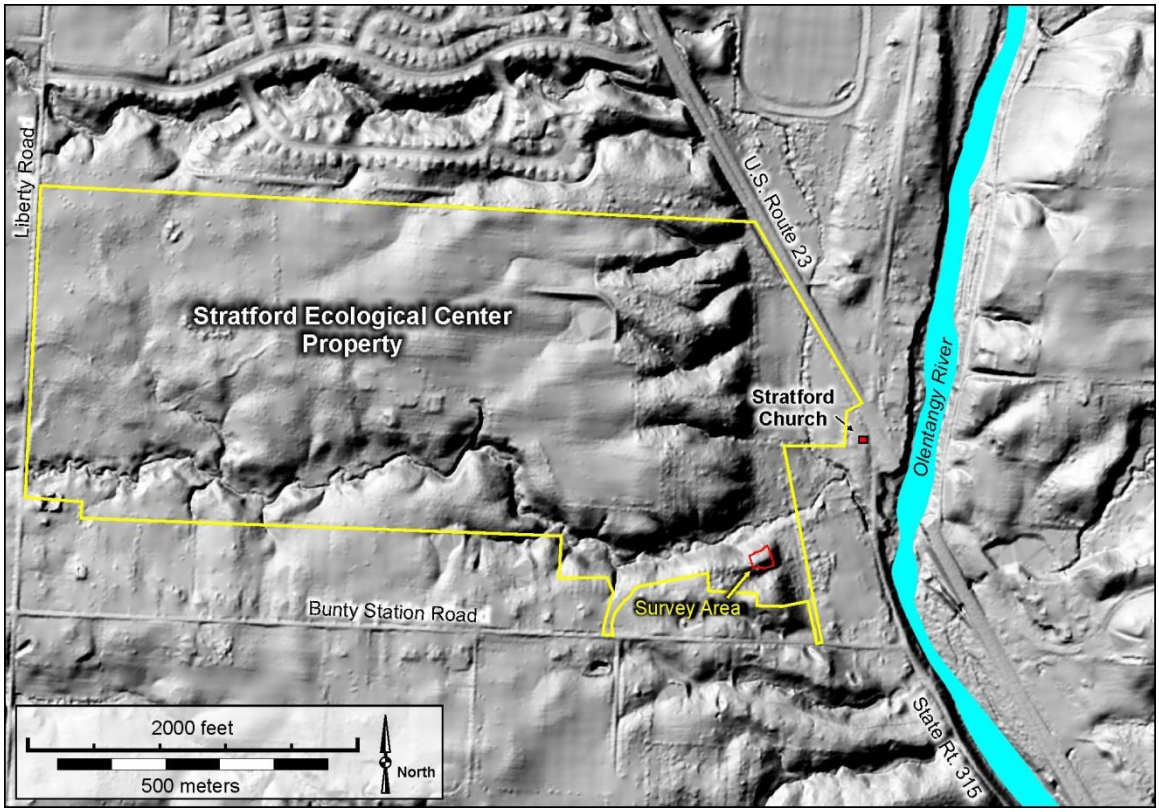


Figure 2. Location of the Stratford Cemetery survey on a digital terrain model of the Stratford area.

A Brief History of the Village of Stratford and the Stratford Cemetery

Surprisingly, there are precious few historical facts to flesh out the history of the Village of Stratford and the Stratford Cemetery. To help explore these possibilities, let's first consider the historical details in timeline form, starting with initial Euro-American settlement in the area and ending with recent work by volunteers from the Stratford Ecological Center (SEC) and the Ohio Genealogical Quarterly (OGSQ). Then, further details about the cemetery and its occupants are explored in narrative form. A more complete timeline is presented in Appendix A.

Timeline

August 3, 1795 With the signing of The Treaty of Greenville, Indian tribes with claims to Ohio cede two-thirds of what is to become the state to the US Government. This opens central Ohio and what would become Delaware County to Euro-American settlement for the first time (Sherman 1925:169-173).

March 20, 1800 A military warrant for approximately 4,000 acres in the 19th Range, 1st Quarter, 4th Township (Liberty), including the present-day location of

Figure 3. An overview panorama of the Stratford Cemetery at the time of the geophysical survey in 2016.

the Stratford Cemetery, is awarded by President John Adams to Nicholas Gilman as payment for military service during the Revolutionary War (SEC 2016).

1801 The Liberty Settlement, a.k.a. Carpenter's Mill is established along Whetstone Creek (later renamed the Olentangy River) and south of what would become the Stratford Cemetery. It is the first Euro-American settlement in the vicinity of the cemetery (Forgotten Ohio 2016).

1803 Ohio achieves statehood and subdivision of the US Military District into one square mile sections is completed (Sherman 1925:106).

December 2, 1807 The 624.25 acre parcel including the present-day location of the Stratford Cemetery is sold to John Beard by Benjamin Ives Gilman, a representative of the land office of the Ohio Company in Marietta. John Beard soon builds a cabin on the bank of the Olentangy River within this parcel (SEC 2016).

February 25, 1811 A 624.25-acre parcel including the present-day Stratford Cemetery is sold by John Beard to Forrest Meeker. Meeker contracts to have a hewed-log house built on the parcel and to clear a 5-acre area of trees that John Beard had previously cut down (Perrin 1880; SEC 2016).

June 18, 1812 The United States declares war with Great Britain, and the state capital is moved temporarily to Chillicothe. Soon the vicinity of the Meekeer Settlement (Stratford) becomes active as U.S. military forces and supplies regularly pass through on the Chillicothe to Sandusky Road, and northward on to Detroit (present-day US Route 23). Forrest Meeker enlists with Captain Murray's Company, Cavalry, Ohio Militia, and takes part in raids into Canada. Meeker is later placed in charge of transportation of the Northwestern Army under General William Henry Harrison, and also serves as Quartermaster General of the Army. Meeker achieves the rank of Colonel. Revolutionary War Veteran, Capt. James Kooken also enlists at age 59 (Lytle 1908; SEC 2016).

August 16, 1812 With General Hull's surrender of Detroit to the British, Col. Meeker and the rest of Capt. Murray's Company return to their homes in Ohio.

March 5, 1813 The US Secretary of War orders General Harrison and his troops to return to Harrison's headquarters at Delaware City. Harrison's men are soon joined by additional US troops from Kentucky and Virginia. This leads to an economic boom in the vicinity and Col. Meeker is said to have kept his mills running night and day grinding wheat for the army. Later recruits from the vicinity are enlisted and horses and wagons are purchased by the army to supply the war effort to the north. In spite of rumors of an impending British and allied Indian attack, no such raid occurs (Perrin 1880; SEC 2016).

1816 Delaware City is incorporated, and the first burial is recorded on what is to become the Stratford Cemetery. The grave is for one of the Meeker children, who died at age 6 years. This is possibly Forrest Jr. or Grove Meeker, or possibly a girl (Find-A-Grave 2016; SEC 2016).

1817-1822 Burials during these six years at the Stratford Cemetery are not members of the Meeker family, and probably represent mill workers or local farmers (Barker and Tetz 2016).

September 24, 1822 Col. Forrest Meeker and his wife Patience sell 100 acres from Lot 13, including the present-day location of the Stratford Cemetery, to Capt. James Kooken, Revolutionary War and War of 1812 veteran, and the first warden of the Ohio Penitentiary in Franklinton (Find-A-Grave 2008; Perrin 1880; Barker and Tetz 2016).

1823 Capt. Kooken moves his family to Delaware County and opens a tavern three miles south of Delaware near present-day Stratford. Capt. Kooken also serves his first term as state senator. Col. Meeker builds the first brick house in the Village of Stratford, which still stands today (Find-A-Grave 2008; Perrin 1880; Barker and Tetz 2016).

September 8, 1823 Eleanor Porter Kooken, wife of Capt. Kooken, dies and is buried in the Stratford Cemetery (Find-A-Grave 2008; Perrin 1880; Barker and Tetz 2016; Sheppard 2016).

1833 Capt. Kooken sells his property, including the Stratford Cemetery, and moves out of Stratford to found the community of Bellpoint (Barker and Tetz 2016; Sheppard 2016).

June 3, 1840 Capt. Kooken dies and is buried in the Stratford Cemetery but the exact location of his grave or his grave marker is not known (Barker and Tetz 2016; Find-A-Grave 2016).

1841 John Hoyt, Superintendent of the paper mill, names the growing community of mills and worker houses "Stratford," in honor of Stratford-on-Avon, England (Lytle 1908). This name appears on the first county atlas (Figure 4). The cemetery first appears on the 1866 atlas, and is shown again on the 1875 atlas (Figure 5).

May 29, 1843 Patience Meeker, the first wife of Col. Forrest Meeker dies at age 72 and is buried in the Stratford Cemetery (Find-A-Grave 2016).

July 4, 1844 The Stratford Methodist Episcopal Church is dedicated. It is built by the local community with local stone and materials donated by mill owners Judge Hosea Williams and Hiram (H.G) Andrews on land 1000 ft northeast of the Stratford Cemetery. The land was provided to the Methodists by Col. Meeker (Forry 1958; Lytle 1908).

April 25, 1845 Col. Meeker and his second wife Sivona (a.k.a. Livonia, Loevina, Levina, and Lavina), sell their property in Stratford to George Bieber, and move to the City of Delaware (SEC 2016).

March 16, 1849 Col. Meeker dies at age 80 and after a memorial service at the Stratford Methodist Episcopal Church is buried in the Stratford Cemetery (Forry 1958).

October 30, 1849 The paper mill burns down but is soon rebuilt (Lytle 1908). Five individuals are buried in the Stratford Cemetery in 1849. This is the highest number recorded for any year at the cemetery, which averages less than one recorded burial per year from 1816 to 1888 (Barker and Tetz 2015).

1850 Judge Hosea Willams and H.G. Andrews formally lay out the settlement at Stratford, which consisted of 17 lots (Barker & Tetz 2016). The size of the congregation at the Stratford Methodist Episcopal Church is in excess of 100 people. The Village of Stratford post office opens (Forte 2016).

1851 The Cleveland-Columbus-Cincinnati Railroad comes to the area and Bunty Station is built. The paper mill is converted to run on steam power derived from coal brought to the area by the railroad (Lytle 1908).

March 1862 Peter Kroninger, the only Civil War Veteran documented in the Stratford Cemetery dies. Peter enlisted Oct. 1, 1861 as a Private in Company B, 48th O.V.L. and was mustered out March 15, 1862 (Sheppard 2016).

1866 F.W. Beers' (1866) *Atlas of Delaware County* includes a map of Stratford Village with 19 separate parcels (Figure 6). The map shows the church, houses, businesses, and the paper mills owned by Hiram Andrews & Norman Perry. The approximate location of the Stratford Cemetery is indicated on the county-wide atlas but not on the Stratford Village map.

1888 **"**Bauder, Infant, d. Oct. 1888" is the last recorded burial in the Stratford Cemetery, after which the cemetery is apparently no longer used. Nevertheless, it has been estimated by Barker and Tetz (2016) that over 70% of the identified burials at this cemetery date between 1844 and 1888, and they probably involved burial services performed in conjunction with the Stratford Methodist Episcopal Church (Barker and Tetz 2015).

By 1896 Milling and manufacturing activities come to an end at the Village of Stratford.

May 9, 1914 A lawsuit is filed with the Court of Common Pleas, Delaware County by the Plaintiff (Olentangy Valley Chapter of the Sons of the American Revolution) concerning the status of the Stratford Cemetery located on a 50-acre

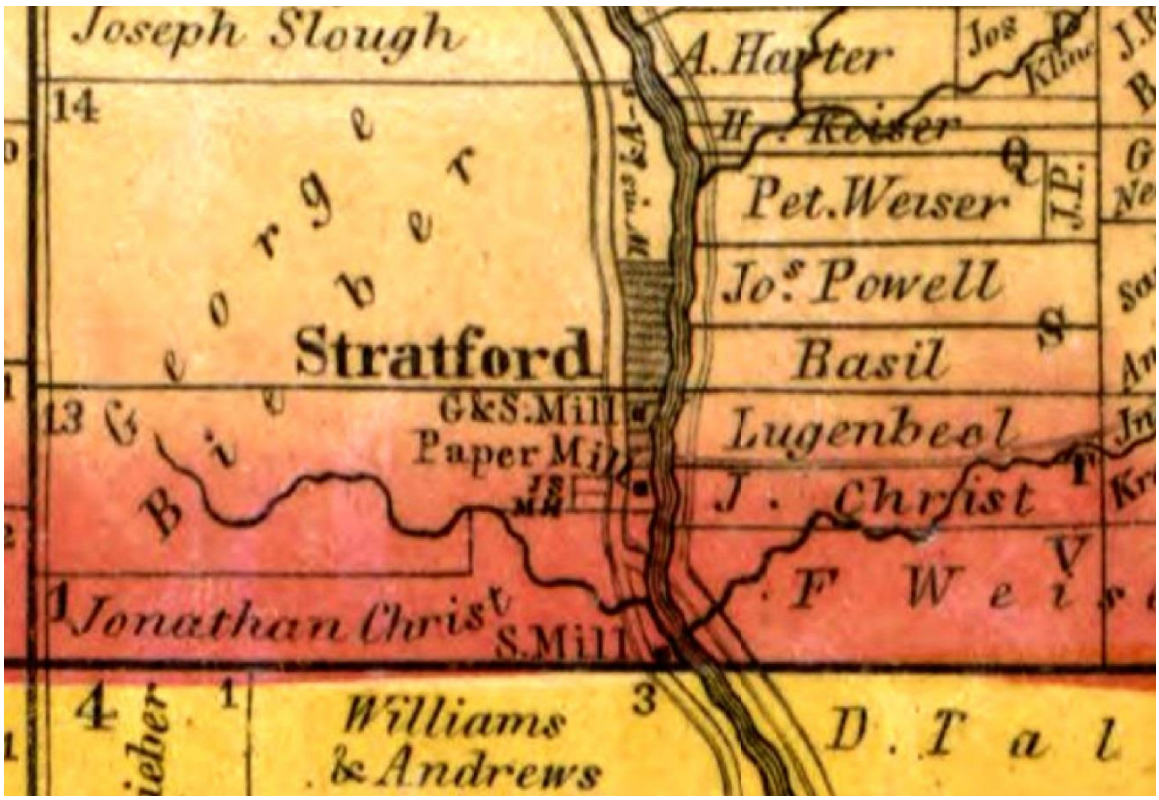


Figure 4. A portion of the earliest historic atlas (1849) of Delaware County showing the town of Stratford (from Eaton and Anderson 1849).

tract owned by the Defendant (landowner, F.F. Greene). The Plaintiff claims the cemetery is a public burial ground, while the Defendant denies that the alleged graveyard was, or ever had been, a public burying ground. The Sons of the American Revolution want to restore the graves of veterans from the Revolutionary War and War of 1812 in the cemetery, but are denied access by the landowner to do this (Barker and Tetz 2016).

March 2, 1915 An answer is filed with the Court of Common Pleas, Delaware County that the Stratford Cemetery is and will remain a private burial ground (Barker and Tetz 2016).

January 17, 1916 The Court of Common Pleas, Delaware County denies that the Plaintiff (Olentangy Valley Chapter of the Sons of the American Revolution) is entitled to relief damage for the Court's overrule of a petition for a new trial. No subsequent appeals are filed, so the Stratford Cemetery's status remains officially as a private burial ground (Barker and Tetz 2016).

January 15, 1939 The Stratford Methodist Episcopalian Church, closed since 1936, re-opens after being remodeled and electrified, and religious services are once again held there (Forry 1958).

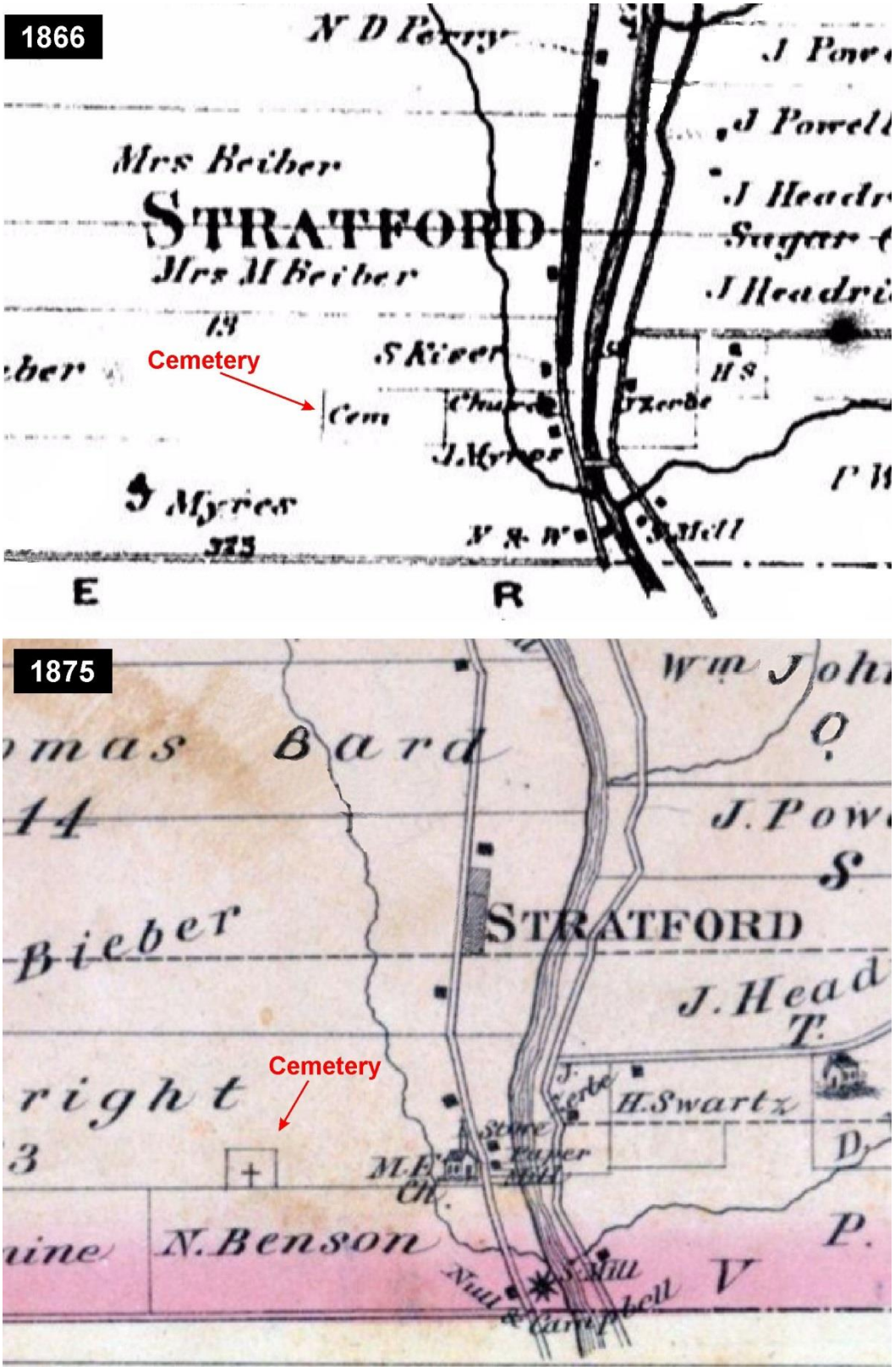


Figure 5. Portions of the historic atlases of Delaware County from Beers, Ellis, and Soule (1866) and Everts and Company (1875).

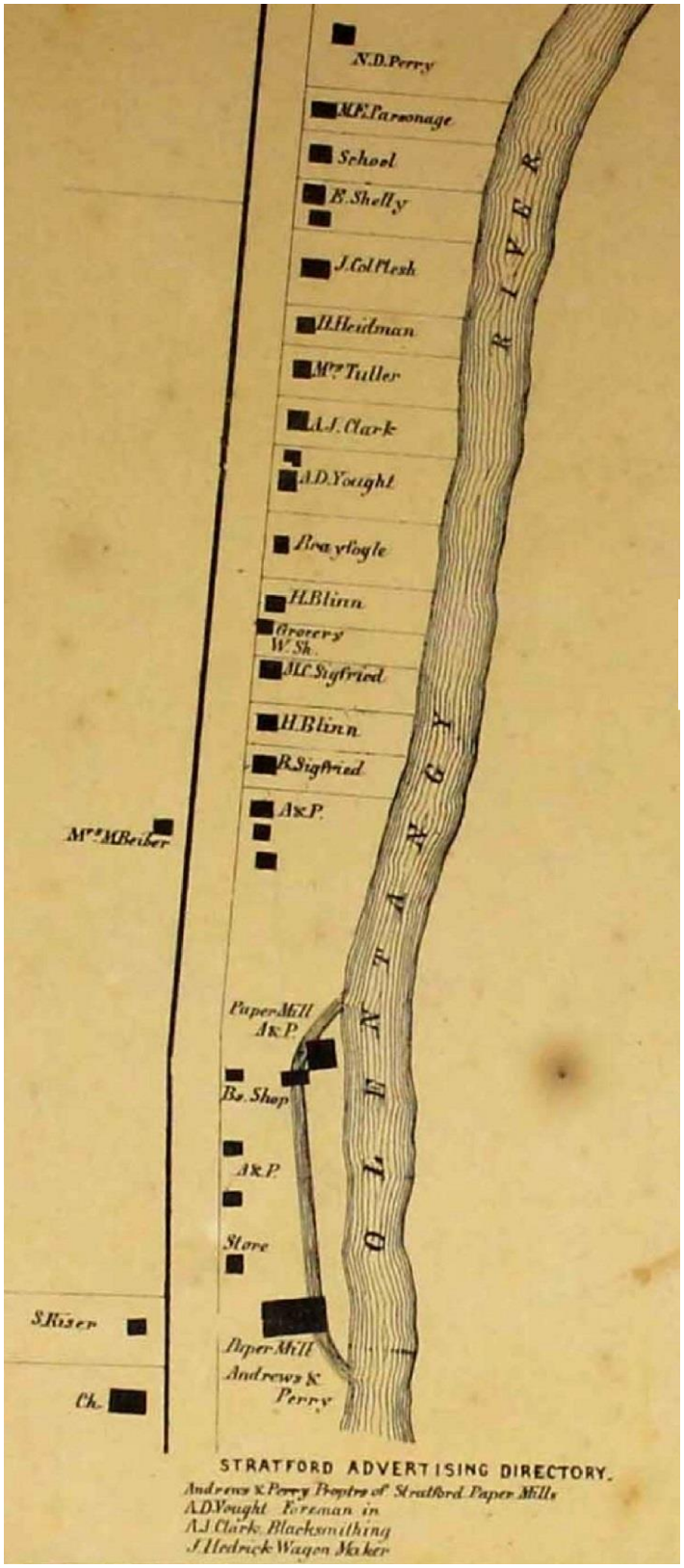


Figure 6. A map of the town of Stratford, circa 1866, from Beers, Ellis, and Soule (1866).

ca. 1939 The Depression Era Works Progress Administration (WPA) Historical Records Survey (HRS) conducts a survey and produces a map of the "Cole" (Stratford) Cemetery (Figure 7).

1941 Garth Oberlander, an Ohio Wesleyan University graduate, buys the former property of Col. Meeker and George Bieber. Oberlander farms the land and eventually opens a very successful antique business in Stratford in the early 1950s (Delaware County Historical Society 2016).

1953 Galen Francis Oman purchases 236 acres of pasture, farmland, and orchard from the Oberlander family in Liberty and Delaware Townships, including the Stratford Cemetery, with the intent of establishing an upscale development and golf course. Health issues prevent Oman from proceeding, so he turns to preserving the land. The pasture and orchard were allowed to succeed to forest, while the tillable ground continues to be farmed (SEC 2011; Scott 2016). The scale of the orchard is evident in a 1960 aerial photo (Figure 8, top), and its return to forest is clear in a 1988 photo (Figure 8, bottom).

1956 Carl and Florence Main document 46 burials at the Stratford Cemetery probably by inventorying inscriptions on headstones (Barker and Tetz 2016). Discussions are held to merge the Stratford Methodist Episcopalian Church with St. Paul's Methodist Church in the City of Delaware to address issues of structural deficiencies and small congregations at both churches (Forry 1958).

1958 The last worship services are held at the Stratford Methodist Episcopalian Church. Stratford Methodist Episcopalian Church merges with the St. Paul's Methodist Church and builds a new church half way between the City of Delaware and the unincorporated Village of Stratford (Forry 1958).

1972 Esther Weygandt Powell of Akron, Ohio compiles tombstone inscriptions and records for the Stratford Cemetery from Delaware County records that were copied in the 1940s (Barker and Tetz 2016).

September 1974 As per a written document**,** Galen F. Oman estimates the size of the Stratford Cemetery to be about 75 feet by 110 feet, though the area is not fenced in or clearly marked at that time (Barker and Tetz 2015).

1987 The Division of Natural Areas and Preserves of the Ohio Department of Natural Resources (ODNR) proposed placing a conservation easement on 95 acres of the forest and buttonbush swamps, to be designated the "Stratford Woods State Nature Preserve" (Warner 2011).

October 1990 Articles of Incorporation for the Stratford Ecological Center are filed with the State of Ohio (Warner 2011). The Stratford Ecological Center begins maintenance of the formerly abandoned Stratford Cemetery (Klein 2016).

1991 Chester A. Kroninger (1991), a decedent of Peter Kroninger, authors a report titled, *Stratford on the River,* which documents the Stratford Cemetery as covering .2 acre with 126 gravesites and an estimated 45 burials (Sheppard 2016). The Stratford community, including the remnants of the log, grist, and paper mills in the area as well as extant farms, are listed on the National Register of Historic Places (NRHP). However, the Stratford Cemetery is not included with this NRHP listing (Barker and Tetz 2016).

March 1991 The Stratford Ecological Center receives official 501(c)(3) status (SEC 2012). Mary and Galen Francis Oman contribute 236 acres of land as well as funds for the Center's educational building. The Stratford Ecological Center becomes the second privately owned nature preserve in the State of Ohio (Platt 2016; Warner 2011).

November 1994 George and Marilyn Cryder, Larry Dulin, Crystal Kohler, Dee Tiberi, and Rachel Zook copy information from extant grave makers at the Stratford Cemetery (Barker and Tetz 2016).

Fall 2013 Stratford Ecological Center volunteers, John Tetz and Liz Barker begin compiling research on the Stratford Cemetery in preparation for a cemetery restoration project (Klein 2016).

Fall 2014 John Tetz and Liz Barker (Barker and Tetz 2015) note that less than 15 gravestones in the Stratford Cemetery are legible. However, they also note that some gravestones have been broken or have fallen over while others may be covered up that could still be legible.

September 28, 2015 Peg Duffy and John Tetz (2015) conduct another cursory reading of 23 headstones at the Stratford Cemetery.

October 9, 2015 Liz Barker and John Tetz (2015) identify three iron stakes at the corners of the Stratford Cemetery measuring 60 feet by 103 feet (Barker and Tetz 2015).

Fall 2015 Stratford Ecological Center Volunteer Bill Swoager clears about 20 trees, honeysuckle, and poison ivy from the Stratford Cemetery in preparation for geophysical survey (Klein 2016).

2016 Laurel Sheppard, Ohio Genealogical Quarterly (OGSQ) Assistant Editor, provides a total estimate of 59 burials at the Stratford Cemetery, which she compiled from multiple sources with death dates ranging from 1816-1888 (Sheppard 2016). In contrast, The Find-A-Grave website (2016) lists 68 burials for the Stratford Cemetery.

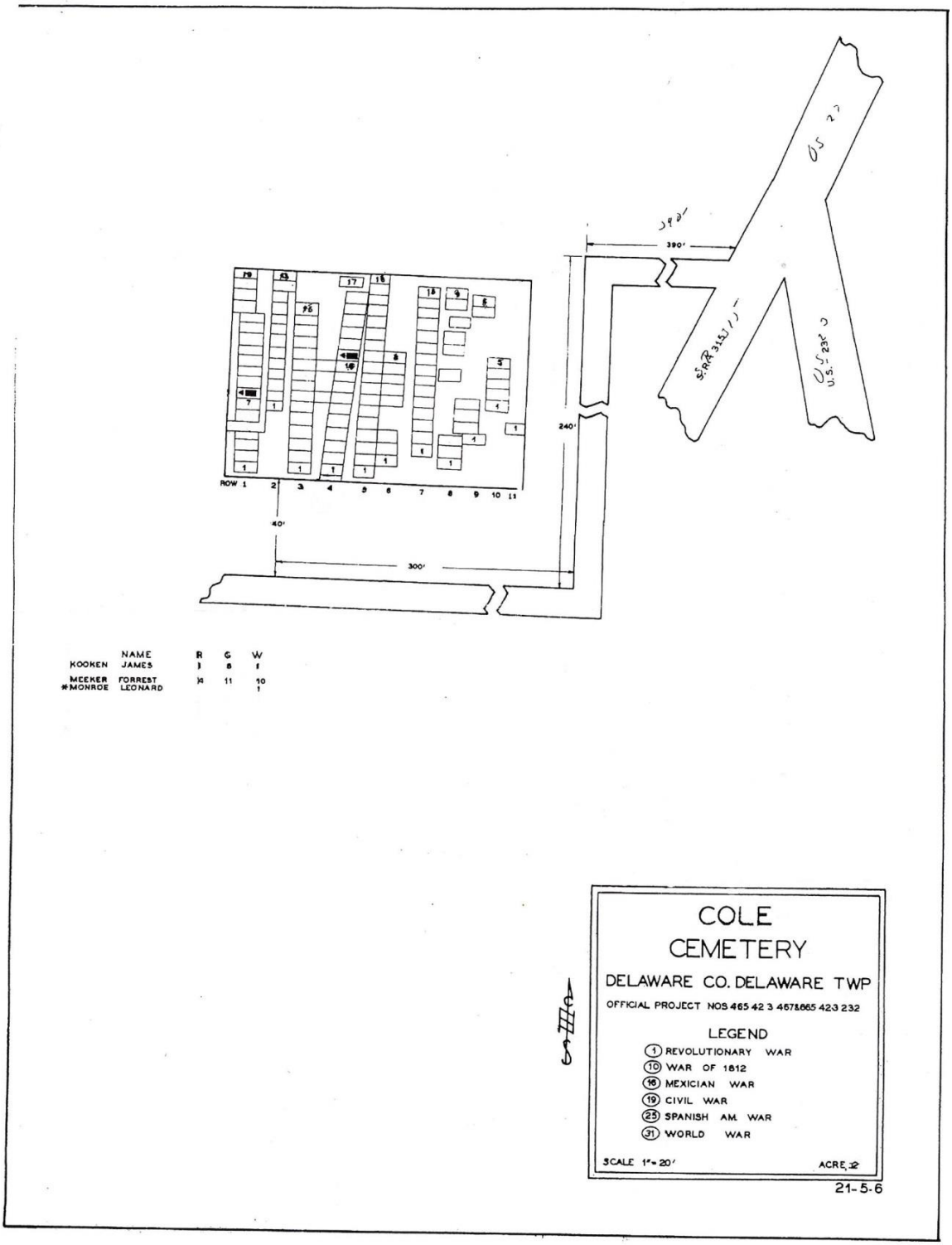


Figure 7. WPA-era map of the Stratford Cemetery (incorrectly identified as the Cole Cemetery). Map on file, Delaware County Engineer's Office, Delaware, Ohio.

Narrative History

The area surrounding the Stratford Cemetery was one of the first areas settled by Euro-Americans in Delaware County. However, the area was extensively used by American Indian groups long before the first interment in the cemetery. Numerous American Indian archaeological sites and mounds are present in this general area, and bluff edges overlooking Ohio's streams were favored places for mounds and occupation sites. As a result, there is high potential for finding American Indian archaeological deposits within the confines of the Stratford Cemetery and on the Ecological Center property, in gneral.

At the turn of the twentieth century, William C. Mills (1914) documented 75 ancient earthworks in Delaware County, with Liberty Township just south of the Village of Stratford having the most with nine mounds and two geometric enclosures. Most of these are located along the Olentangy River, in a setting similar to that of the cemetery. In addition to this, within the last few decades the Ohio History Connection's archaeological inventory database has documented thousands of pre-contact period archaeological sites located throughout the county and dating back to approximately 12,000 years ago.

Historic period American Indians in the eighteenth and early nineteenth centuries traveled extensively throughout the area and had villages and encampments in the vicinity of what would become the Village of Stratford. Tribes of note included the Delaware, Mingo, and Wyandot, who resided in the area prior to the Treaty of Greenville in 1795. Many Indians continued to travel through and trade with local settlers up until the outbreak of hostilities during the War of 1812 (1812-1814).

There are two reasons why American Indians and the earliest Euro-Americans favored this area around Stratford. First, the close proximity of Whetstone Creek (a.k.a. the Olentangy River) provided a natural north-south transportation route as well as a source of permanent fresh water, rich farmlands, and abundant plant and animal species. The river was also critical to the first Euro-American settlers for hydropower for the county's first sawmills and grist mills, which were some of the first industries on the Ohio frontier. The second important feature was the proximity of Stratford to what was originally called the Scioto Trail. The Scioto Trail was one of the most important American Indian trails in Ohio. It connected indigenous settlements in northern Ohio, along the south shore of Lake Erie and on up to Detroit, with groups living in the Scioto Valley and southward to the Ohio River. At the Ohio River the trail became the "Great Warrior's Path" and extended south all the way south to the Gulf of Mexico (Mills 1914). The Scioto Trail undoubtedly had its origins in the ancient past long before European contact, but it later served as one of the most important routes for Euro-American military expeditions, Euro-American settlement, and Euro-American trade up through and following the War of 1812. Present-day US 23 largely follows the original route of the Scioto Trail, and continues to be a major thoroughfare across the state. These two

factors made Stratford particularly well positioned for early nineteenth century Euro-American settlement and for the early development of local water-powered industries.

The first Euro-American settlement in what would become Delaware County was the Liberty Settlement, a.k.a. Carpenter's Mill, which was established in 1801 a few miles south of Stratford on the Olentangy River. The first mill in Delaware County was built at Carpenter's Mill, transforming the Stratford area into an early manufacturing center (Forgotten Ohio 2016; Lytle 1908). Euro-American settlement at what would become Stratford began in 1807 when John Beard purchased a 624.25-acre parcel on the present-day site of Stratford and built a cabin, along with a water-powered log grist mill and log dam on the Olentangy River (SEC 2016).

While Delaware county was established in 1808, the population of the county remained relatively low prior to the War of 1812. The US Census of 1810 identified only 2,000 inhabitants for the entire county (ODD 2016).

In 1811, John Beard sold his parcel where the Stratford Cemetery is now located to Forrest Meeker, who contracted to have five acres of land cleared for the construction of a house. Within a few months, Meeker returned to Delaware County from Paris, Kentucky with his wife Patience and their seven children (Perrin 1880). Historical accounts indicated that Patience persuaded her husband to move from Kentucky to Ohio because of her disdain for slavery (Lytle 1980; Perrin 1880). This suggests that Meeker himself also disliked slavery and may have been sympathetic to the abolitionist cause. Soon after the Meekers arrived, settlers from Virginia, Pennsylvania, and Kentucky established homesteads in the immediate area, which soon came to be called the Meeker Settlement (Perrin 1880).

The War of 1812 brought a surge of activity and wealth to the Meeker Settlement, as troops and supplies went back and forth along the road connecting the state capital at Chillicothe with the war front along the south shore of Lake Erie and up to Fort Detroit. Forrest Meeker was under contract to provision the military with flour and ran his milling operations 24 hours a day during peak periods to meet the demand (Lytle 1908; SEC 2016). This period would have encouraged Meeker to bring in more people to staff his milling operations, and it would have brought other individuals to the area including representatives of the U.S. military, as well as state militias. Lytle's (1908) Military History of the County reports that ten soldiers succumbed to an epidemic near Gen. Harrison's camp in Delaware and were buried near the Odovene Spring. They reportedly were later reinterred in a single grave in what was described as the "old cemetery, and being unmarked have never been removed." Barker and Tetz (2015) speculate that these War of 1812 soldiers could be buried in the Stratford Cemetery; however, there is no clear evidence to support or refute this claim.

The oldest known death date documented at the Stratford Cemetery dates back to 1816 and is the grave of one of the Meeker children (Find-A-Grave 2016; SEC 2016). While this child could have been reinterred at the Stratford Cemetery sometime after

1816, it does not seem likely that this was done since the property was already owned by the Meekers at that time. What this earliest death date does suggest is that the Stratford Cemetery may have begun as a family burial place that the Meekers later made available for at least four others who were buried there between 1817-1822. Since there was no church or formal cemetery in the Meeker Settlement, those other than the Meekers buried there would have likely been mill workers or local farmers (Barker and Tetz 2016). This suggests that this cemetery served as a community burial ground from its earliest beginnings.

In 1823, the Meekers sold their parcel of land including the cemetery to Capt. James Kooken. That same year Kooken's wife Eleanor Porter Kooken, and one other person, died and were buried in the Stratford Cemetery. The next recorded burial did not occur until 1833 (Barker and Tetz 2016; Find-A-Grave 2008; Perrin 1880; Sheppard 2016).

Starting in 1839, rapid changes came to what would become the Village of Stratford when Caleb Howard and Judge Hosea Williams purchased Meeker's flour mill and converted operations to the manufacture of paper (Lytle 1908). Paper was a costly and rare commodity west of the Allegheny Mountains, and demand for it was rapidly increasing with the growth of nearby cities like Columbus and Delaware. Beginning in the late 1830s and into the 1840s, the mills as well as many of the houses and businesses were built out of local limestone. This was likely done as a protective measure against widespread damage from fire, which was apparently a very real hazard in Stratford and was associated with flammable materials used in the manufacture of paper. By 1841, the former Meeker Settlement had developed enough of a new community identity that it was given a new name, Stratford, by John Hoyt, superintendent of the paper mill (Lytle 1908). Further evidence of a growing community was the formation of the Stratford Methodist Episcopal Church in 1844, which was built on land donated by Col. Meeker and with local stone and materials donated by the paper mill. The building of the church created a center for community gatherings and also provided a place for memorial and funeral services for burials in the Stratford Cemetery. This church was built as a non-sectarian place of worship to serve all in the community, though it was administered by the greater Methodist Episcopalian Church.

During Stratford's early paper mill period, Delaware County was a center of abolitionist activity in the state, and the nearby Chillicothe to Sandusky Pike was a major corridor for Underground Railroad activities (Seibert 1898). While no Underground Railroad stations are known from the Village of Stratford, the Methodist Episcopalian Church (in northern states) and nearby Ohio Wesleyan University were both leading institutions in the national antislavery movement. The importance of these institutions in the community, combined with the presence of the nearby road and Col. Meeker's and probably Judge Hosea Williams' anti-slavery leanings, suggests that runaway slaves and

their attendants would most likely have found safe passage through Stratford on their journey northward to Canada, and freedom.

One irony of the 1840s-1860s in the region is that despite a rapid increase in wealth and industrial productivity, there is a concurrent sharp decline in life expectancy over the same time period. Overcrowding and poor sanitary conditions allowed for increased transmission of infectious diseases like cholera (see Pyle 1969), which disproportionally took otherwise healthy adults out of the population in higher numbers than had happened before (Pope 1992). Towns along major transportation routes like the Chillicothe to Sandusky Pike, as well as manufacturing and other population centers, would have been especially susceptible to epidemics, and evidence for this may occur at the Stratford Cemetery with the relatively high number of individuals (n=5) with death dates from this period (all dating to 1849). The local effects of the 1849 cholera epidemic may also be partially reflected in U.S. Census data for Delaware County, which shows a drop in the county-wide population from 22,060 in 1840 to 21,817 in 1850 (ODD 2016). It should also be noted, however, that this ten-year period also marks the time of the closing of the Ohio frontier, and it witnessed mass migrations by Euro-Americans westward along the Oregon Trail to the 1849 California Gold Rush. Nevertheless, Barker and Tetz (2015) document that from 1816 to 1888, the average number of known deaths at the Stratford Cemetery was only one per year, and that the highest recorded number of deaths documented at the Stratford Cemetery for any given year is five deaths which occurred in 1849.

One question that is difficult to answer with certainty is how many people lived in the Village of Stratford during the time the Stratford Cemetery was in active use (ca. 1816-1888). While US Census records began for Delaware County in 1810, they do not differentiate residents of Delaware Township at large (i.e., outside of Delaware City) from residents in the Meeker Settlement or the Village of Stratford. Furthermore, individuals who may have worked in the Meeker Settlement/Village of Stratford could have easily resided in nearby Liberty Township, which is just to the south on the south side of Bunty Station Road. Other complicating factors are that US Census records are only taken every ten years and they are most likely to document residents living within formal households. This is problematic for estimating population size and composition in small mill towns/manufacturing centers where a significant portion of the workers may not have resided there long enough to be counted on a census. Furthermore, some may not have lived within a household, but rather resided in communal worker housing for various periods of time. Or, some lodgers could have been seasonal residents of Stratford, only living there during times of the year when the mills were especially busy. For instance, the 1860 Federal Census lists a residence in the Stratford area with 11 occupants (5 women and 6 men, none married), all paper mill workers, ranging in age from 16-23 years. Nevertheless, we do have some clues as to the relative size of the Village of Stratford during its most productive period from ca. 1850-1866. For example, the

Stratford Methodist Episcopal Church congregation was said to consist of more than 100 people, making it one of the largest in Delaware County at the time. A more specific way to estimate Stratford's population size is by household size. In 1850 Judge Hosea Williams and H.G. Andrews laid out the Village of Stratford, dividing it into 17 lots. If we estimate approximately five people per household, accounting for the fact that some households certainly had fewer individuals, while others had more (this is supported by the 1870 census for the area), and that some residents lived in communal worker housing, then an estimate between 85-100 people seems reasonable for full-time residents at Stratford ca. 1850. The F.W. Beers (1866) *Atlas of Delaware County* is one of the few nineteenth century maps depicting the Village of Stratford, and it shows 19 separate parcels including houses, businesses, and paper mills owned by Hiram Adams and Norman Perry (Figure 6), and probably depicts this mill town near or at its peak in population. Population estimates based on this map yield a slightly higher projection of 95-110 people in Stratford just after the Civil War.

Following the Civil War, growth in the nearby cities of Delaware and Columbus, and expansion of the railroads and road networks across the state, would have led to increased competition for the paper mills at Stratford, not only in terms of other places producing competitive products, but also for laborers to work at their mills. Larger cities would have been more attractive to workers for a variety of reasons, including a greater variety of jobs, more housing, and better transportation options. Therefore, it seems reasonable that by the 1870s the population at the Village of Stratford may have already started to decline, and likely was under 100 inhabitants.

If, for the sake of argument, we accept an estimate of around 100 inhabitants for the average number of living occupants at the Village of Stratford at any given time, we can estimate the number of people who should have died and perhaps been buried in the cemetery. From the time of the founding of the Stratford Methodist Episcopal Church in 1844 to the date of the final recorded burial in 1888 (44 years), there likely were about 100 people living in Stratford. Haines (2001) has suggested a mortality rate of about 2.25 percent for rural nineteenth century American populations. This would mean a death rate of about 2.25 people per year in Stratford, or about 99 people during the 44 year period. This number would be a bit over 100 if we extend the range of the cemetery back to the cemetery's founding date of about 1816. Of course, not all of these individuals were necessarily buried at the Stratford Cemetery. Wealthier families could have buried their dead elsewhere, such as in the cities of Delaware or Columbus, particularly after the arrival of the railroad in 1851. In contrast, it seems likely that mill workers, laborers, and those of more modest means would have likely been buried locally. If deaths from Stratford Village from 1844-1888 represent approximately 70 percent of all the burials at the Stratford Cemetery, as suggested by Barker and Tetz (2015), then we should add another 30 percent to this estimate, making it as many as 141 individuals from 1816-1888. Based on a painstaking compilation of five different surveys of headstone

inscriptions and from Delaware County Records searches, Barker and Tetz (2015) obtained a burial estimate of 59 for the Stratford Cemetery, and the Find-A-Grave (2016) website lists 68 burials for the Stratford Cemetery—both of which are much lower than the projected 141. While the estimates of 65, 59, and 68 burials are all relatively close, all could be significantly over or under the actual number of burials that were interred within the Stratford Cemetery. In 1991 Chester Kroninger (1991) estimated that the Stratford Cemetery covers a total area of 0.2 acre with potentially 126 gravesites present, though he documented only 45 burials within the cemetery (Sheppard 2016).

Financial troubles starting in the 1850s contributed to the decline of the mills and the Village of Stratford, ultimately resulting in the abandonment of the Stratford Cemetery. Perrin (1880) indicates that on February 27, 1857, all of the paper mills at Stratford burned, resulting in a loss of $25,000, of which only $10,000 was covered by insurance. Rebuilding cost $30,000, and by 1861, the State of Ohio had rescinded a large contract for printed paper with these mills. During the 1870s, the mills changed hands several times, and in 1882 the Hills Paper Company sold the business and the property to the Columbus, Delaware, and Marion Railway, who converted the main paper mill into a power house for the railroad (Lytle 1908). By 1889, the last remaining mill, the Bieber Mill was auctioned off to satisfy debts incurred by James Bieber, and while owned by a series of subsequent owners, the Bieber Mill ceased milling operations. By 1896 all milling operations had ceased and in 1900 the US Post Office at Stratford was officially closed (Forte 2016).

Sometime after the last known death date of 1888, the Stratford Cemetery went out of active use and was apparently abandoned. Between 1914 and 1916 a series of lawsuits filed with the Delaware County Court of Common Pleas involved a claim by the Ohio Valley Chapter of the Sons of the American Revolution that the Stratford Cemetery was a public burying ground and that their organization should be allowed access to restore graves of veterans of the Revolutionary War and the War of 1812. The Court determined that the Stratford Cemetery was and had always been a private burial ground on private land (Barker and Tetz 2016).

Sometime around 1939 the Works Progress Administration (WPA) Historical Records Survey (HRS) conducted a survey and produced one of the few existing maps of the "Cole" (Stratford) Cemetery (Figure 7). Apparently, the name "Cole" for the cemetery resulted from the WPA confusing the Stratford Cemetery with the nearby Cole-Hardin Cemetery (Barker and Tetz 2016). The map shows a rectangular-shaped cemetery with eleven rows of varying numbers of burial plots adding up to a total of 127—far more than are visible in the cemetery today. Rows on the map towards the east and west ends of the cemetery parallel those sides of the cemetery, but several rows in the middle of the cemetery run at a slight angle to the main axes of the cemetery. This appears to be very similar to the layout of the Stratford Cemetery, except for the larger number of graves than most more recent counts give for the cemetery. An access road on the WPA map

suggests that the cemetery was accessed from State Route 315 in the early twentieth century, close to its intersection with US Route 23.

While there was a short-lived revival of sorts of the congregation at the nearby Stratford Methodist Episcopal Church during the 1940s and 1950s, there is no indication that the church used the cemetery during this period. The church closed its doors for the last time in 1958 when the congregation merged with St. Paul's Methodist Church of Delaware and moved to a new location to the north (Forry 1958).

In 1953, Galen Francis Oman purchased 236 acres of land including the Stratford Cemetery with the intent of establishing an upscale development and golf course, but soon turned his efforts to preserving the land, instead (SEC 2011; Scott 2016). This transition is reflected in aerial photographs of the site, which for example show open ground in 1960 reverting back to forest by 1988 (Figure 8). In 1974, Oman estimated the size of the Stratford Cemetery as being approximately 75 feet by 110 feet, though there was no fencing or clear markings for him to define the cemetery's boundaries at the time (Barker and Tetz 2015). A wire fence with at least some barbed wire, was probably erected in the early twentieth century, and may have been standing in the 1930s when the WPA map was made, but it was not long lasting since it fell down and disappeared into the vegetation well before the 1970s. This wire fence likely had wooden posts, as we will see below in the magnetic survey section.

Preservation of the cemetery and the surrounding land began in earnest in 1986 with Gale Warner's plan for creating a non-profit educational center on the property. This was soon followed in 1987 by the Division of Natural Areas and Preserves of the Ohio Department of Natural Resources' (ODNR) proposal for a 95-acre conservation easement to be designated the "Stratford Woods State Nature Preserve" (Warner 2011). Around 1990, the Stratford Ecological Center (SEC) began maintenance of the property including the Stratford Cemetery (Klein 2016). Starting in Fall 2013, SEC volunteers, John Tetz and Liz Barker began compiling research on the Stratford Cemetery in preparation for a restoration project (Barker and Tetz 2015). In the fall of 2015, Barker and Tetz (2015) identified three iron stakes at the apparent corners of the Stratford Cemetery that encloses an area measuring 60 feet by 103 feet, and SEC Volunteer Bill Swoager cleared 20 trees, honeysuckle, and poison ivy in preparation for the geophysical investigations (Klein 2016).

In summary, the Stratford Cemetery was first used as a family burial plot by the Meekers, and could date as early as circa 1807-1816. Between 1817-1822, use of the cemetery apparently expanded to include people who were not related to the Meeker family, and those interred there may have been mill workers or local laborers. Therefore, by 1817 there is evidence that the Stratford Cemetery was in use as a community burying ground. While the cemetery itself was not ever officially established, or listed as a public cemetery, the nearby Stratford Methodist Episcopal Church was built and dedicated in 1844, and served as a community center at Stratford. The Stratford Methodist Episcopal

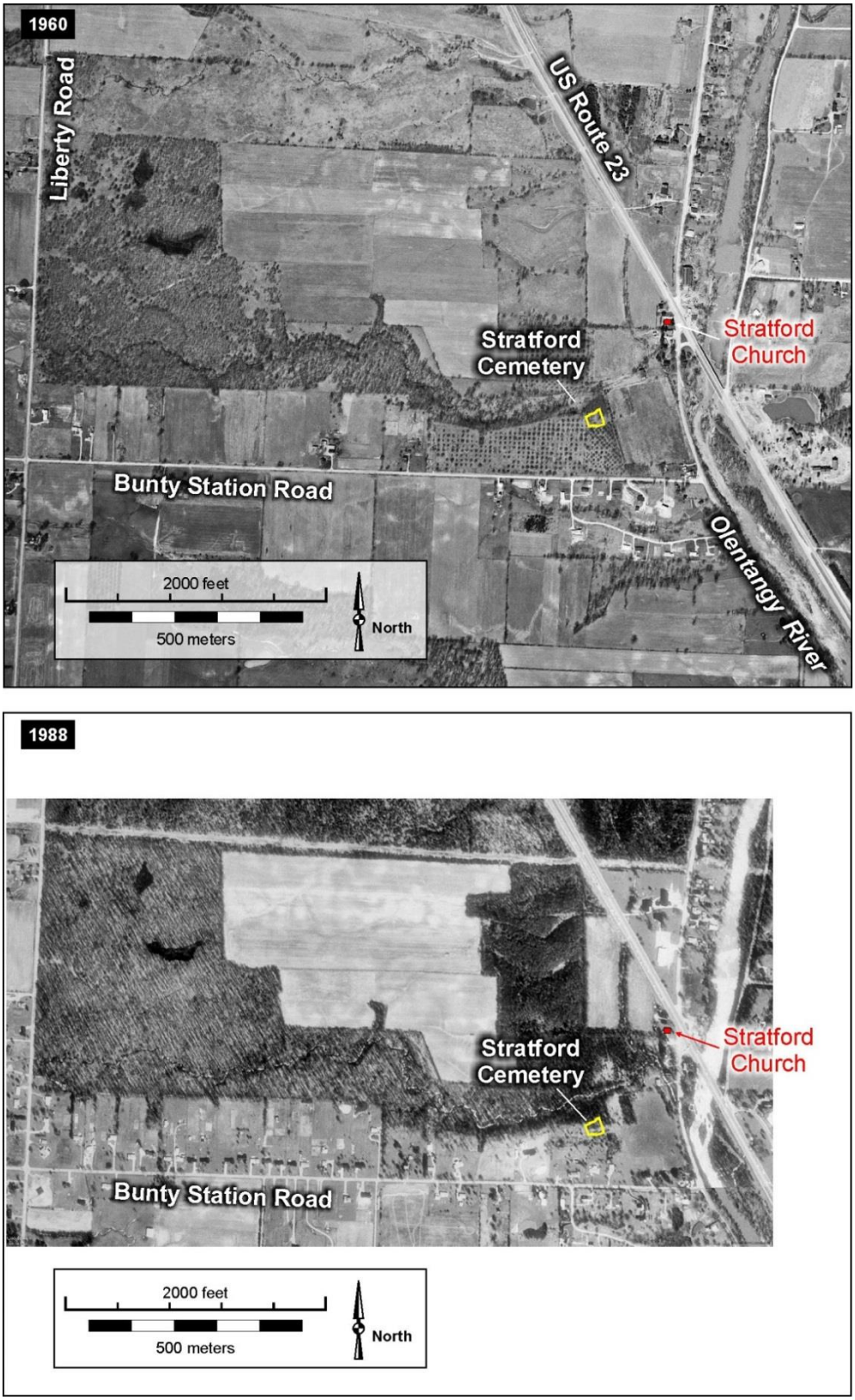


Figure 8. Aerial photographs of the Stratford area showing changes through time from 1960 to 1988 (source: United States Geological Survey).

Church also probably served as the place for memorial services and graveside burial ceremonies during the mid-to-late nineteenth century for many if not most of the residents of the Village of Stratford. Estimates for the size of the community at the Village of Stratford range between 85-110 individuals at any given time during the mid-nineteenth century, while estimates for the total burial population at the Stratford Cemetery range between approximately 59 to 68 individuals, and perhaps as many as 127 if the WPA map shows actual graves rather than both proposed and in-use plots. Since there are still open areas lacking graves on the WPA map, its unlikely that the cemetery was abandoned because it was filled up. Instead, the Stratford Cemetery likely was abandoned due to the demise of milling operations, the subsequent decline of the population of the Village of Stratford, and the closing of the Methodist Episcopal Church.

With that as historical background, let's now turn to the new surveys of the site to determine if any of this historical information can be corroborated with new data from the cemetery. First we present some background information on the techniques used during the survey, and then we present the survey results.

Methods

Background on Geophysics and Cemeteries

Any frank and honest discussion about cemeteries and geophysical survey must begin with a caveat: graves are notoriously difficult to detect with geophysical survey instruments and often for unpredictable reasons (e.g., Jones 2008). In some cemeteries every single grave might be detected while in others the graves are totally invisible to the instruments. Most of this difference in detectability is related to variability in the types of soils found in the areas used for burial, such as sandy soils versus clayey soils. Some soil types facilitate grave detection more than others (Bevan 1991; King *et al*. 1993; Scott and Hunter 2004). Of course, what is in the grave is also a major contributor to detectability—concrete vaults are quite easy to detect with nearly every kind of survey instrument and in any soil type.

Each of the instruments we have at our disposal for detecting graves, from magnetometers to electrical resistance meters and ground-penetrating radar units, works by identifying contrasting geophysical properties in the ground. What is inside the grave shaft must be geophysically different than the surrounding soil if the grave is to be detected. In particular, these instruments are good at detecting (1) differences in soil moisture levels, (2) varying amounts of different materials in the soil and sediment layers (especially the presence of sand, gravel, and clay), and (3) the presence of disturbed ground, especially in the form of increased air pockets. In addition to being able to detect graves by the soil that was used to fill them in, we can also sometimes locate unmarked graves by finding things that were associated with them but are now invisible at the

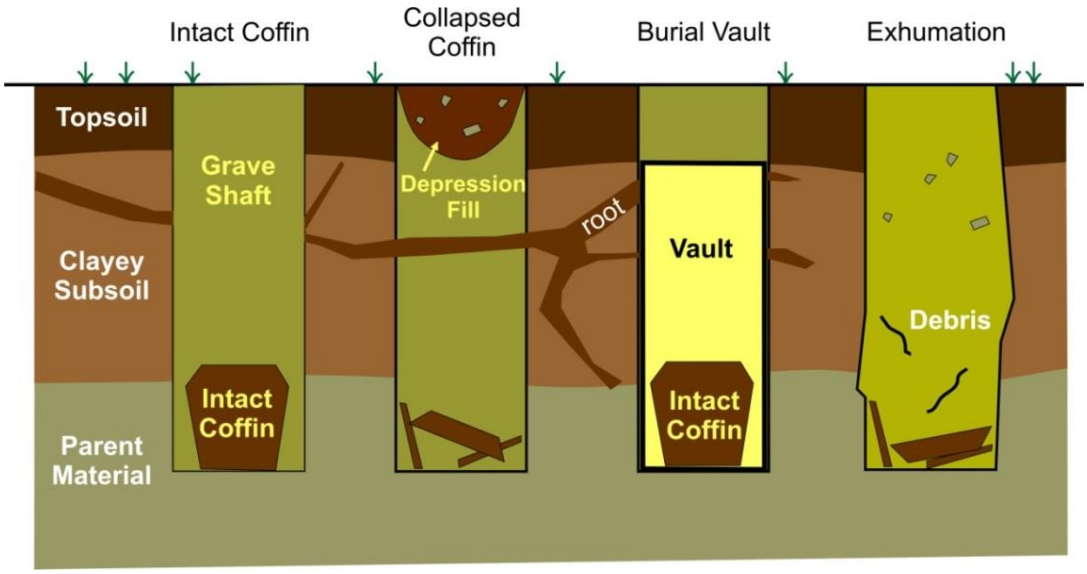


Figure 9. Idealized examples of graves and their components.

surface, such as the foundations of headstones and footstones, or the remains of objects placed at the graveside.

Several properties of the graves themselves can make them stand out from the background soil in a geophysical survey, including most importantly: the grave shaft and its fill (Bevan 1991), the presence of a burial vault, and the type of coffin used and its condition at the time of survey (Conyers 2006) (Figure 9).

Grave Shaft and Fill

Perhaps the most important aspect of older graves (i.e., 19th century and earlier) for successful detection during geophysical surveys is the grave shaft and its fill (Bevan 1991). Grave shafts are oval to rectangular holes excavated two to six feet into the ground. Their horizontal extent varies widely and is dependent on the size of the grave's occupant (e.g., adult versus child) and the use of a coffin and/or a burial vault. Larger grave shafts, such as those of adults, are more likely to be detected by geophysical instruments than those of smaller, child burials. In general, adult graves should be about 5-7 feet (1.5-2 m) long and 1.5-2.5 feet (0.5-0.75 m) wide.

Along with grave size, the type of soil within which the grave shaft is excavated is also important for detection with geophysical survey devices. The sediments in grave shafts are detectable because their properties are significantly different (i.e., they are disturbed) than the surrounding, intact soils. However, a grave shaft dug into soil without distinctive layers will be less detectable than one dug into a well-developed soil (one with numerous, distinctive layers). In the extreme, a hole dug into a homogeneous medium, such as sand, that is then backfilled with the same sand will be even more difficult to detect (if not impossible).

Several other soil characteristics also factor in to grave shaft detectability. Because the soil properties (porosity, compactness, etc.) of grave shaft fill differ from the undisturbed soil that surrounds them, grave shafts tend to hold and drain moisture differently than their surroundings. Thus, differential soil moisture plays a key role in grave detectability. In particular, recent heavy rains can make the tops of grave shafts (i.e., at and just below the ground surface) easier to detect in radar and electrical resistance surveys. Interruptions or disturbances of soil layers, which are common to all graves, can sometimes be detected by geophysical instruments, especially ground-penetrating radar (Conyers 2006). In these cases, the instruments detect the intact soil layers that surround graves and the graves appear as gaps in the layers. Finally, many graves, especially older ones lacking burial vaults, experience subsidence as the grave shaft fill settles and the coffin collapses. Often, the soil brought in to fill the subsided grave is obtained from a different source than the original grave shaft fill. This different soil is sometimes detectable to magnetometers because it is usually subsoil from other recently excavated nearby graves or it is fill dirt, perhaps from outside the cemetery, that contains refuse such as building debris or other magnetic materials.

Presence of a Burial Vault

Nearly all modern graves in the United States involve placing a coffin in a subsurface burial vault—this practice is also used in many other parts of the world. Today, these vaults are made from reinforced concrete or fiberglass, for example. Older graves sometimes contain vaults made with brick. Whatever the material, vaults will certainly impact the soil moisture levels present in the grave, making them detectable with most instrument types sensitive to moisture. Reinforced concrete vaults and brick vaults are easily detected during magnetic surveys. Ground-penetrating radar units can detect just about any kind of vault, especially if it has not filled up with soil. During times of the year when the soil is moist, an electrical resistance meter should be able to detect vaults. Unfortunately, vaults were not commonly used in the early nineteenth century when the first interments were made at the Stratford Cemetery. This means that the geophysical data will need to be more closely examined for subtle indications of possible graves.

Type of Coffin Used

Coffin type may also affect a grave's detectability during a geophysical survey. Most wooden coffins cannot be detected, and in older cemeteries many wooden coffins have collapsed and rotted away. However, it is possible that intact wooden coffins, if they still contain an air pocket, will be detected by ground-penetrating radar. With only one exception, coffins and coffin hardware are generally not detectable during magnetic

surveys because of the small size of the magnetic components of the coffin (mostly the coffin hardware) and the depth of burial, which is usually beyond the range of detection for magnetometers. One type of coffin, on the other hand, is easily detected by magnetometers—cast iron coffins/caskets. The first patent for a cast iron coffin in the U.S. was issued in 1848 and not long thereafter (1850s) iron coffins were used in cemeteries across the country, though in small numbers and largely for affluent individuals (Crane, Breed, and Co. 1858). Large cast iron objects, be they coffins, cook stoves, or utility pipes, are highly magnetic and should be detectable with magnetometers even when buried at five to six feet below the surface. Because iron coffins are so magnetic, their magnetic signatures tend to be larger than the actual size of the coffin or grave shaft—this is true for many types of vaults, as well. The ground-penetrating radar can detect metallic coffins of any type and may even be able to detect coffin hardware if it is large enough (nails are not likely large enough to detect with radar)—assuming the radar signal can penetrate deep enough into the ground to reach the coffin, which is not always the case.

In sum, three main aspects of graves determine their detectability in geophysical surveys: the grave shaft and the soils within and around it, the presence of burial vaults, and the type of coffin used and whether or not it is still intact. Except in cases of very recent or very shallow burial, it is unlikely that any of the instruments will detect the individual at the bottom of a grave, especially given that in most cases a skeleton is all that remains. In fact, the radar is the only instrument that can penetrate deep enough into the ground, and with sufficient resolution, to even reach the depth necessary for detecting the human occupants of most graves (certain resistance meters can detect down many feet into the ground, but their resolution drops off with depth). But even when the radar can penetrate deep enough, bones and dirt have a similar radar signature. Furthermore, the detection of very subtle features or objects, such as bones in dirt, is complicated by the presence of other, more easily detected things in most cemeteries. For example, tree roots can be very distinctive in radar data and they can obscure any subtle radar reflections next to and below them.

In addition to graves, cemeteries also contain burial plot markers, walls, paths, roads, small building foundations, perimeter fences, wells, and other kinds of decorative/garden features. Finding the geophysical signatures of these kinds of features can be important to determining the structure of the cemetery, and by extension the general locations of graves, as well as the locations of the cemetery boundary. Cemetery edges can also be distinguished by activities that have occurred outside the cemetery. For instance, plowing around the edges of burial areas or cemeteries often creates distinctive plow patterns in geophysical data that are notably absent within the cemetery.

Notes on Geophysical Survey Instruments

Geophysical survey instruments are commonly used around the world by archaeologists to find buried features, such as graves. Most things of archaeological interest are no more than a few feet below the surface. At these depths, the instruments detect archaeological features and graves by measuring subtle changes caused by differences in the soil, including for example changes in its electrical conductivity, electrical resistance, and magnetism (e.g., Bevan 1998; Clark 2000; Conyers 2004, 2012; Gaffney and Gater 2003; Heimmer and DeVore 1995; Lowrie 1997; Weymouth 1986). Certain types of *objects* can also be detected with regularity.

Each instrument is designed to measure a different property of the ground, and some of these properties, like magnetism and electrical resistance, vary almost totally independent of one another. This means that when looking for buried things that are subtle and difficult to detect, such as graves, it is worth using multiple instruments when possible. It can be difficult to anticipate which instrument will work the best, and often each instrument detects a different aspect of the target feature. Combining the results of multi-instrument surveys in cemeteries almost always yields a richer interpretive map than a single instrument survey.

Two geophysical survey instruments were used at the Stratford Cemetery to search for graves and other features of note: a **magnetometer** and a **ground-penetrating radar** (Figure 10). Geophysical surveys are typically conducted by using the instruments to collect a series of readings along parallel lines (a.k.a. transects) in a rectilinear block (a.k.a. block). Data points are recorded at timed intervals, or based on distance, as the instruments are moved along the transects in each block. When possible, it is better to survey an area that is considerably larger than the target feature to provide a context within which to see that feature. So, for example, if one is looking for a single grave it is important to survey well beyond the edges of the grave to locate other possible nearby graves or the remains of a fence that might have surrounded the burial area. It also is important to collect high-density data when possible, especially when looking for graves or other small features. Higher density data provide a clearer image of what lies underground.

Mapping the topography of cemeteries is also useful since graves often subside, creating depressions. A map of the depressions in a cemetery can be just as useful as a map of geophysical anomalies. That said, mapping subtle topography can be very time consuming. Photogrammetry is a relatively quick way to create high-resolution topographic maps. At Stratford, we used a drone (Figure 10, bottom) and a ground-based camera to capture images for use in producing a digital surface model of the site.

Ground-Penetrating Radar

Magnetometer

Drone for Aerial Photography & Photogrammetry

Figure 10. Remote sensing tools used at the Stratford Cemetery.

Generally, the data collected by geophysical survey instruments during cemetery surveys must be transferred to a computer where special software is used to process the data and make maps of the survey results. In these maps the data values are assigned a range of colors related to their strength. In areas with little change in the readings, the colors are all similar—think of these areas as the typical background signature of the site. Areas in the data with unusual values that differ from the background are referred to as

anomalies, and the goal is for graves to appear as anomalies in the data. Of course, the real challenge is knowing which anomalies are important and which are caused by tree roots, animal burrows, and other things not significant to the goals of the project.

Magnetometers

Magnetometers detect subtle changes in the earth's magnetic field caused by the magnetic properties of things close to the instrument (Figure 11). They can detect the presence of magnetic objects (e.g., iron objects) and subtle changes in the soil, especially if these soil changes involve the local accumulation or removal of topsoil or other magnetically distinct sediments (Aspinall *et al*. 2008; Clark 2000; Gaffney and Gater 2003). While small objects in the ground such as coffin nails (iron ones, anyway) are quite magnetic, they are usually too far away from the instrument to be detected during a survey. Nevertheless, most iron objects larger than the average nail and located in the top several inches of soil are detected. Old fence wire, iron pins used to mount or repair headstones, and iron fencing are all quite magnetic and can be found in cemeteries. Sometimes, graveside offerings that have broken up and become incorporated into the soil contain magnetic components that give away the locations of graves, as well. More recent iron-based things at cemeteries can essentially blind the magnetometer to graves. These include chain link fences, utility lines, and landscaping features such as edging held in place by rebar.

At the Stratford Cemetery, the magnetic data were collected using a Geoscan Research FM256 fluxgate gradiometer (Figure 10, upper right). This is a type of magnetometer with two sensors fixed at a spacing of 50 cm. As this handheld magnetometer was walked back and forth over the survey area, eight readings were collected per meter along transects spaced 50 cm apart. This data collection density has been used in many cemetery settings to detect graves. Data were collected in a grid north-south direction, roughly perpendicular to the long axes of the graves.

In general, the FM256 can detect down into the ground about three feet, unless there is something exceptionally magnetic in the area—which could be detected even deeper. Buried features such as wells, cisterns, privies, burned areas, and some kinds of foundations can be detected with magnetometers. Graves can also be detected, and usually it is the soil within the grave shaft that the magnetometer detects. If the area surveyed has lots of other magnetic things on or near the surface, such as iron or steel fences, this can make it difficult or impossible to detect subtle graves.

Though often complicated with many kinds and shapes of anomalies, magnetic data can be distilled down to a small selection of anomaly types that are useful for understanding what has been detected. Figure 12a presents the three primary types of magnetic anomalies, along with some variants, that are typically encountered during surveys on archaeological sites and in cemeteries. Monopolar anomalies are small areas where stronger or weaker readings have been detected. These anomalies are often

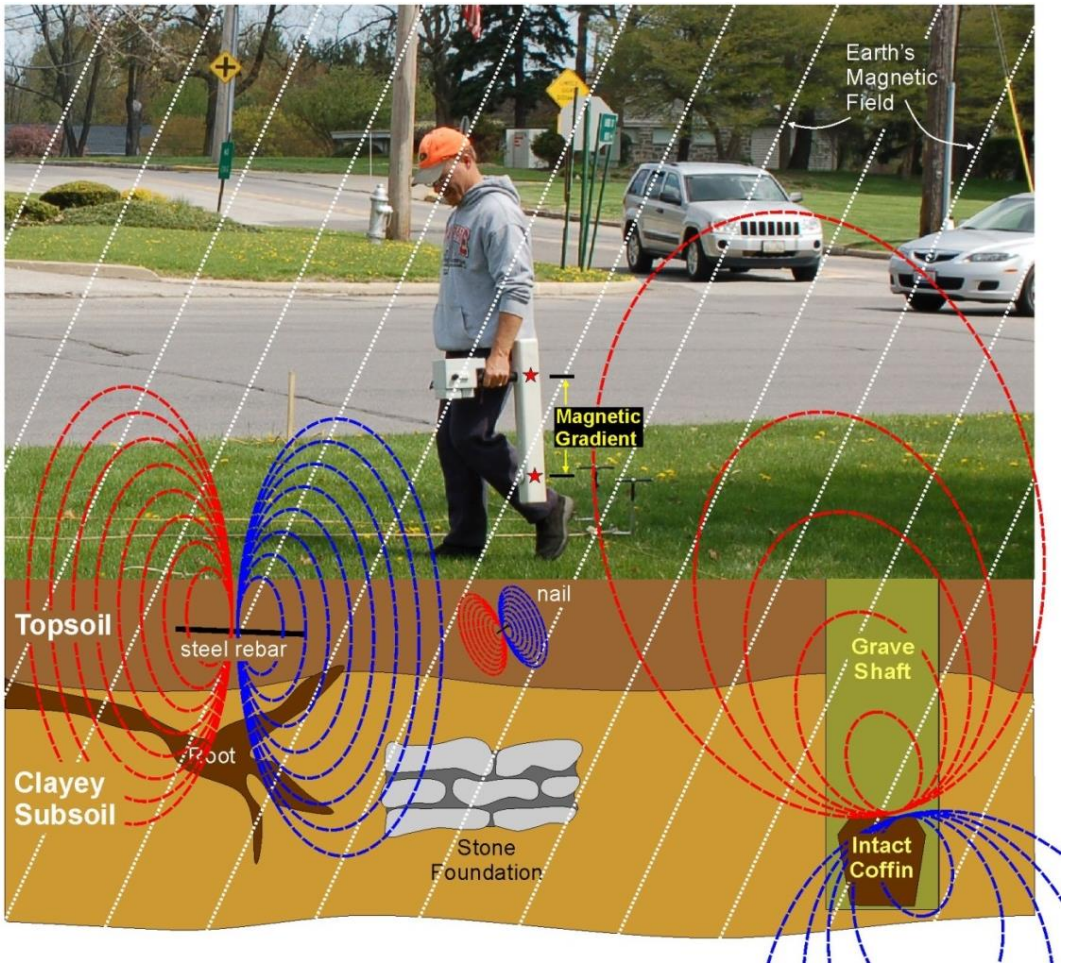


Figure 11. An illustration of magnetic fields on an archaeology site—red and blue lines are the magnetic fields of objects and features; white lines represent the earth's magnetic field.

associated with pits that have been dug into the ground. If topsoil or magnetically enhanced soil ends up inside the pit, then a monopolar positive anomaly will be created. If subsoil or sand is used to fill up the pit, and occurs near the surface, then it is possible that a monopolar negative anomaly will be created, though these are rare (Figure 12b). Dipolar simple anomalies are the easiest to identify in magnetic data as they have side-by-side positive and negative peaks. They most often are associated with iron objects and magnetic rocks—the larger the object or rock, the larger and stronger the magnetic anomaly. Vaults in cemeteries often appear as large dipolar anomalies (Figure 12c). Sometimes dipolar anomalies are found clustered together or as very irregular areas of negative and positive readings. These clusters of anomalies are referred to as dipolar complex anomalies and they often are associated with historic refuse dumps, building foundations, and burned areas. Utility lines can also produce linear arrangements of complex anomalies (see Figure 12a, left column, bottom).

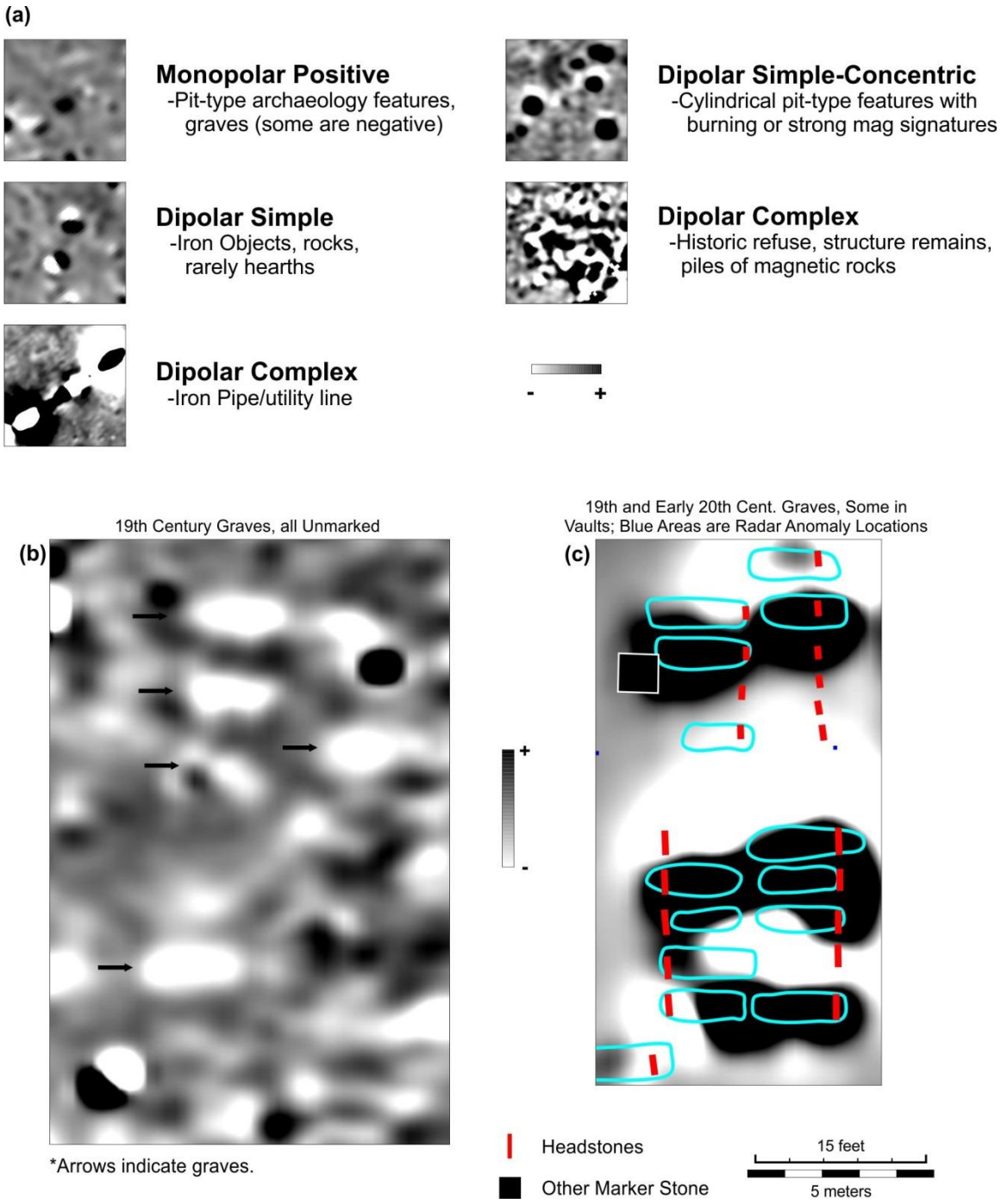


Figure 12. Magnetic anomaly types (a) commonly encountered in archaeological surveys, and (b-c) examples of the magnetic signatures of graves in 19th century cemeteries in the Midwest.

Once collected and downloaded to a computer, the magnetic data must be processed with special software to prepare them for analysis and presentation. The data from the Stratford Cemetery were processed using the Geoplot 3.0(s) software. Several

different data processing steps were used, including zero mean traverse, interpolation, and low pass filter.

Ground-Penetrating Radar

Ground-penetrating radar (GPR) is most often associated with cemetery surveys. It works by moving a radar antenna along the ground as it transmits thousands of pulses of radar energy per second (Figure 13). As these waves of energy travel into the ground and encounter objects and layers, especially those with distinctly different electrical properties, some of the energy is reflected back to the surface and received by the antenna (Conyers 2004, 2012; Gaffney and Gater 2003; Witten 2006). The instrument records the strength of the reflections and how long it took the energy to travel away from and back to the antenna. This radar travel time can be used to calculate the depth of a detected object or feature.

Many things below ground can cause strong and weak radar reflections, including tree roots, pipes, larger rocks/bedrock, distinct soil layers, foundations, shaft-type features (e.g., graves, wells, cisterns, and privies), and disturbances to the natural soil layers. Radar energy can also penetrate asphalt, concrete, and gravel. In fact, concrete and asphalt are excellent materials on which to survey because they are very good at allowing the radar energy to pass into the ground. Other materials, especially clayey, moist soils, tend to absorb radar energy and do not allow it to pass. At the extreme, radar energy cannot penetrate metals, so metal pipes and other large metal objects are easily detected, but they do obscure things below them. Ultimately, the depth of the radar signal penetration, and the depth to which objects can be detected, depends on the frequency of the antenna being used and the conductivity of the ground. Higher frequency antennas (e.g., 1000 MHz) can detect very small things but only at shallow depths, while lower frequency antennas (e.g., 50 MHz) can penetrate into the ground much deeper but can only detect larger things. The frequency of the antenna, however, can be irrelevant if the ground is so conductive that all of the radar energy is absorbed before it can make its way back to the surface.

For the Stratford Cemetery survey, a Sensors and Software Noggin Plus 500 MHz system was used to collect radar data (Figures 10 and 13). It is a mid-range frequency system that is ideally suited to most archaeological applications. Forty traces, essentially "readings," per meter were collected along transects spaced at 25 cm intervals. Collecting data at this density with a single antenna system is a very time consuming process but it increases the odds that subtle features such as graves can be detected and discerned in the data. A 40 nanosecond time window was used to "listen" for return reflections from the transmitted radar pulses.

Each radar trace is akin to a very narrow profile of the ground. Arranging the 40 traces per meter side by side along the data collection transect creates a radargram

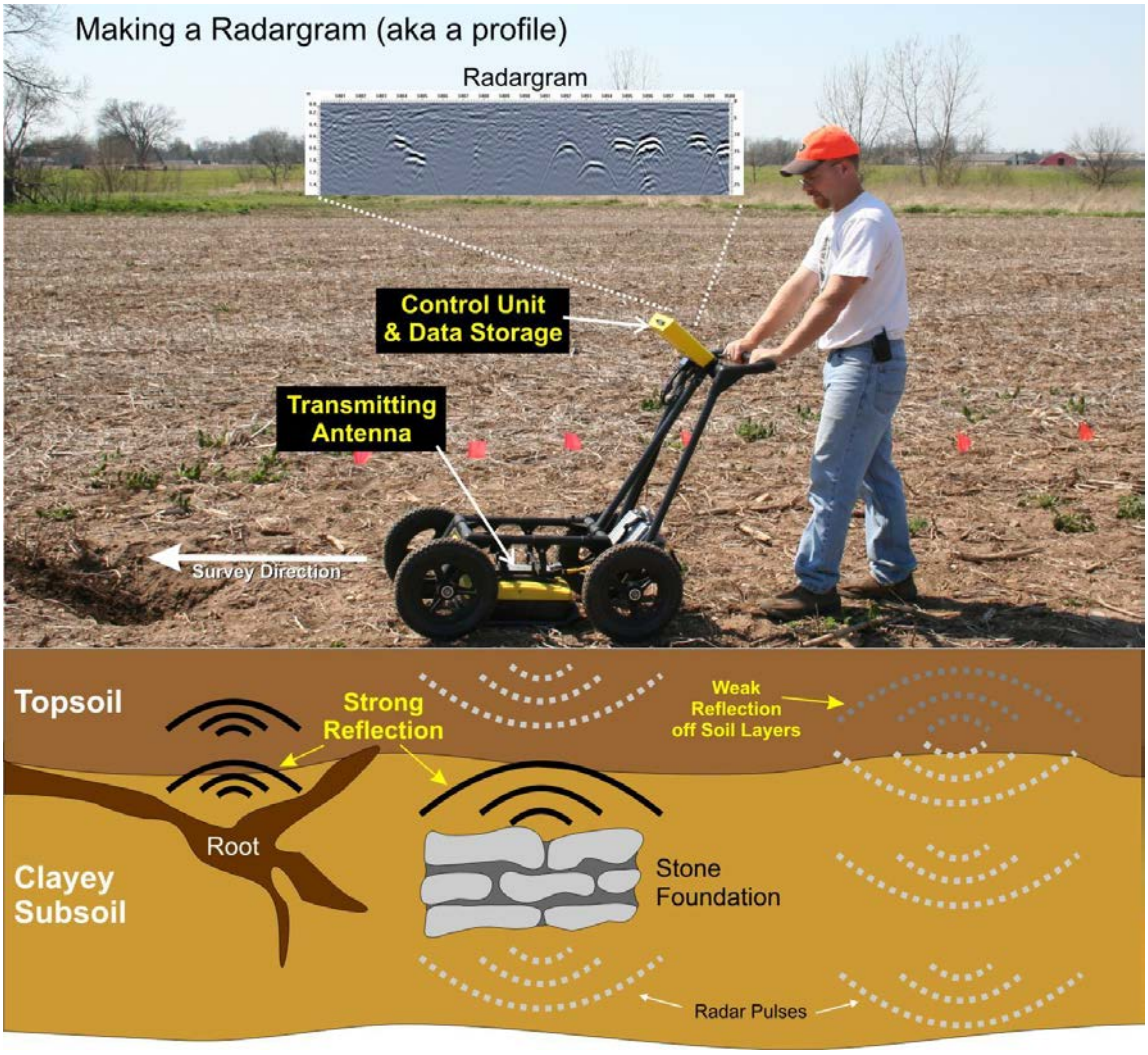


Figure 13. A demonstration graphic showing use of the ground-penetrating radar instrument.

(Figure 13), or a profile of the ground as the radar "sees" it. These radargrams are the nuts and bolts of a radar survey; they show the locations, shapes, and strength of the radar reflections. However, it can be difficult to interpret what has been found based on the radargrams alone.

Radargrams can be turned into three-dimensional blocks of data by stacking them up side-by-side and having the computer software fill in the gaps by estimating (i.e., interpolating) what should be in between the radargrams. The resulting 3D block of data can then be "sliced" horizontally and looked at from the top rather than the side—making it seem as if one is excavating down through the data, and the site, one layer at a time (Figure 14). These horizontal data slices are called "time slices" or "amplitude slices" and they show a horizontal map of the radar reflection strength at a desired depth. Graves should appear in the slice images as small anomalies, about 2x7 ft (for adult graves), and

they often occur in rows. The graves can be positive anomalies, where the graves themselves are what is causing the reflections (Figure 15a), or graves can appear as gaps (i.e., negative anomalies) in an otherwise reflective layer (Figure 15b). In some cases the graves are obvious in the radar data, and in others they are more subtle. Sometimes, even when graves are detected, they do not show up well in the time slice maps; therefore, it can be important to closely inspect all of the radargrams for the telltale signs of a grave.

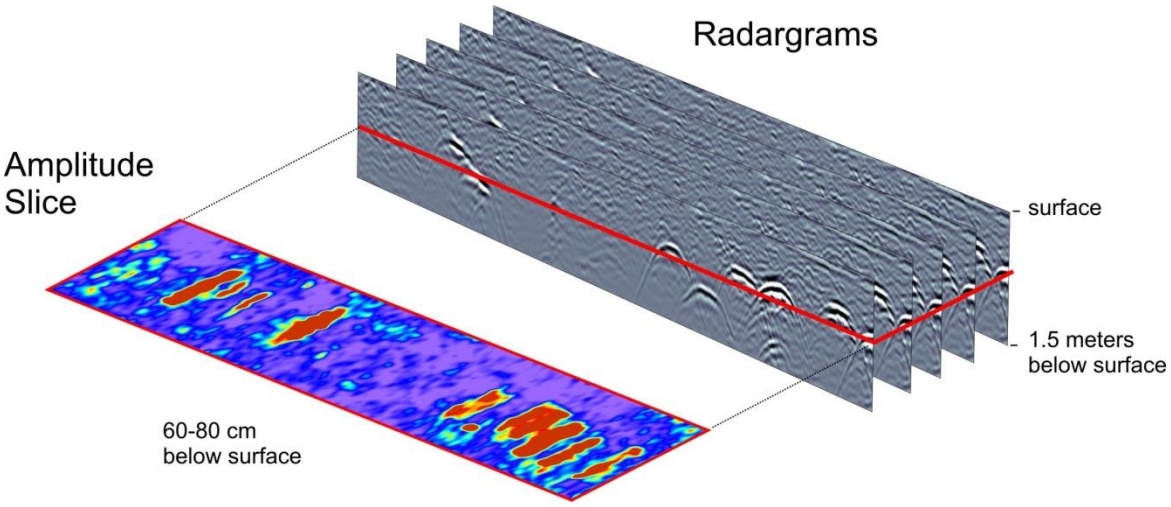


Figure 14. A demonstration graphic showing the creation of a radar amplitude slice from radargrams.

Figure 16 shows how interpreting both amplitude slice maps and radargrams can work together to produce a more complete interpretation of the radar data. In the top two images (Figure 16a) only the amplitude slice maps are used to identify graves, of which there are many and most occur in rows. In the bottom two images, Figure 16b, we see that an examination of the radargrams, with a plotting of distinctive anomalies from the radargrams (the small red dots), has led to the identification of at least six more probable and possible graves. Therefore, it is important to include both amplitude slice maps (and at varying depths and thicknesses) and radargrams in an analysis of radar data focused on detecting graves.

The radar data presented here, including the data from Stratford Cemetery, were processed using Sensors and Software's Ekko_Mapper 4 software, including a combination of the following steps: dewow, migration, enveloping, background subtraction, gain, and interpolation. Ekko_Project 4 was used for analyzing the profiles. Even with good data processing and conscientious interpretation, graves can be difficult

to detect in radar data. Therefore, a lack of graves in the radar data should not be used as the only indication that graves are absent from a survey area.

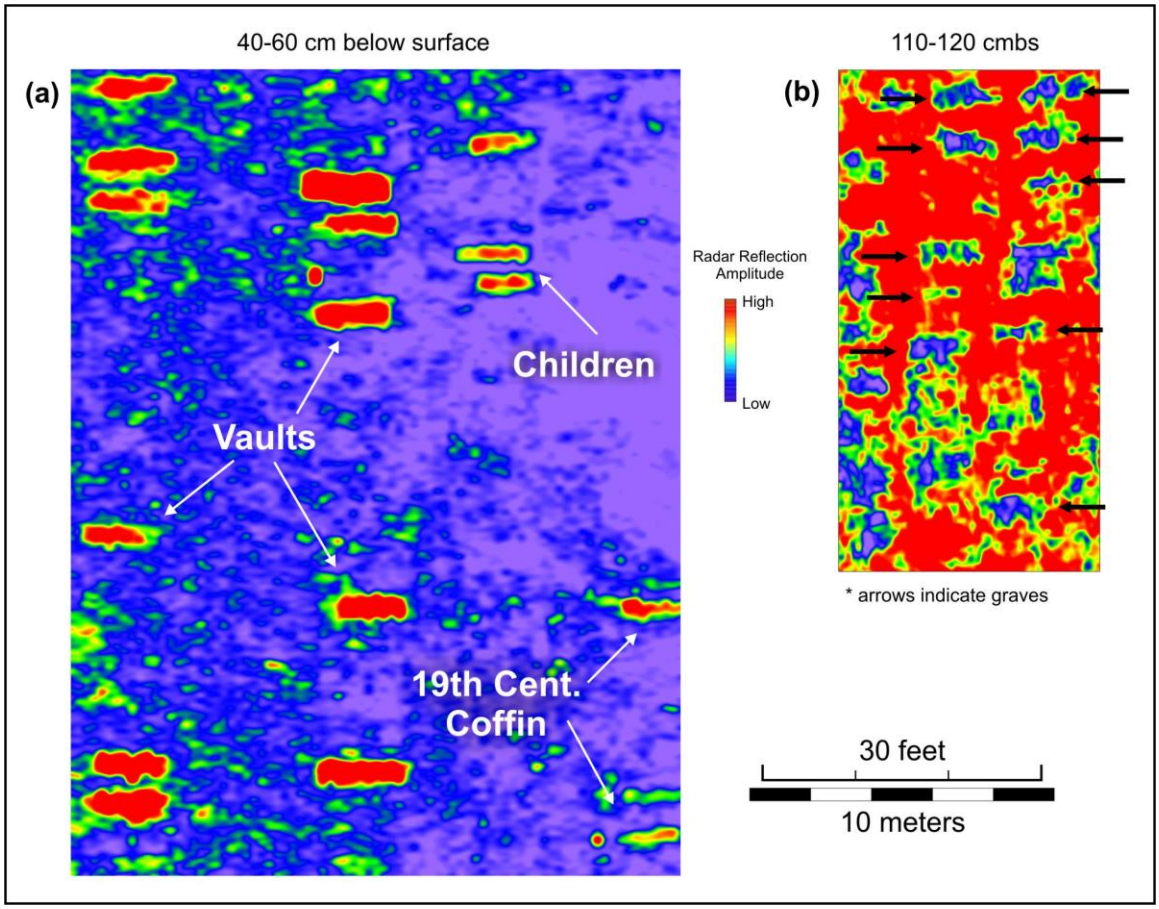


Figure 15. Examples of graves in amplitude slice maps detected at nineteenth and early twentieth century cemeteries in the (a) Ohio and (b) Pennsylvania.

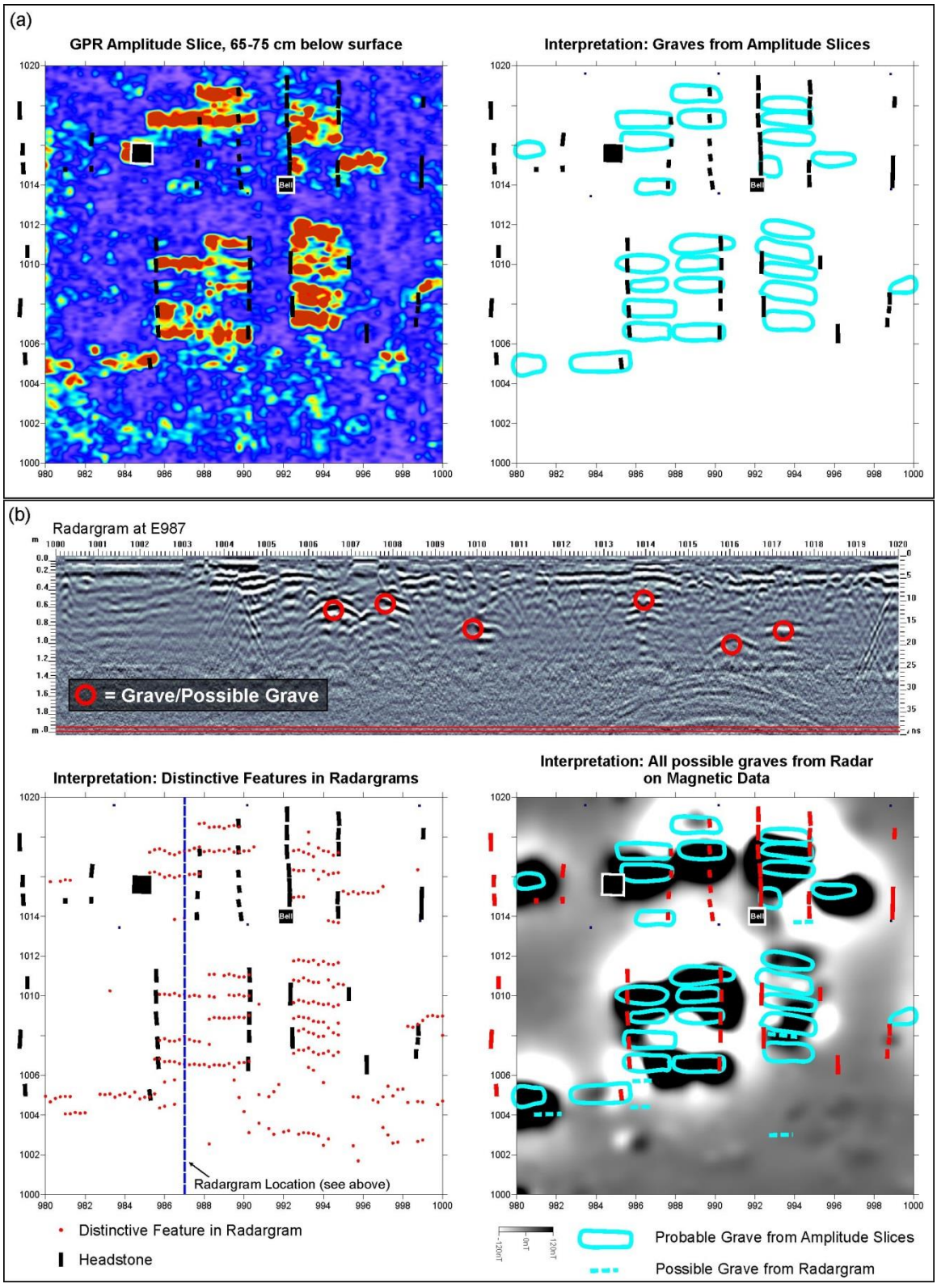


Figure 16. An example of radargram analysis to identify graves.

Drone-Based Photogrammetry

In addition to collecting geophysical data to look for below-ground evidence of graves, two different techniques were used to map the surface of the site. A Leica TC405 laser transit was used to collect data on the locations of grave marker stones and trees. These data were then used to make a line-drawing map of the site. While line drawings made with transit data are incredibly useful and usually are very precise, they are not the most intuitive kinds of maps for people to understand. Furthermore, they do not capture the locations of subtle changes in topography that might indicate the locations of graves.

In addition to mapping the site with the transit, we also used a drone to fly over the cemetery and take numerous pictures from various altitudes and angles. The pictures were then loaded into a software package called Pix4D, which stitched them together into a seamless aerial photograph. And using a technique known as photogrammetry, the Pix4D software also was used to create a 3D model of the site. This 3D model was used to generate 3D fly-throughs of the site, as well as a very high resolution topographic map of the ground surface that shows subtle depressions that might be the locations of subsided graves.

Results of the Field Work

Mapping Work

The Stratford Cemetery survey project began with setting up the survey grid. The geophysical instruments used in the project collect data along lines arranged in blocks—typically we use 20x20 meter blocks in cemeteries. Therefore, block corners must first be established before data collection can begin. Since the site is so small, fiberglass tape measures (rather than the transit) were used to set up the survey grid squares. First a tape measure was pulled down the middle of the cemetery, following the spine of the ridge that the cemetery sits on. Stakes were set at 20-meter intervals along the 40-meter length of tape measure. Then, with two tape measures, additional stakes were set to the north and south of this baseline using basic geometry to achieve square grid corners.

Once the grid was in place, a Leica TC405 laser transit was set up at one of the grid corners and was used to map in the locations of visible grave marker stones and trees. A map of the site showing the trees and the survey grid is presented in Figure 17. The topographic contour lines in this map were taken from LiDAR data (laser-based elevation data commissioned by the State of Ohio in 2006/2007) and anchored to the site using global positioning system measurements of the survey grid. The one foot topo contour lines in Figure 17 nicely capture the lay of the land within the cemetery—a relatively flat-topped ridge that continues to the west and falls off down slope in the other three directions. The cemetery straddles the end of the ridge top.

Two datums were left in the field to help re-establish the survey grid in the future (Figure 17). Table 1 contains the survey grid and global positioning system (GPS) coordinates for the datums, which are 10-inch galvanized nails pounded down flat with the ground surface (i.e., they are not visible to the casual cemetery visitor). The GPS data recorded for the datums and the rest of the site were collected with a Trimble GeoXT (sub-meter) GPS. Datum nails and survey grid corner GPS coordinates are an average of 15-20 real-time, WAAS-corrected GPS positions. With these coordinates, a good GPS, and a metal detector, it should be relatively easy to relocate the datums and re-establish the survey grid so that in the future geophysical anomalies can be marked on the ground or additional measurements using the survey grid can be made and added to the map.

Table 1. Survey grid datum coordinates.

	Site Grid Coordinates		**Geographic Coordinates UTM***		
Datum	**Northing**	**Easting**	**Northing**	**Easting**	**Comment**
1	1000	1000	4458013.16	324285.97	10-inch galvanized nail
2	1000	960	4458025.58	324322.97	10-inch galvanized nail

*UTM Zone 17 north, Datum=NAD83. Data collected with a Trimble GeoXT 2005 series global positioning system. All coordinates are an average of at least 20 GPS positions. These coordinates are meant for use in relocating the datums, not necessarily for georeferencing the archaeology grid.

Mapping the grave marker stones, that is, headstones and footstones, started with a systematic walk over of the cemetery to look for stones. While many of the stones are fairly obvious (Figure 18, top), some of the footstones and other fragments are just barely visible at the ground surface (Figure 18, bottom). To make sure that all of the stones were

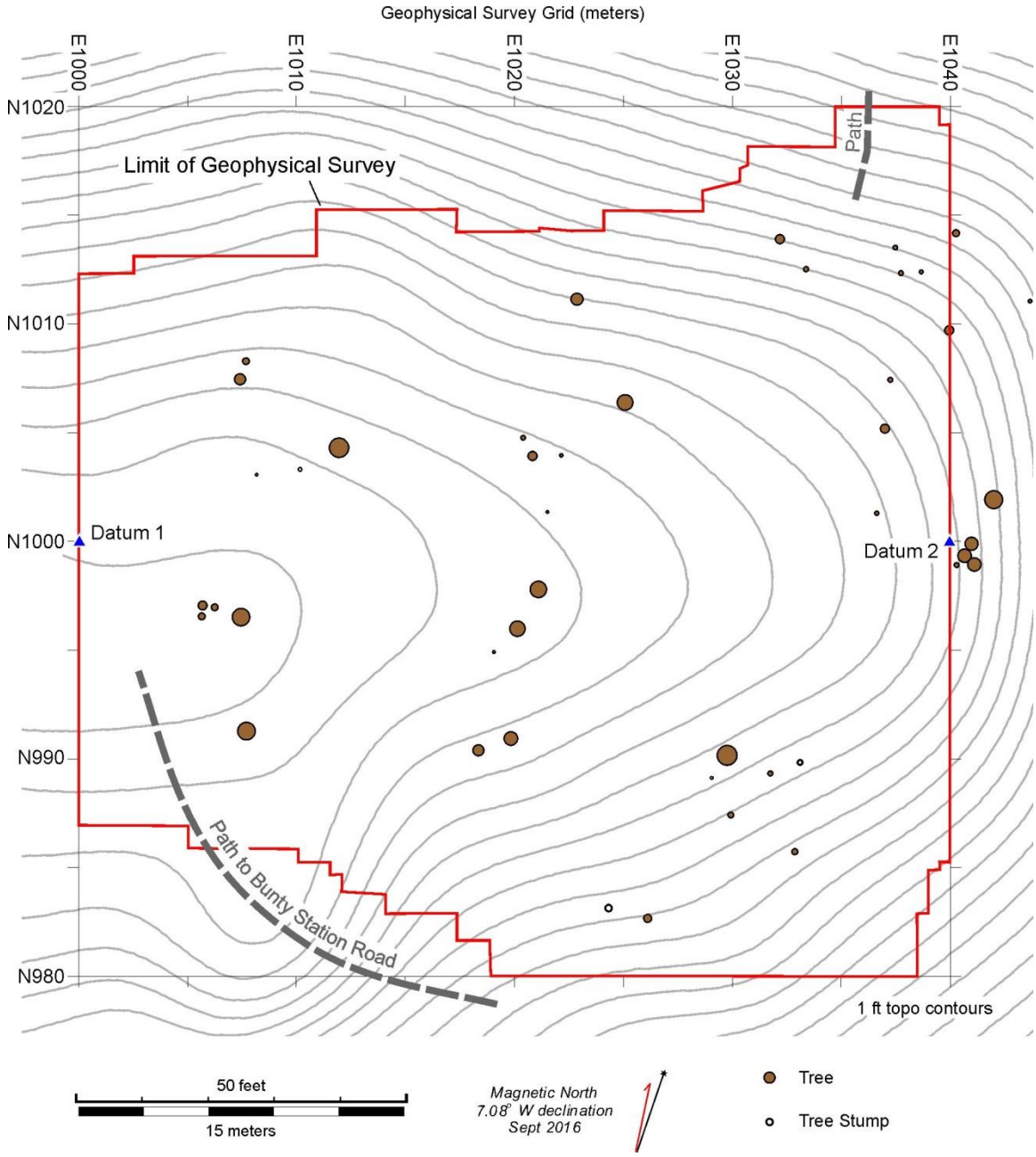


Figure 17. Map of the survey area.

included on the map, a team of four or five individuals lined up side by side and systematically walked back and forth across the cemetery, marking stones with pin flags as they were encountered. The stones were then numbered and measurements were taken with the transit to record their locations, and the pin flags were pulled as each stone was mapped. Each stone's location in Figure 19 is the result of two measurements, one at the middle of each side of the stone. Therefore, the size and angle of the stones on the map is an accurate reflection of stone size and orientation in the cemetery. For stones lying on the ground, the measurements were taken as close to the stone's base as possible.

Figure 18. A range of marker stones visible in the cemetery.

Table 2 presents information about each of the numbered stones, including what type of stone it is (head, foot, base, or indeterminate [“stone”]), the name of the individual or some other legible inscription on the stone, and a basic condition. In all, 118

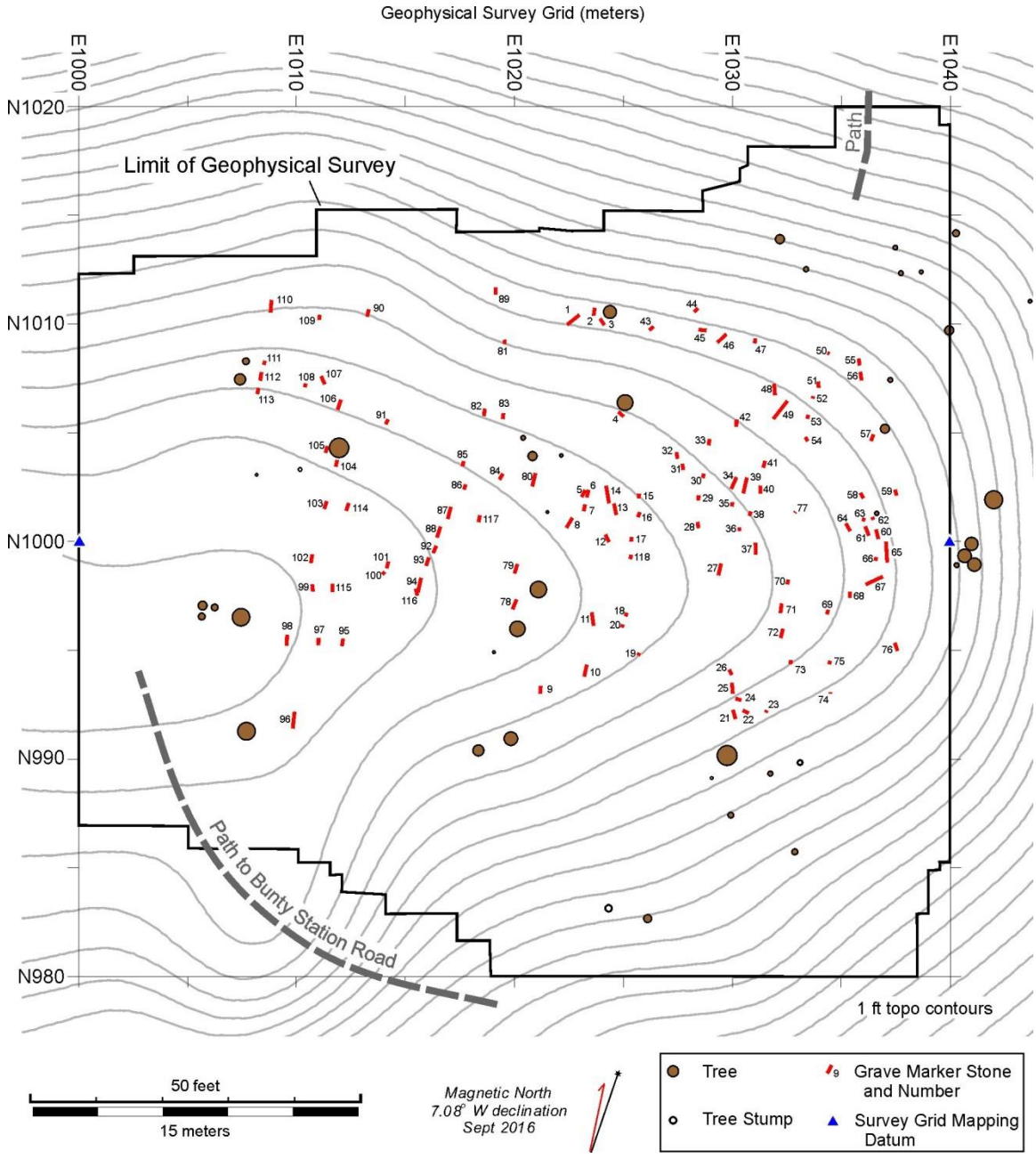


Figure 19. Map of marker stone locations with numbers assigned for this project.

stones were identified in the field and mapped. Most of these (60) are headstones, though not all have visible inscriptions. No attempt was made to conduct a complete reading of the stones—i.e., record all legible inscriptions. The recorded information was simply meant to aid in matching up the actual stones with their numbered counterparts on the map. Footstones, or footstone-sized marker stones, are the next most abundant with 34. There are eight bases, some slotted and others solid. And finally, there are 16 indeterminate stones that could not be assigned to a category. Some of these might not, in fact, be marker stones. That said, there likely are more stones present in the cemetery

than were mapped. Quite a number of footstones were just barely visible at the surface, suggesting others might be completely buried. Furthermore, some of the headstones and footstones were lying prone on the surface, including some that were nearly completely buried. More than likely, additional prone stones are present beneath the surface. Some of these may be detected in the radar survey.

In summary, the mapping work with the transit found that at least 59 of the headstones/bases are paired with footstones. Another 19 headstones/bases occur without footstones, and there are 12 footstones lacking paired headstones/bases. While there no doubt is some wiggle room in this number, together the marker stones may represent about 90 graves.

Table 2. Numbered marker stone descriptions.

Stone No.	Type	Name	Condition/Position*
1	Headstone	?	Mossy, flat
2	Headstone	?	Too eroded, tree leaner
3	Headstone	?	Almost legible, tree leaner
4	Footstone	E.B.	Tree leaner
5	Headstone	?	-
6	Stone	?	-
7	Stone	?	-
8	Headstone	Alexander	Two pieces
9	Headstone	?	Uncut
10	Headstone	(?) MA (?)	Rough, broken
11	Headstone	Elizabeth wife of J. Powell	-
12	Headstone	Samuel son of Joseph (?)	Prone
13	Headstone	?	Prone, broken
14	Base	-	-
15	Footstone	?	-
16	Footstone	?	-
17	Footstone	?	Barely above surface
18	Footstone	?	-
19	Footstone	?	Uncut
20	Stone	-	Very small, low
21	Base	-	-
22	Stone	-	Flat, uncut, on surface
23	Footstone (?)	?	-
24	Headstone	?	Prone
25	Headstone	Lydia Ann	-
26	Headstone (?)	?	Rough, uncut
27	Headstone	John	-
28	Headstone	?	Very deteriorated
29	Headstone	?	Very deteriorated
30	Headstone	?	Partially deteriorated
31	Headstone	Melvin	Prone
32	Headstone	Sylvester	Prone
33	Headstone	?	Almost legible
34	Headstone	Gathe (?)	Broken, 3 pieces
35	Footstone	?	Low
36	Stone	?	Squarish, possible plot marker
37	Headstone	?	-
38	Footstone	L.A.D.	-

Stone No.	Type	Name	Condition/Position*
39	Base (?)	-	Mostly buried
40	Footstone	-	Uncut (?)
41	Headstone	P (?)	Prone, chunk
42	Stone	?	Uncut
43	Headstone	?	Obelisk
44	Stone	?	Granite
45	Headstone	?	Prone
46	Headstone	Jacob Hedreick	Broken
47	Footstone	J.M.	-
48	Headstone	(?) E (????) W.	Tall
49	Headstone	?	Cluster of 4 fragments
50	Stone	?	Seemingly uncut stone
51	Footstone	?	Low, rough
52	Footstone	?	Low
53	Footstone	?	Low but distinctly cut
54	Foot	S.H.	Prone
55	Headstone (?)	?	Uncut
56	Headstone (?)	?	Uncut
57	Headstone	?	Tree leaner
58	Stone	?	Uncut, prone
59	Stone	?	(Uncut)
60	Headstone	?	Prone
61	Headstone	?	Prone, part of #60?
62	Footstone	?	Obelisk-shaped, prone
63	Footstone	S.C.B.	Prone
64	Base	?	-
65	Base	?	Large
66	Footstone	?	Prone
67	Base	?	Large
68	Stone	?	Low
69	Footstone	E.H.	-
70	Footstone	?	Low
71	Headstone	Ester Harris	-
72	Headstone	?	Rough
73	Footstone	?	Low
74	Stone	?	Cut, buried
75	Footstone	?	Low
76	Headstone	?	Prone
77	Footstone	?	Low
78	Headstone	?	Prone
79	Headstone	Reubin (?)	Broken, 2 pieces
80	Headstone	?	Scrolled top
81	Stone	?	Low
82	Headstone (?)	?	Low
83	Headstone (?)	?	Low
84	Headstone	?	High arched top
85	Footstone	S.C.S.M	-
86	Headstone	Cnl Forrest Meeker	-
87	Headstone	Patience Meeker Consort of Forrest Meeker	-
88	Headstone	Emrey Bennet	-
89	Base	-	Open mortise
90	Headstone	Sykes	Prone, part buried

Stone No.	Type	Name	Condition/Position*
91	Footstone	C.S.	-
92	Headstone	John Davis Son of D.A. & E.	-
93	Headstone	died May 11 1816	Top broken off
94	Headstone	Ephram Doolittle	Tall, footstone leaning on it
95	Headstone	Henry Albert	-
96	Headstone	Neff	Tall, many small stones around base
97	Footstone	J.H.	-
98	Headstone	John Hoyt Son of J & M.M.	-
99	Headstone	Susan M.	Prone
100	Footstone	S.M.P.	Prone
101	Stone/base	-	-
102	Headstone	Alice Perry daughter of N.D. & S.M.	-
103	Headstone	Lewis Albert	-
104	Headstone	Son of George S (?)	-
105	Headstone	?	Tree leaner
106	Headstone	?	Bottom only
107	Headstone	Caroline Wife of G. (?)	Top of #106
108	Footstone	?	-
109	Footstone	?	Short
110	Base	-	Hefty
111	Stone	?	
112	Headstone	Henry Keiser	Broken, two pieces
113	Stone	?	Small, like footstone
114	Footstone		Flush with ground
115	Footstone		Flush with ground
116	Footstone		Blank, out of ground and leaning against 94
117	Footstone		Flush with ground
118	Footstone		Flush with ground

*Prone stones are lying flat on the ground; inscriptions are sometimes up, down, or missing.

In addition to mapping the cemetery with a transit, we also employed a drone to capture photographs from the air. It is nearly impossible to see the Stratford Cemetery in aerial photographs because it has been covered by trees for much of the last 100 years—especially since the time when aerial photographs began to be regularly taken of Ohio around 1940. The drone, a DJI Inspire (Figure 20, left), was flown under the tree canopy by OVAI specialist Jamie Davis. Hundreds of overlapping photographs were taken with the drone's Zenmuse X5 16 megapixel digital camera. In areas where the drone could not fly, because of low hanging tree branches, the camera was removed from the drone and attached to a DJI Osmo gimbaled handheld stabilizer for taking photos from the ground (Figure 20, right).

While flying a drone is good fun, though a little nerve-racking in the woods, the point of taking so many photographs of the cemetery was to use them in creating a 3D model of the site using special software and a process called photogrammetry. In particular, our hope was that the 3D model would capture the locations of subtle

Figure 20. The drone (without its rotors) being prepared for flight (left), and Jamie Davis capturing additional images for photogrammetry using a hand-held camera.

depressions indicating where graves had subsided. Figure 21 presents three views of the 3D model created by Jamie Davis from the drone and Osmo imagery. The marker stones all show up nicely. While Jamie has cut out the trees, to make the stones more visible, the sun-dappled appearance of the ground and the shadows cast by the trees are still evident. These make it nearly impossible to see depressions.

The effects of sun and shadow are not a problem when the 3D model is viewed as a shaded relief map, without an overlay of the photographs. Figure 22 is a shaded relief map of the site with an overlay of marker stone and tree locations. The variations in gray in the background of the image indicate topography—imagine a low-angle light source is shining across the site to highlight subtle changes in topography. Some of the more notable depressions are indicated by blue arrows, but at least 15 distinctive depressions are scattered across the cemetery. Some are associated with existing marker stones while others are not, perhaps indicating the presence of unmarked graves. These depressions are revisited in the final interpretative map, after we next examine the geophysical survey results.

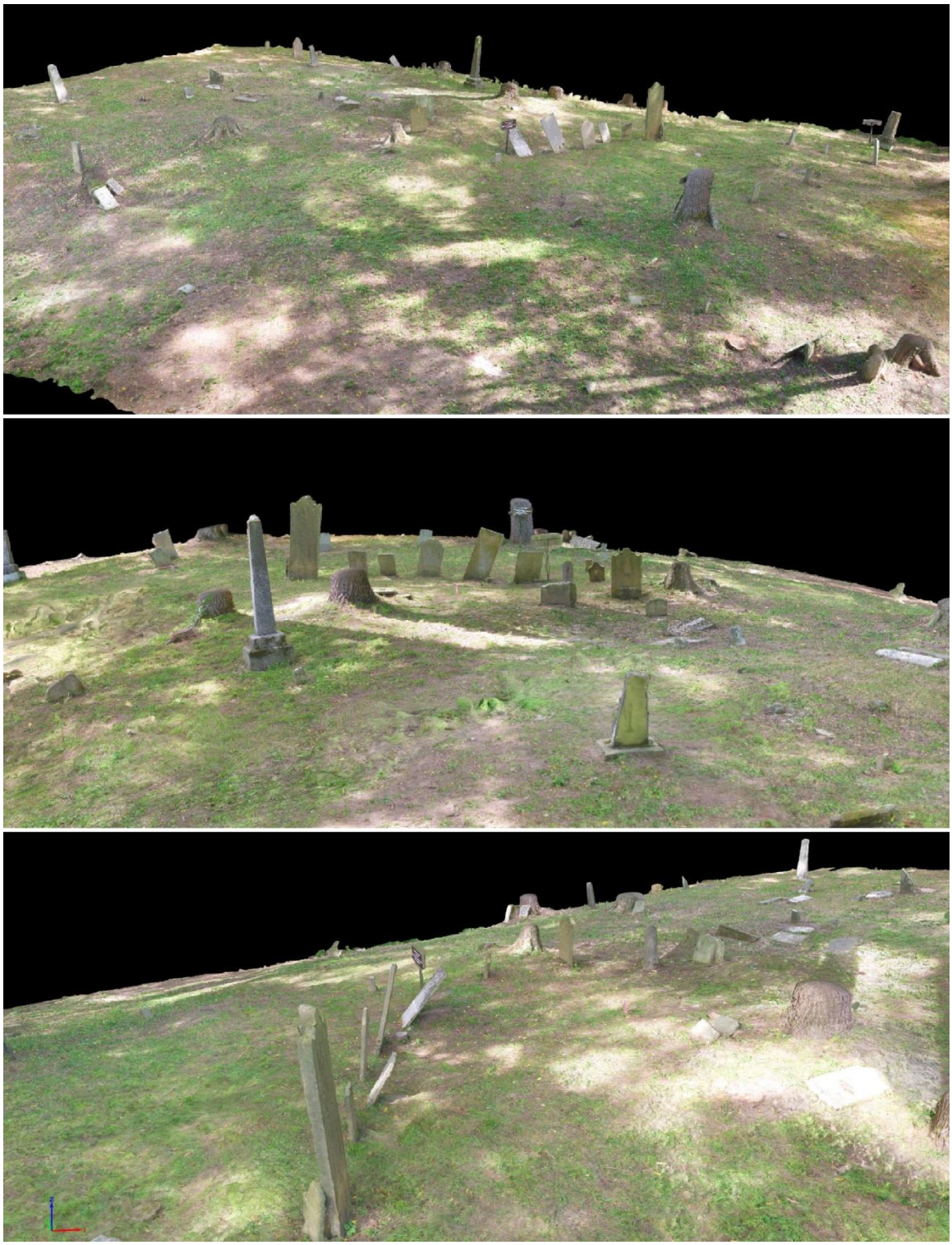


Figure 21. Examples images pulled from the 3D model of the cemetery created with the drone images.

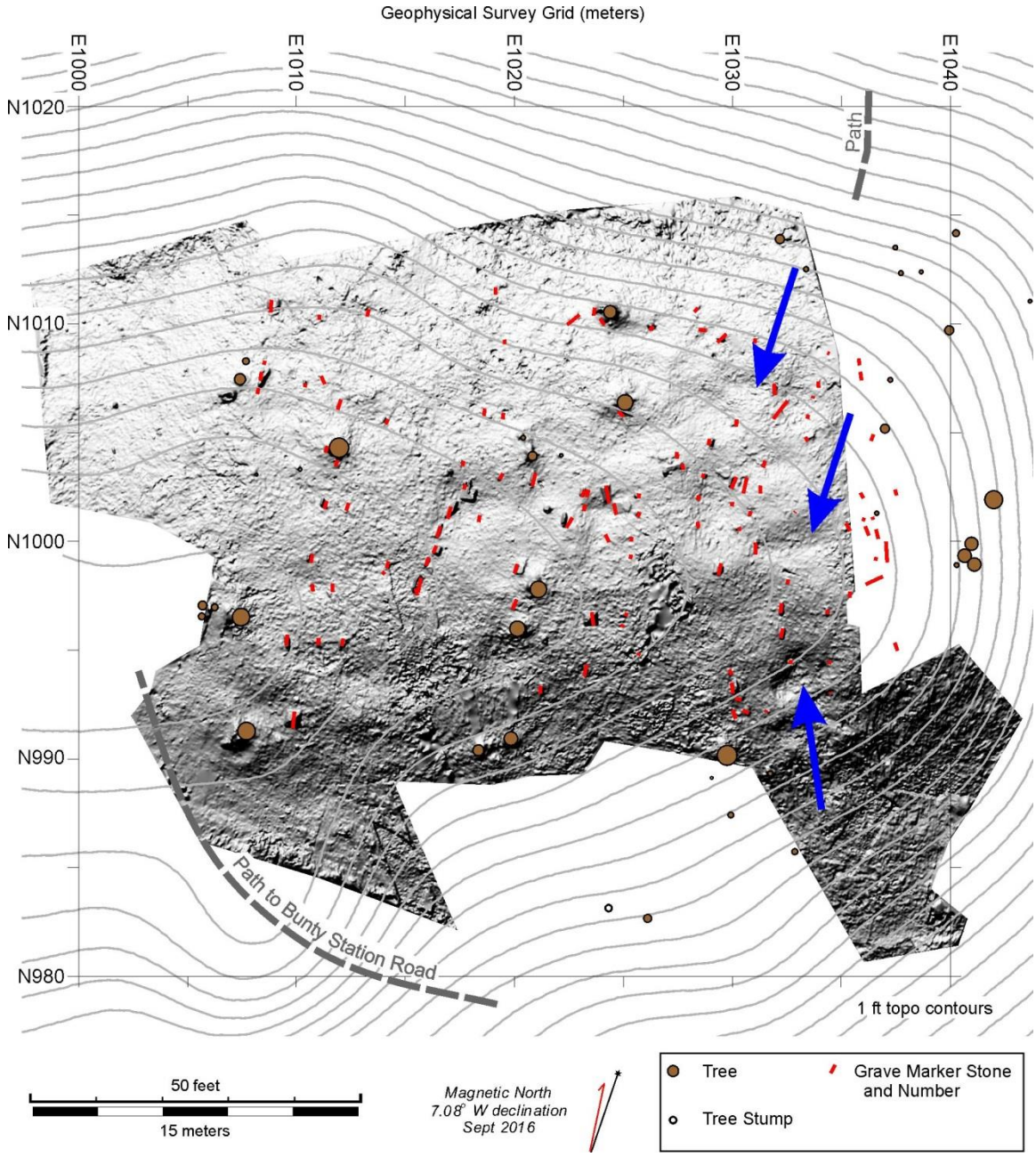


Figure 22. Shaded relief map created with photogrammetry from drone images and 3D model—note the locations of grave-sized depressions, some of which are highlighted with blue arrows.

Geophysical Survey Results

The magnetometer was the first of the instruments to be run across the site. The survey took a few hours as we attempted to cover nearly all of the cleared area, going beyond the apparent edges of the cemetery. The results are presented in Figure 23. Dark areas in the data are more magnetic and light areas are less magnetic. Remember, when

trying to make sense of magnetic data, the most common things detected at cemeteries are iron/steel objects that appear as dipolar simple and dipolar complex anomalies—strong white/black anomalies of various sizes. We can see in the Figure 23 map that there are many probable iron objects in the data. Most notable is the linear cluster of strong anomalies that appears to make a rectangle, about 79x108 ft (24x33m) in size and tilted just a bit off the main axis of the survey grid. This large rectangular feature is the remains of a wire fence. Bits of barbed wire were encountered at the surface in the northwest corner of the cemetery. More than likely, the wire was attached to wooden posts that have since been pulled out or have rotted away. The wire likely was not attached to steel posts since there are none visible in the data, and in our experience at least the bottoms of some old steel posts usually remain in the ground when fences with steel posts are abandoned.

Inside of the fence are numerous other small dipolar anomalies that are pieces of iron or steel. Some of these likely are the remains of plastic flowers, which typically have plastic-covered, steel wire stems. Unfortunately, these iron objects are scattered across the cemetery with no obvious patterns indicating rows of graves. There is a notable cluster of iron objects at the east end of the cemetery in the area of stones 58-68. Many of these stones appear to have been dumped at this location, perhaps along with other magnetic debris.

In addition to the magnetic signatures of iron objects, the magnetometer also detected a number of monopolar positive and monopolar negative anomalies that seem to be about the size of graves and are lined up in or near the marked rows. These are rather subtle in the Figure 23 map of the magnetic data. In the Figure 24 interpretive map of the magnetic survey, possible grave-related anomalies are indicated by red dashed lines. Note that at least 17 of these are directly associated with marker stones. Another seven lack an obvious marker stone and thus could be the locations of now-unmarked graves.

The magnetic survey interpretive map also includes six numbered anomalies. Anomalies 1-3 are clusters of positive and negative readings that could be associated with clusters of iron objects, burned soil, or larger areas of soil disturbance that may include magnetic rock or other distinctively magnetic objects. Anomaly 1 has a large monopolar positive component to it, suggesting an area of burning or thickened topsoil associated with a shallow pit. Anomalies 2-3 look more like clusters of iron objects. Since both are located next to a large tree, they could be the magnetic remains of debris (fence parts?) piled near the tree. Anomalies 4-6 are discrete, monopolar positive anomalies that are similar to anomalies often found to be associated precontact period American Indian pit-type features. Given the location of the cemetery—on a bluff overlooking a major stream—we might expect to find such archaeological features in the magnetic data.

The ground-penetrating radar survey also produced a range of anomalies. The radar amplitude slice map in Figure 25 shows the major radar reflections at 60-70 cm below surface. Red areas are strong radar reflections while blue are weak. In this slice map we can see that the strongest reflections appear to be associated with the trees at the west edge of the cemetery, rather than graves. Inside the cemetery there are fewer radar anomalies, but some do seem to be possible graves.

The sequence of slice maps in Figure 26 shows how the radar reflections change with depth. There are a number of small, strong reflectors close to the surface. These are the small but distinct red areas in the 10-20 cm slice map. Tree roots are strongly evident in the shallow slices and become less noticeable with depth. Grave-sized anomalies begin

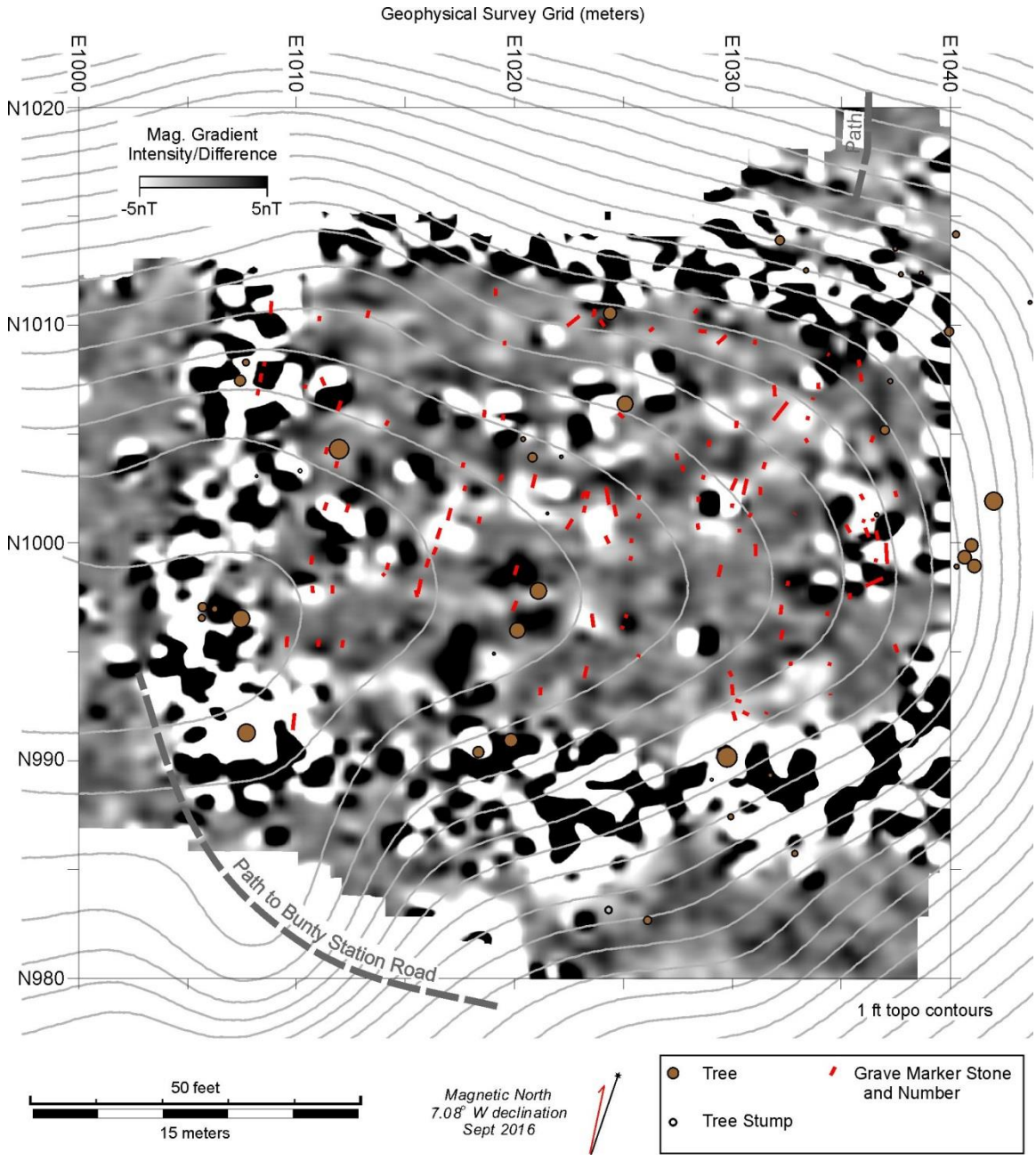


Figure 23. Magnetic survey results.

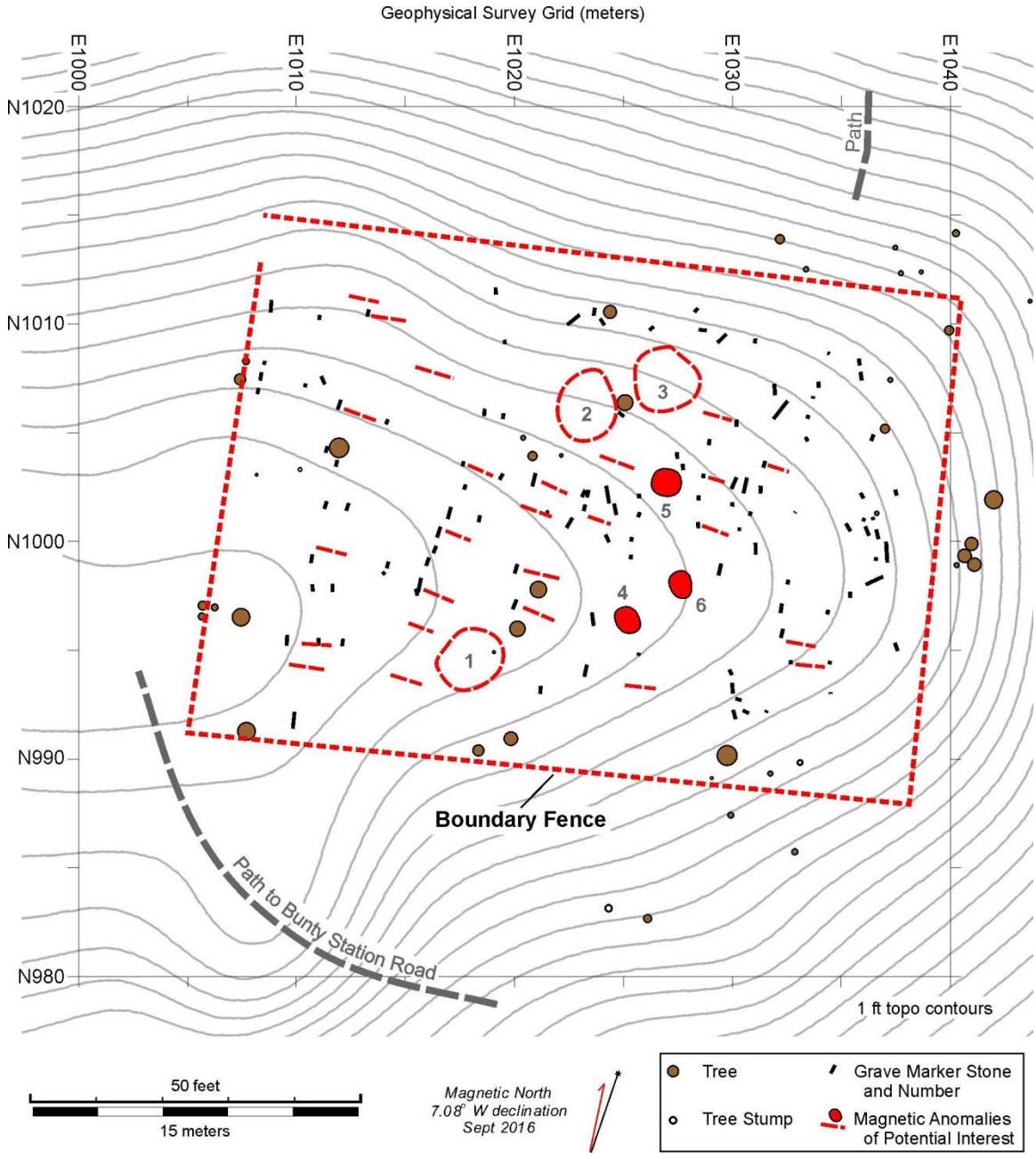


Figure 24. Magnetic anomalies of potential interest.

to emerge from the mass at about 50-60 cm below surface. However, the tree roots still make it incredibly difficult to see possible graves in the radar slice maps, even at depth.

An examination of the radar profiles also found distinct anomalies caused by tree roots. Two radargrams from the survey area are provided in Figure 27. In the top profile, tree roots appear as distinct hyperbolas (i.e., upside down u-shaped anomalies), most of which are within 50 cm of the surface. Very few tree roots were detected below 50 cm. The bottom profile in Figure 27 exhibits what likely is a grave visible in profile. Since roots are so common in the profiles above 50 cm and graves are potentially visible below

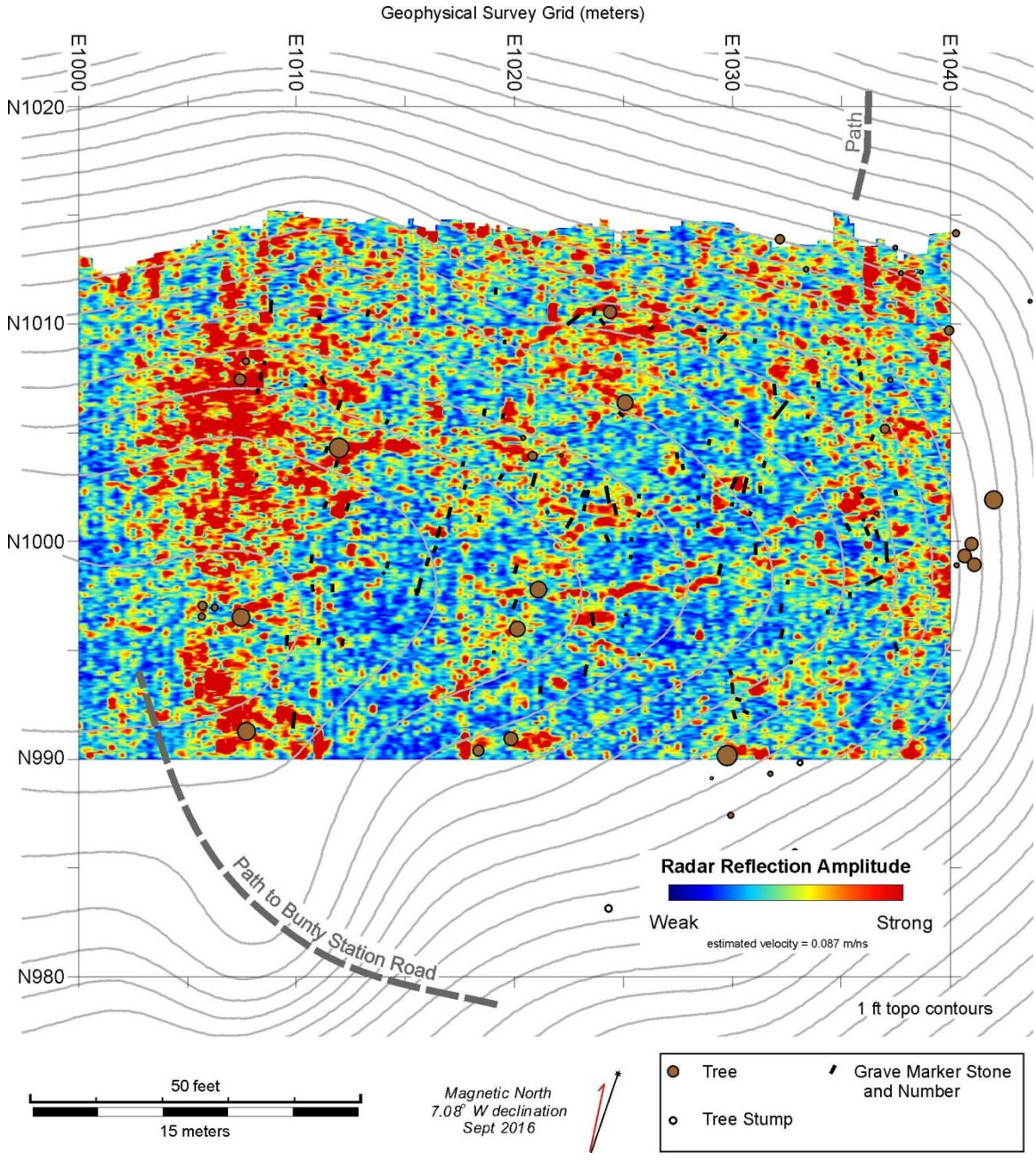


Figure 25. Radar amplitude slice map 60-70 cm below surface, detailed view.

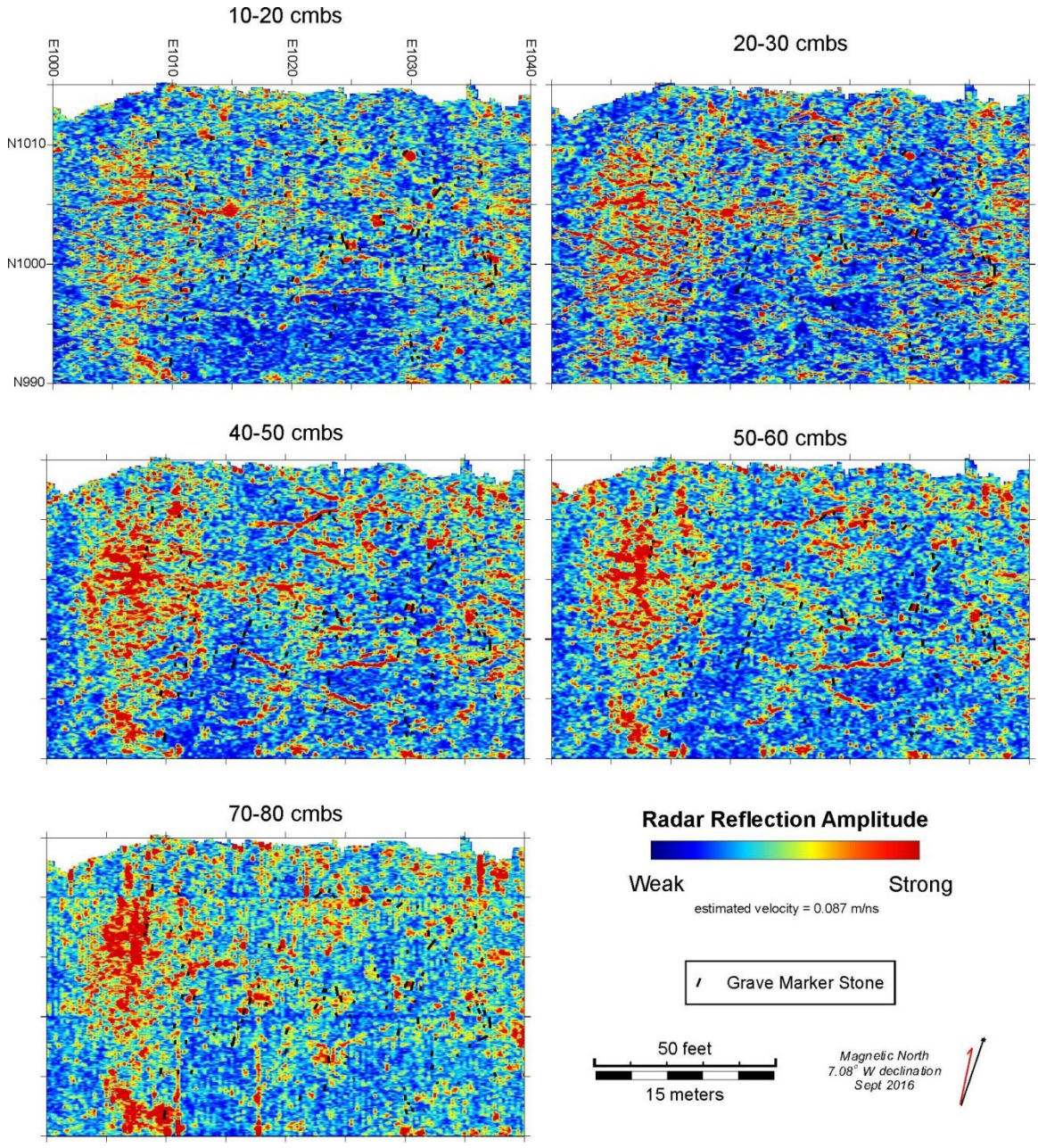


Figure 26. A series of radar amplitude slice maps at select depths.

50 cm, every radar profile was examined for possible evidence of graves below 50-60 cm. As the profiles were individually examined, every time an anomaly of interest appeared in a profile below the 50-60 cm mark, a dot was added to the site map showing its location. Using this approach, if graves are present, then they should appear on the map as short lines of dots, perhaps 4-8 dots long (0.75-1.75 m long). Figure 28 presents the final map of distinct radar anomalies visible in profile. Hundreds of anomalies (the red dots) were selected and some do line up next to one another indicating the presence of possible graves. However, most of the dots appear to be scattered across the cemetery,

occurring alone or in lines of two or three. In other cases much longer lines of dots indicate the locations of deeper tree roots.

After examining the radar profiles and amplitude slice maps, 37 anomalies of potential interest were identified in the radar data. These are divided into two types in Figure 29. Possible graves (18) are indicated by blue dashed lines. More than half of these (10) are associated with existing marker stones; eight occur without stones and could be the locations of unmarked graves. At least three of these are located at the southern edge of the cemetery, where they co-occur with trees. More than likely, these are deeper tree roots, but they could be possible graves instead. In addition to possible graves, the Figure 29 map also includes 19 possible marker stones detected in the radar data. These are the strong but small radar reflectors found in the shallow amplitude slice map and they are indicated by slightly transparent, blue fill in Figure 29. They are widespread in the cemetery but seem to occur in the major rows.

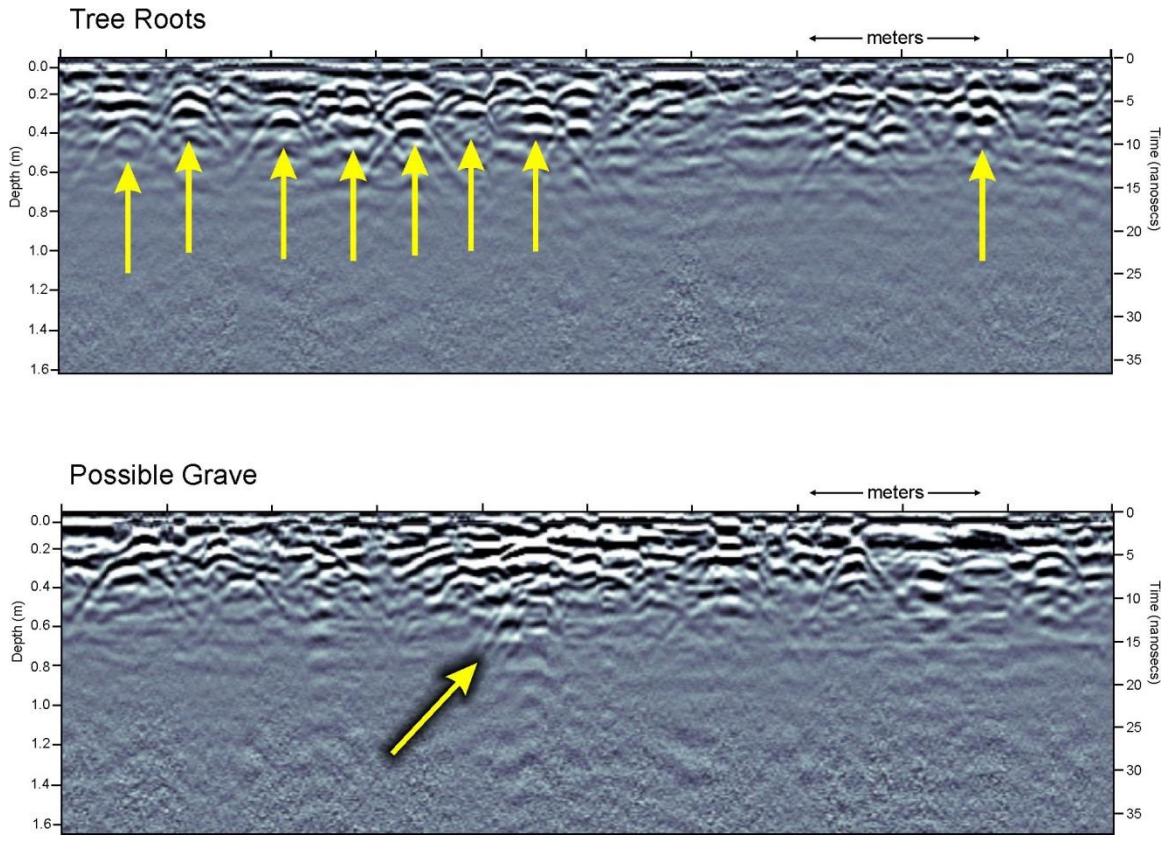


Figure 27. Two radar profiles showing how tree roots and a possible grave look in profile.

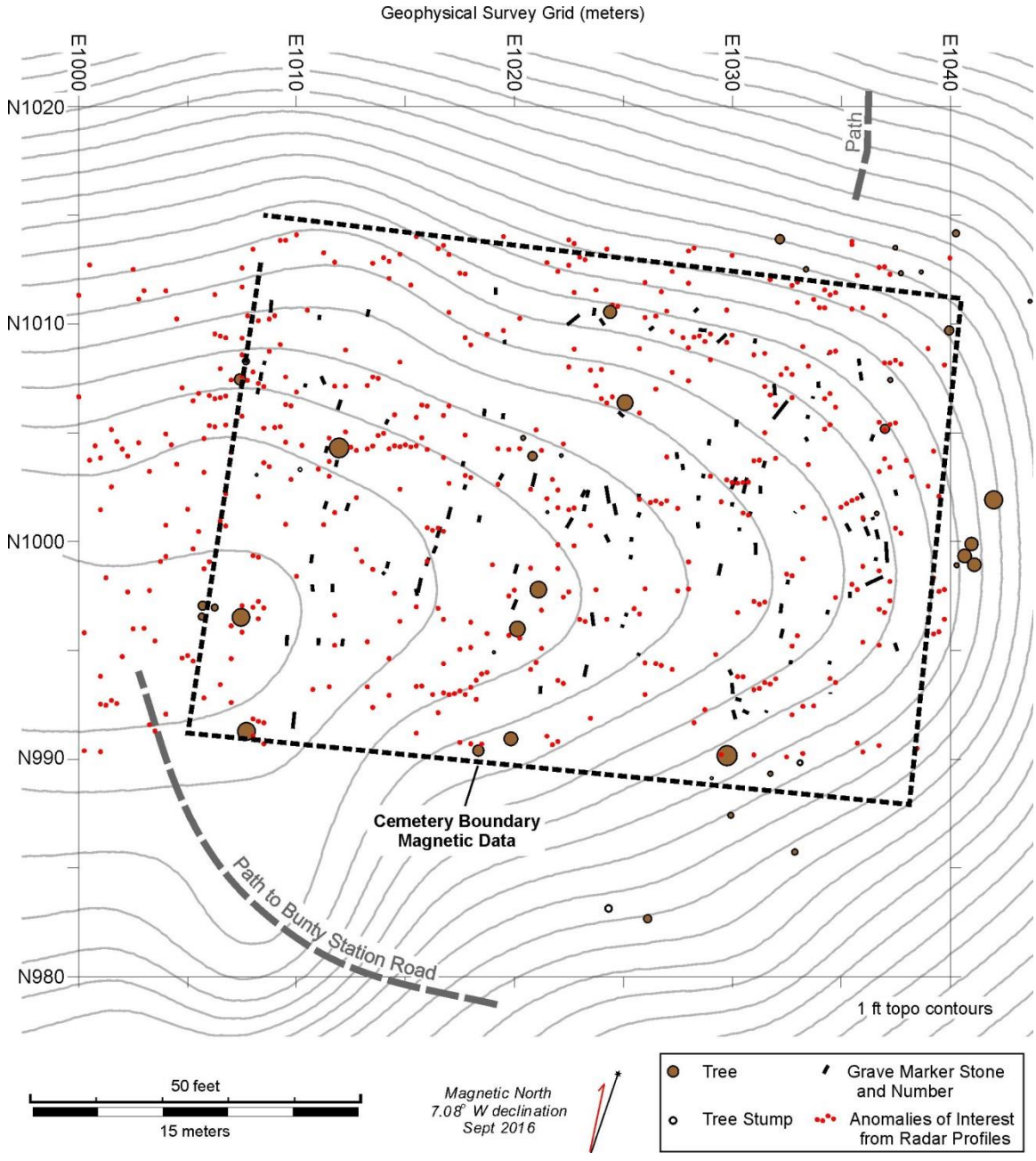


Figure 28. Locations (red dots) of distinct anomalies from an examination of all radar profiles.

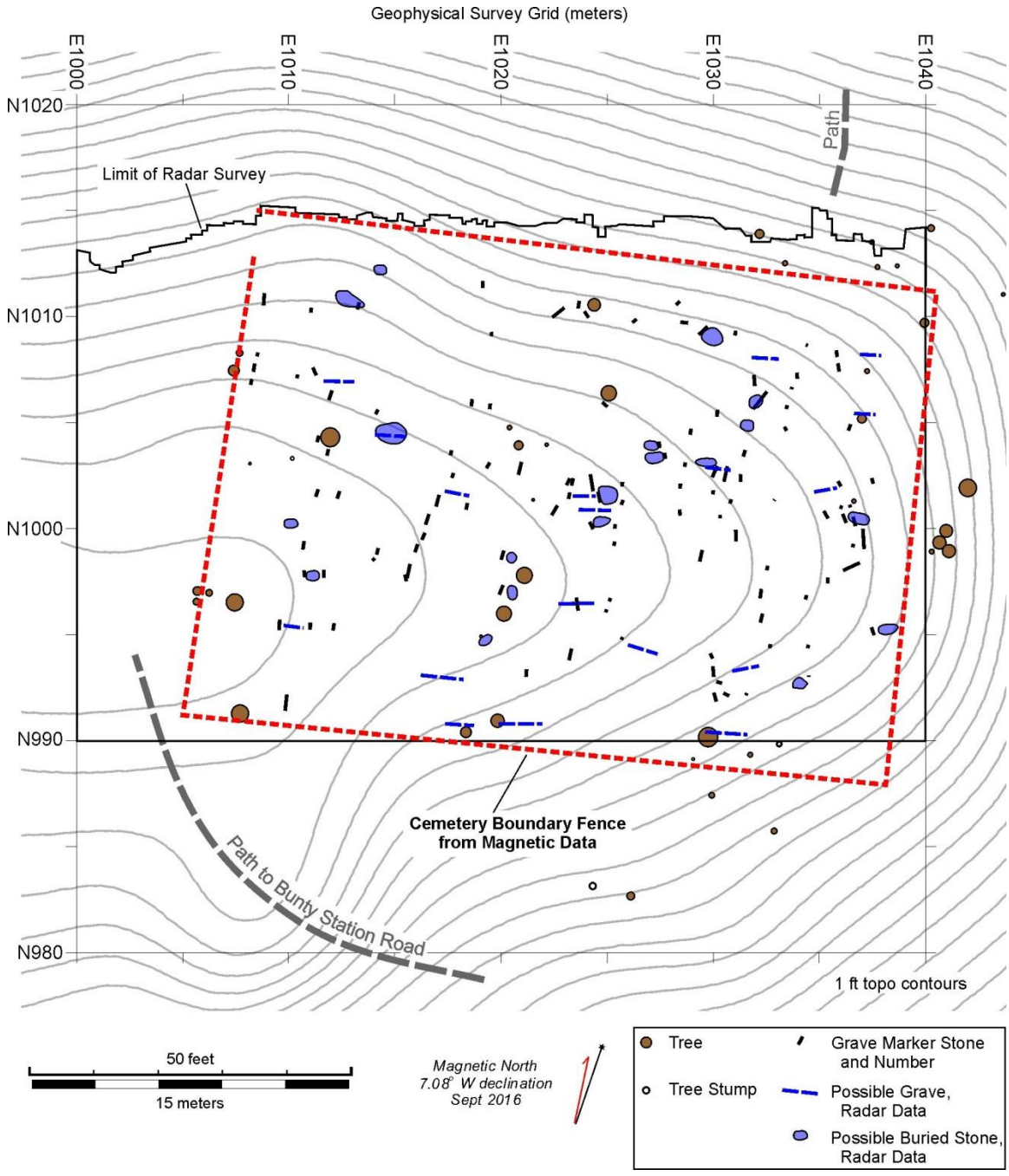


Figure 29. Radar anomalies of potential interest.

Conclusions and Recommendations

In summary, the geophysical surveys conducted at the Stratford Cemetery in southern Delaware County on August 30th and 31st, 2016 detected 69 anomalies of potential interest. These are shown together on the final interpretation map in Figure 30, including an additional 15 slight depressions identified in the 3D elevation model created with the drone photographs. Anomalies or depressions were found at 26 of the cemetery marker stones, with another 18 perhaps indicating the locations of unmarked graves. While detecting only 26 of the marked graves seems like a failure for the geophysical survey, it must be remembered that many of the graves are those of infants and children, which likely are too small to be detected. The transit mapping work identified 59 headstone/footstone pairs. This is about the number of graves determined to be present in the cemetery by most of the previous attempts to count graves. However, there also are 19 headstones or bases without footstones and 12 footstones without headstones or bases. These additional 31 markers likely mark more graves, bringing the total up to 90 based on marker stones. Adding in the possible unmarked graves from the geophysics surveys results in a final tally of 108 known and possible graves. This number is not far off the number of mapped graves or burial plots indicated in the WPA map from the 1930s.

In addition to detecting possible graves, the magnetometer also identified the remains of a cemetery perimeter fence, three larger clusters of magnetic anomalies, and three possible precontact period American Indian cooking/storage features. The fence has dimensions (79x108 ft) that correspond very closely to those mentioned by Galen Oman (75-110 ft) in 1974. However, Oman noted that no fence was visible at that time, so the fence detected in the magnetic survey was probably built some time earlier, perhaps in the 1910s or 1920s.

We can also now examine the fit between the WPA cemetery map and the various maps made during our investigations. In Figure 31 the WPA map is layered in behind the anomaly map, and it is scaled to fit the anomaly map using the perimeter line defining the outside edge of the cemetery. In this overlay, there is some agreement between what we found in our surveys and the WPA map, but it is not a perfect fit. There do seem to be geophysical anomalies and rows or clusters of marker stones that match the eleven rows of graves in the WPA map (see Figure 32). But there also are some major differences. In particular, the three angled rows of graves near the middle of the cemetery do not line up nicely with their WPA-era locations. Why this is has yet to be determined. It may be that the WPA map is incorrect, or perhaps some of the stones in the cemetery have been moved or reset, and thus are no longer in the locations they were when the WPA map was made. Another important difference is that nearly all of the marker stones from the first row of graves appear to be missing in the cemetery, today. This corner would have been closest to the orchard visible in the 1960 aerial photograph, and presumably the agricultural field or pasture that preceded it. Therefore, the first row of marker stones could have been damaged or removed by activities dating back to the late nineteenth or early twentieth century. Unfortunately, the geophysical survey instruments did not detect many of these graves in the first row.

With the new mapping results in hand, it's now time to think about next steps for the cemetery. The following are some ideas for carrying the cemetery project forward. Whatever else might be done in the cemetery, care should be taken not to damage any of

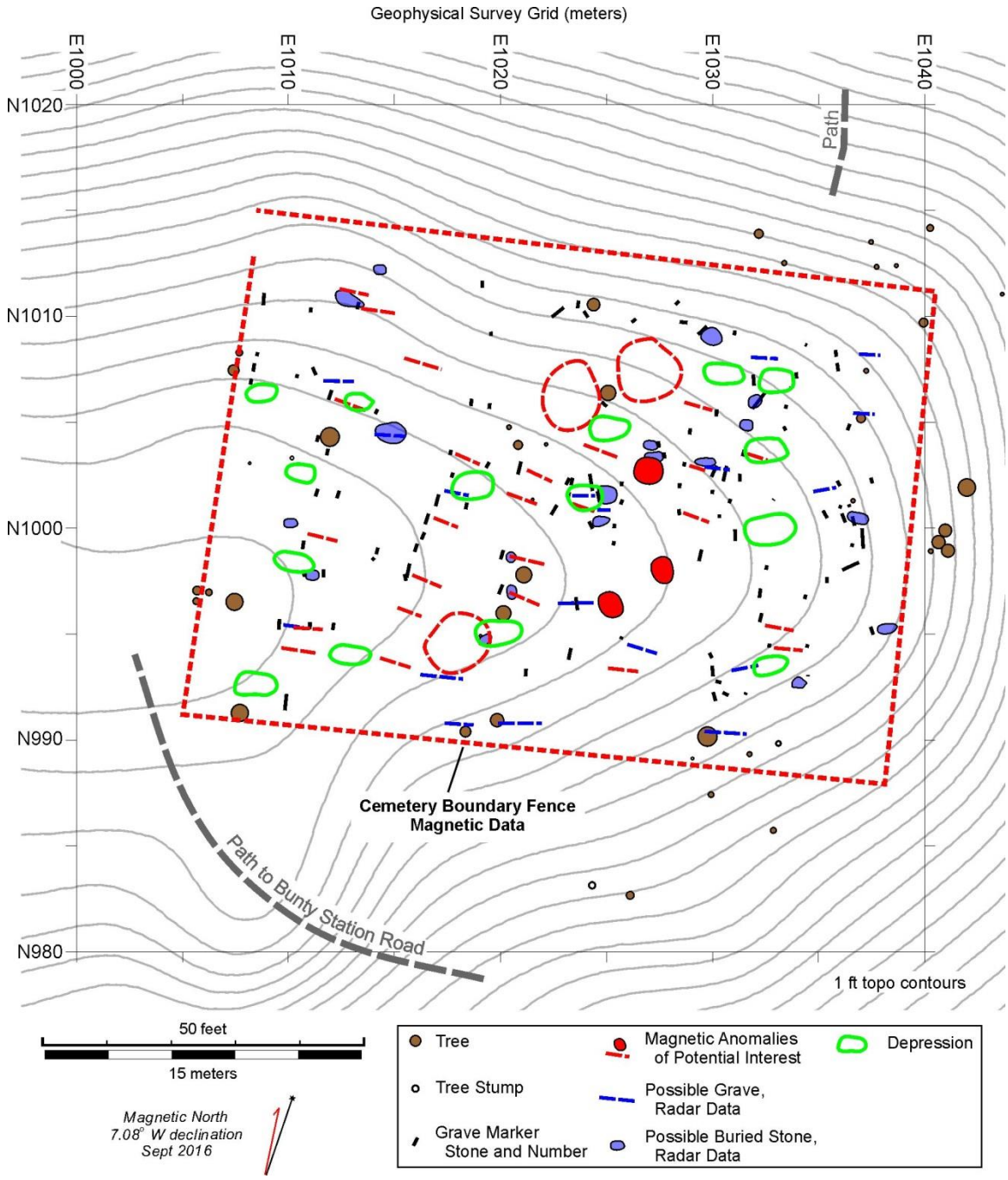


Figure 30. All geophysical anomalies of potential interest.

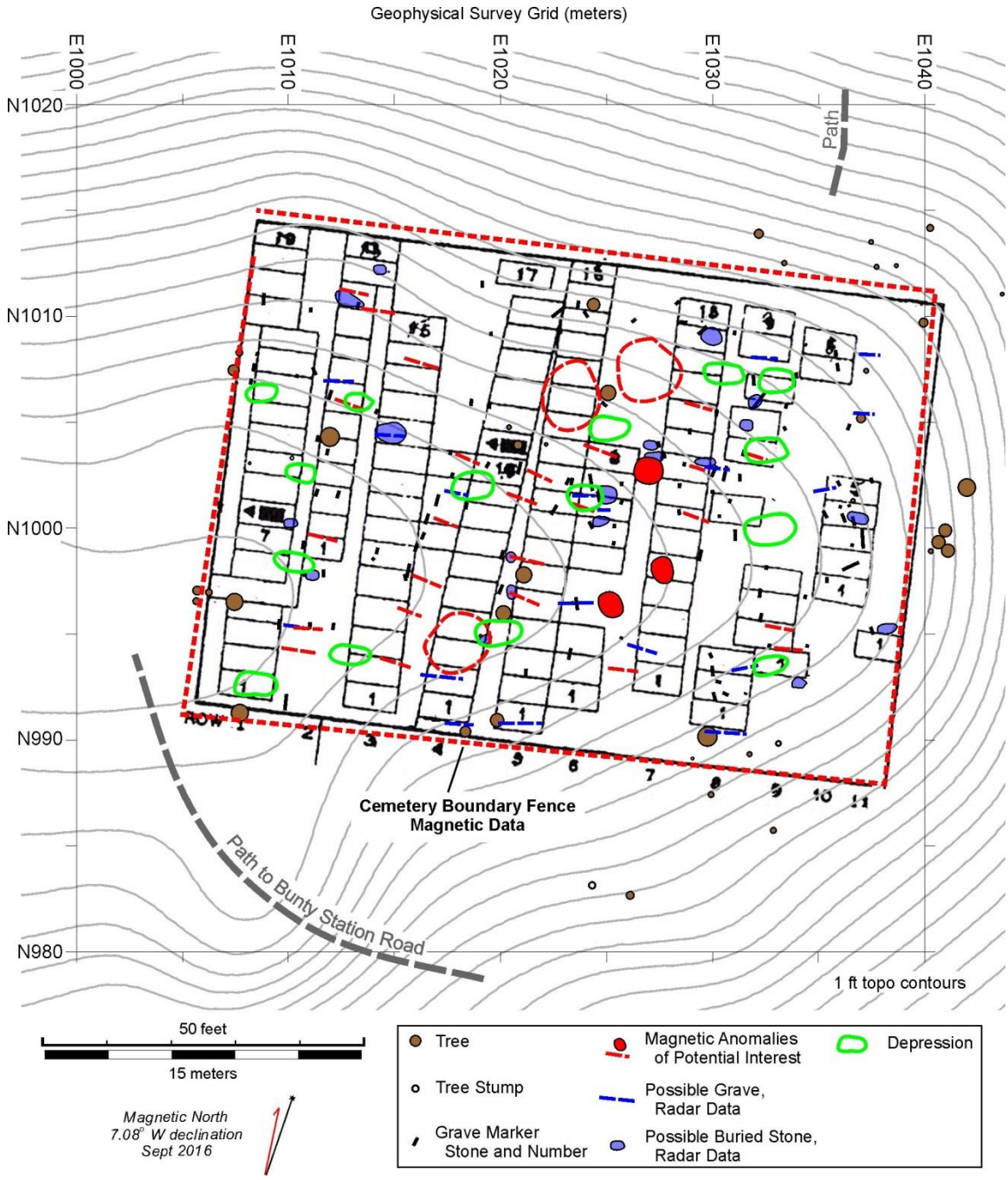


Figure 31. All geophysical anomalies of potential interest overlaid on the WPA map of the cemetery.

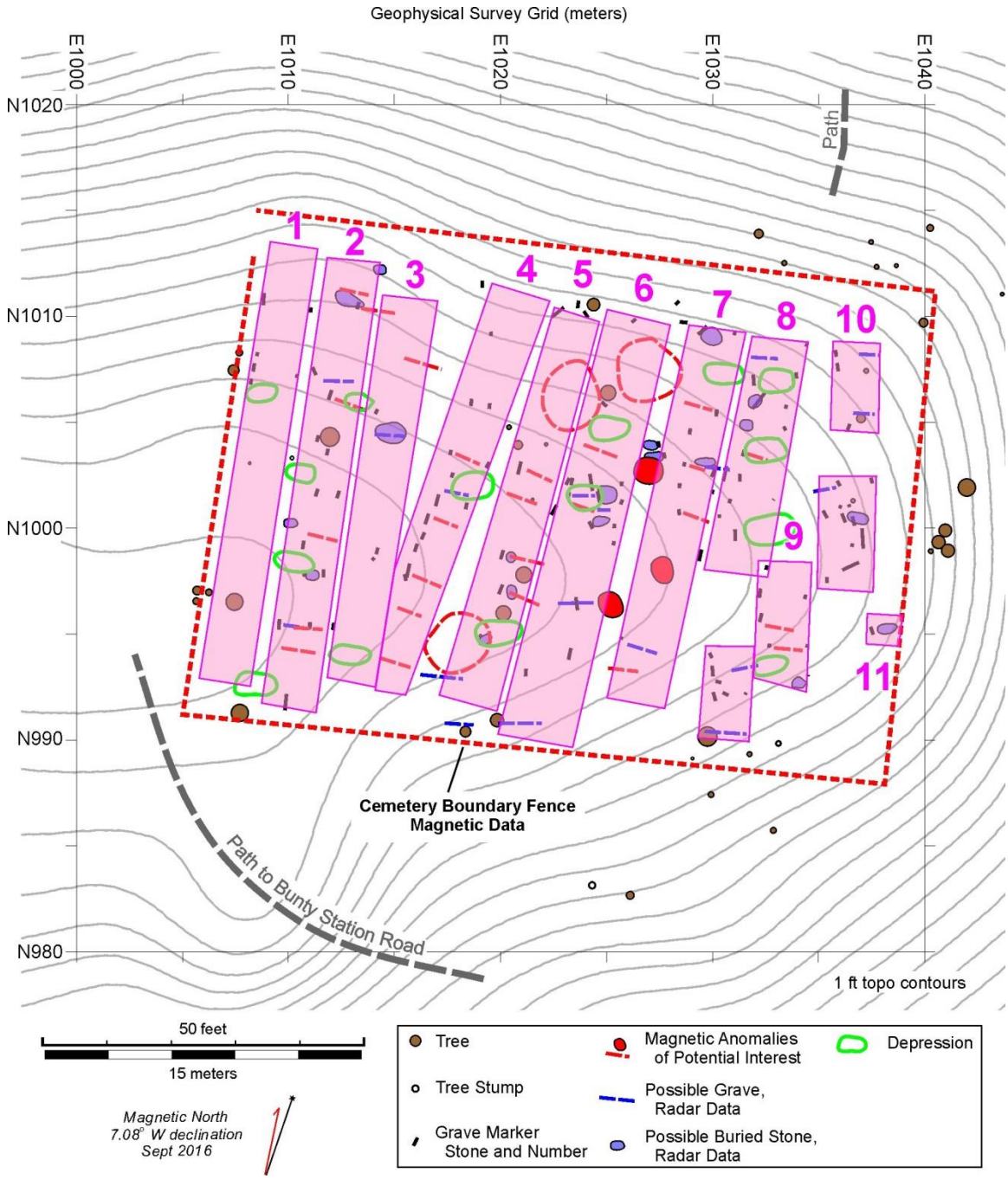


Figure 32. Stratford Cemetery grave marker and geophysical anomaly map with approximate delineation of rows (in pink).

the stones (e.g., it's easy to inadvertently damage the stones with mowing equipment) or make major changes to the cemetery without good documentation. To insure that future generations can piece back together what has happened to the cemetery, reports of project progress or particular tasks should be made and filed in the Stratford Ecological Center,

the Delaware County Historical Society, and perhaps with the Ohio Historic Preservation Office.

Proposed tasks for continued work at the Stratford Cemetery:

(1) Conserve and reset marker stones as needed. Conserving and resetting stones is no easy task. Many of the stones are quite heavy and certain kinds of treatments can cause permanent damage to the stones. Consider using an experienced company or individual when addressing stone conservation. This could be very important for the future of the monuments in the cemetery. Many of the stones in the cemetery are now lying on the ground, suggesting that they could be located some distance from their original positions. An attempt should be made to pair up headstones with their associated footstones.

(2) Mark "possible unmarked graves" from the geophysical survey. We recommend using a small but distinct type of stone marker for the possible unmarked graves. These are possible, but not definite, graves based on interpretations of geophysical data. It might be worth having an archaeologist do further testing, for example coring or shallow trenching, to determine which, if any, of these possible unmarked graves are actually graves. It is not necessary to uncover human remains to determine if a grave is present, only the grave shaft needs to be revealed and that can happen through excavations that extend down no deeper than a foot.

(3) Probing to find additional buried marker stones. Some unknown number of stones and bases lie buried beneath the ground surface in the cemetery. Some of these are in-place stones, such as bases and footstones, while others could be toppled and/or moved—especially headstones. In fact, many prone (i.e., lying flat on the ground) headstones were mapped during the transit mapping work, suggesting more likely are present. Additional prone stones could be buried as much as 8-12 inches below surface. Possible buried stones were found during the radar survey, and these are indicated on the geophysical interpretation maps. However, there likely are more buried stones in the cemetery than were detected by the radar. Probing is one technique for finding buried stones. Probing surveys should be done systematically, with probes conducted at set intervals (e.g., every foot) along evenly spaced lines (e.g., spaced 3 ft apart). Metal probes will likely be the most effective, but they can damage stones. Probing is easiest when the ground is moist. Once probing encounters a possible stone, care should be taken in excavating the probing target so that buried stones are not damaged—a stone buried in the ground may be softer and easier to damage than those above ground. Excavations should work from outside in when uncovering possible stones. Once buried stones are found, they should be added to the final cemetery map made with the transit so that their locations are not lost or forgotten.

(4) Erect a cemetery perimeter fence. At the moment, our best information for the location of a cemetery fence comes from the magnetic data, which located the remains of a wire fence measuring about 79x108 ft. This obviously is not the original cemetery fence. If the cemetery ever had a fence, it likely was a split

rail fence. We recommend erecting a wooden split rail fence with wooden fence posts spaced at 8-10 ft intervals. This fence should follow the path of the magnetic remains of the wire fence, or be placed just outside of the old wire fence. The WPA map shows a gap at the southeast corner in the rectangular line (presumably the fence?) surrounding the graves. This may be the cemetery's pedestrian access point, though it would mean accessing the cemetery from a sloped side.

(5) Erect interpretive panels. One or two interpretive panels, perhaps just outside the west side and at the east end of the cemetery, could tell the story of the cemetery, some of the individuals buried there, and the town of Stratford. Make sure panels are displayed in such a way that people of all ages, standing or seated, can read the signs. Any sign posts set in the cemetery should be excavated with great care since there may be unmarked graves present within the cemetery.

(6) Create a companion website to go along with the interpretive panels. The website could contain detailed personal profiles on the individuals buried in the cemetery, as well as some of the detailed maps from this report. Other possible subjects/material for the website include a detailed history of the property containing the cemetery, historic maps and aerial photographs showing the location of the cemetery, photographs of people (or their descendants) buried in the cemetery, and links to other genealogical resources available on the internet.

References Cited

Aspinall, Arnold, Chris Gaffney, and Armin Schmidt
2008 *Magnetometry for Archaeologists*. Altamira Press, New York.

Barker, Elizabeth, and John Tetz,
2015 Preliminary Research of the Stratford Community Cemetery and Restoration Project: A Draft for Discussion Purposes. Ms on file, Stratford Ecological Center, Delaware, Ohio
2016 Continuing Research and Restoration of the Stratford Community Cemetery: A Draft for Discussion Purposes. Ms on file, Stratford Ecological Center, Delaware, Ohio.

Beers, F. W., Ellis, and Soule
1866 *Atlas of Delaware County Ohio*. Published by Beers, Ellis, and Soule, New York.

Bevan, Bruce
1991 The Search for Graves. *Geophysics* 56:1310-1319.
1998 *Geophysical Exploration for Archaeology: An Introduction to Geophysical Exploration*. Special Report No. 1. Midwest Archeological Center, Lincoln, Nebraska.

Clark, Anthony
2000 *Seeing Beneath the Soil: Prospecting Methods in Archaeology*. Revised Edition. Routledge, New York.

Conyers, Lawrence B.
2004 *Ground-Penetrating Radar for Archaeologists*. Altamira Press, Walnut Creek, California.
2006 Ground-Penetrating Radar Techniques to Discover and Map Historic Graves. *Historical Archaeology* 40(3):64-73.
2012 *Interpreting Ground-penetrating Radar for Archaeology*. Left Coast Press, Inc. Walnut Creek, California.

Crane, Breed, and Company
1858 *Fisk's and Crane's Patent Metallic Burial Cases and Caskets*. Cincinnati.

Delaware Historical Society
2016 Garth Oberlander Barn /The Barn at Stratford. Delaware Historical Society Website. http://www.delawareohiohistory.info/?page_id=43, accessed October 12, 2016.

Duffy, Peg, and John Tetz
2015 A Cursory Reading of the Stratford Cemetery. Manuscript on file at the Stratford Ecological Center, Delaware, Ohio.

Eaton, George C., and Hugh Anderson (publishers)
1849 Map of Delaware County: Also a Part of Marion and Marrow Counties. Published by Eaton and Anderson. Map available from the Library of Congress: http://hdl.loc.gov/loc.gmd/g4083d.la000617, accessed November 11, 2016.

Everts, L. H. and Company
1875 *Illustrated Historical Atlas of Delaware County, Ohio*. Published by L. H. Everts and Company, Philadelphia.

Find-A-Grave
1999 Jonathan Dayton. Find-A-Grave Website: http://www.findagrave.com/cgi-bin/fg.cgi?page=gr&GRid=4714, accessed, October 12, 2016.
2008 James Kooken. Find-A-Grave Website: http://www.findagrave.com/cgi-bin/fg.cgi?page=gr&GScid=1982158&GRid=27883646&, accessed October 12, 2016.
2016 Stratford Cemetery: Also Known as Cole Cemetery. Find-A-Grave Website:http://www.findagrave.com/cgibin/fg.cgi?page=cr&GRid=125350957&CRid=1982158&, accessed October 13, 2016.
Forgotten Ohio
2016 Ghost Towns of Delaware County. Website. http://www.forgottenoh.com/GhostTowns/delawareco.html, accessed October 12, 2016.
Forry, David L.
1958 *A Historical Sketch of the Stratford Methodist Church and the surrounding Community of Stratford, Ohio*. Ohio Wesleyan University Digital Collections Website.http://dcollections.oberlin.edu/cdm/ref/collection/p15963coll29/id/7285, accessed October 12, 2016.
Forte, Jim.
2016 Post Offices: Ohio, Delaware County. Website Postal History. http://www.postalhistory.com/postoffices.asp?task=display&state=OH&county=Delaware&searchtext=&pagenum=3, accessed October 12, 2016
Gaffney, Chris, and John Gater
2003 *Revealing the Buried Past: Geophysics for Archaeologists*. Tempus, Stroud, England.
Haines, Michael R.
2001 *The Urban Mortality Transition in the United States, 1800-1940*. Historical Paper 134. National Bureau of Economic Research, Cambridge, Massachusetts.
Heimmer, Don H., and Steven L. DeVore
1995 *Near-Surface, High Resolution Geophysical Methods for Cultural Resource Management and Archaeological Investigations*. National Park Service, Rocky Mountain Region, Denver.
Jones, Geoffrey
2008 Geophysical Mapping of Historic Cemeteries. *Technical Briefs in Historical Archaeology* 3:25-38.
King, Julia A., Bruce W. Bevan, and Robert J. Hurry
1993 The Reliability of Geophysical Surveys at Historic-Period Cemeteries: An Example from the Plains Cemetery, Mechanicsville, Maryland. *Historical Archaeology* 27(3):4-16.
Klein, Brandon
2016 *Historic Cemetery to Undergo Radar Mapping.* The Delaware Gazette, August 24, 2016.
Kroninger, Chester A.
1991 Stratford on the River. Ms. On file at the Delaware County District Library, Delaware, Ohio.

Lowrie, William
1997 *Fundamentals of Geophysics*. Cambridge University Press, Cambridge, Great Britain.
Lytle, James R. (editor and compiler)
1908 *20th Century History of Delaware County, Ohio and Representative Citizens.* Biographical Publishing Company, Chicago.
Mills, William C.
1914 *Archeological Atlas of Ohio.* Published by the Ohio State Archaeological and Historical Society, by Frank J. Heer, Columbus, Ohio. .
Ohio Department of Development (ODD)
2000 *Delaware County: Ohio County Profiles.* Prepared by the Office of Strategic Research. Columbus.
Perrin, William Henry (editor)
1880 *History of Delaware County and Ohio.* O.L Baskin & Company, Chicago.
Platt, Deb
2016 Stratford Woods. TrekOhio.com Hiking the Parks and Preserves of Ohio. Website. http://trekohio.com/2013/03/14/stratford-woods/, accessed October 12, 2016.
Political Graveyard
2016 Jonathan Dayton. Website. http://politicalgraveyard.com/bio/dayan-deamer.html, accessed October 12, 2016.
Pope, Clayne L.
1992 Adult Mortality in America before 1900: A View from Family Histories. In *Strategic Factors in Nineteenth Century American Economic History: A Volume to Honor Robert W. Fogel.* edited by C. G. and H. Rockoff, pp. 267-296. University of Chicago Press, Chicago.
Pyle, G.F.
1969 The Diffusion of Cholera in the United States in the Nineteenth Century. *Geographical Analysis* 1(1):59-75.
Santore, Beth
2013 Cole-Stratford Cemetery, Delaware Ohio. Grave Addiction Website. http://www.graveaddiction.com/colestrat.html, accessed October 12, 2016.
Scott, Pauline
2016 Radar Imaging at Stratford's Historic Cemetery. *The Delaware Gazette* September 16, 2016.
Scott, J., and J. R. Hunter
2004 Environmental Influences on Resistivity Mapping for the Location of Clandestine Graves. In *Forensic Geoscience: Principles, Techniques and Applications*, edited by K. Pye and D. J. Croft, pp. 33-38. Geological Society Special Publication No. 232. The Geological Society, London.
Sheppard, Laurel
2016 Stratford Cemetery: Restoring a Pioneer Burial Ground in Delaware County Ohio-Based on report by John Tetz. *OGSQ* 56(2):320-334.
Siebert, Wilbur H.
1898 *The Underground Railroad From Slavery to Freedom*: The MacMillan Company, New York.

Sherman, C. E.
1925 *Original Land Subdivisions*. Volume III of the Final Report. Ohio Cooperative Topographic Survey. Ohio Department of Natural Resources, Columbus.
Stratford Ecological Center (SEC)
2016 Stratford Ecological Center Website. http://stratfordecologicalcenter.org/, accessed October 12, 2016.
Ten Eyck, Arthur
1990 Stratford Historical Sites, 1990. Buildings in Stratford that are on the National Register of Historic Places (Map). Delaware County Historical Society Photo Record Website: http://delawareohio.pastperfectonline.com/photo/37E55E1F-4DC1-45E4-93AC-978537072774, accessed October 12, 2016.
United States Department of Agriculture (USDA)
2007a Glywood Series soils description accessed electronically at: https://soilseries.sc.egov.usda.gov/OSD_Docs/G/GLYNWOOD.html, accessed 22 November 2016.
2007b Lybrand Series soils description accessed electronically at: https://soilseries.sc.egov.usda.gov/OSD_Docs/L/LYBRAND.html, accessed 22 November 2016.
Warner, Louise
2011 A series of articles recounting the history of the Stratford Ecological Center and the Warner family. Stratford Ecological Center Website: http://stratfordecologicalcenter.org/legacy/, accessed October 12, 2016.
Weymouth, John W.
1986 Geophysical Methods of Archaeological Site Surveying. *Advances in Archaeological Method and Theory* 9:311-395.
Witten, Alan J.
2006 *Handbook of Geophysics and Archaeology*. Equinox Publishing, London.

Appendix A: Expanded timeline of dates significant to the Stratford Cemetery.

August 3, 1795 With the signing of The Treaty of Greenville, Indian tribes with claims to Ohio cede two-thirds of what is to become the state to the US Government. This opens central Ohio and what would become Delaware County to Euro-American settlement for the first time (Sherman 1925:169-173).

June 1, 1796 US Congress sets aside lands for the US Military District, which are subdivided into 5 sq. mile townships, including what would become Delaware and Liberty Townships in Delaware County (Sherman 1925:93).

March 1797 Monies are appropriated by Congress for surveys of the US Military District lands (Sherman 1925).

March 20, 1800 A military warrant for approximately 4,000 acres in the 19th Range, 1st Quarter, 4th Township (Liberty), including the present-day location of the Stratford Cemetery, is awarded by President John Adams to Nicholas Gilman as payment for military service during the Revolutionary War (SEC 2016).

1801 The Liberty Settlement, a.k.a. Carpenter's Mill is established along Whetstone Creek (later renamed the Olentangy River) and south of what would become the Stratford Cemetery. It is the first Euro-American settlement in the vicinity of the cemetery (Forgotten Ohio 2016).

March 3, 1802 All lands in the US Military District uncovered by warrants (including what would become the Stratford Cemetery) are ordered surveyed into one square mile sections (640 acres) and are put up for sale with the same terms as other public lands (Sherman 1925:101).

1803 Ohio achieves statehood and subdivision of the US Military District into one square mile sections is completed (Sherman 1925:106).

1804 The first mill in Delaware County is built at Carpenter's Mill (a.k.a. the Liberty Settlement) in Liberty Township, establishing the vicinity of the Stratford Cemetery as an early manufacturing center (Forgotten Ohio 2016; Lytle 1908).

1807 Jonathan and Elnathan Scofield complete the survey of 624.25 acres in Section 1, Township 4, Range 19, including the present-day location of the Stratford Cemetery (Forry 1958; SEC 2016).

December 2, 1807 The 624.25 acre parcel including the present-day location of the Stratford Cemetery is sold to John Beard by Benjamin Ives Gilman, a representative of the land office of the Ohio Company in Marietta. John Beard soon builds a cabin on the bank of the Olentangy River within this parcel (SEC 2016).

February 10, 1808 Delaware City is founded a few miles to the north of the Stratford Cemetery (Forry 1958; Perrin 1880).

Spring 1808 John Beard and Ira Carpenter build a water-powered log grist mill west of the Olentangy River and construct a wooden dam across the river at this point near the Stratford Cemetery (SEC 2016).

February 25, 1811 A 624.25-acre parcel including the present-day Stratford Cemetery is sold by John Beard to Forrest Meeker. Meeker contracts to have a hewed-log house built on the parcel and to clear a 5-acre area of trees that John Beard had previously cut down (Perrin 1880; SEC 2016).

May 21, 1811 Forrest Meeker returns to Delaware County from Paris, Kentucky with his wife Patience and their seven children; their eighth child, Forrest Jr., is born later in Delaware City (Perrin 1880).

1811-1814 Settlers from Virginia, Pennsylvania, and Kentucky establish homesteads around Meeker's section (a.k.a. the Meeker Settlement) (Perrin 1880).

February 14, 1812 Columbus wins out in the state legislature over runner up, Delaware City to become the new state capital of Ohio (Perrin 1880; SEC 2016).

June 18, 1812 The United States declares war with Great Britain, and the state capital is moved temporarily to Chillicothe. Soon the vicinity of the Meekeer Settlement (Stratford) becomes active as U.S. military forces and supplies regularly pass through on the Chillicothe to Sandusky Road, and northward on to Detroit (present-day US Route 23). Forrest Meeker enlists with Captain Murray's Company, Cavalry, Ohio Militia, and takes part in raids into Canada. Meeker is later placed in charge of transportation of the Northwestern Army under General William Henry Harrison, and also serves as Quartermaster General of the Army. Meeker achieves the rank of Colonel. Revolutionary War Veteran, Capt. James Kooken also enlists at age 59 (Lytle 1908; SEC 2016).

August 16, 1812 With General Hull's surrender of Detroit to the British, Col. Meeker and the rest of Capt. Murray's Company return to their homes in Ohio.

1812 Col. Meeker either converts John Beard's original sawmill into a grist mill, or builds a new mill at this location to provide flour to Harrison's army.

1812-1814 General William Henry Harrison and his troops frequently camp near Delaware City, and often visit Col. Meeker on Meeker's property, which includes the present-day Stratford Cemetery (SEC 2016).

March 5, 1813 The US Secretary of War orders General Harrison and his troops to return to Harrison's headquarters at Delaware City. Harrison's men are soon joined by additional US troops from Kentucky and Virginia. This leads to an economic boom in the vicinity and Col. Meeker is said to have kept his mills running night and day grinding

wheat for the army. Later recruits from the vicinity are enlisted and horses and wagons are purchased by the army to supply the war effort to the north. In spite of rumors of an impending British and allied Indian attack, no such raid occurs (Perrin 1880; SEC 2016).

1816 Delaware City is incorporated, and the first burial is recorded on what is to become the Stratford Cemetery. The grave is for one of the Meeker children, who died at age 6 years. This is possibly Forrest Jr. or Grove Meeker, or possibly a girl (Find-A-Grave 2016; SEC 2016).

1817-1822 Burials during these six years at the Stratford Cemetery are not members of the Meeker family, and probably represent mill workers or local farmers (Barker and Tetz 2016).

September 24, 1822 Col. Forrest Meeker and his wife Patience sell 100 acres from Lot 13, including the present-day location of the Stratford Cemetery, to Capt. James Kooken, Revolutionary War and War of 1812 veteran, and the first warden of the Ohio Penitentiary in Franklinton (Find-A-Grave 2008; Perrin 1880; Barker and Tetz 2016).

1823 Capt. Kooken moves his family to Delaware County and opens a tavern three miles south of Delaware near present-day Stratford. Capt. Kooken also serves his first term as state senator. Col. Meeker builds the first brick house in the Village of Stratford, which still stands today (Find-A-Grave 2008; Perrin 1880; Barker and Tetz 2016).

.

September 8, 1823 Eleanor Porter Kooken, wife of Capt. Kooken, dies and is buried in the Stratford Cemetery (Find-A-Grave 2008; Perrin 1880; Barker and Tetz 2016; Sheppard 2016).

October 9, 1824 General Jonathan Dayton, Revolutionary War veteran and member of the US Continental Congress and New Jersey Delegate to the Constitutional Convention, purportedly dies at Capt. Kooken's home in Stratford and some suggest that Gen. Dayton may have been buried in the Stratford Cemetery (Barker and Tetz 2016). Other references indicate Gen. Dayton died and was buried in his hometown of Elizabethtown (now Elizabeth), New Jersey (Find-A-Grave 1999; Political Graveyard 2016). Nevertheless, Gen. Dayton did have extensive land holdings in Ohio, and may well have visited Capt. Kooken in Stratford at some point. However, there is no evidence to suggest that Gen. Dayton is buried there.

1829 Col. Meeker adds facilities for carding and filling enabling his flour mill to also serve as a woolen mill (Lytle 1908).

1833 Capt. Kooken sells his property, including the Stratford Cemetery, and moves out of Stratford to found the community of Bellpoint (Barker and Tetz 2016; Sheppard 2016).

1838 Caleb Howard and Judge Hosea Williams purchase Meeker's flour mill near the Stratford Cemetery and replace the old wooden dam on the Olentangy River with a new stone structure (Lytle 1908).

October 1, 1839 Meeker's old flour mill is converted by Caleb Howard and Hosea Williams into a paper mill (Lytle 1908).

June 3, 1840 Capt. Kooken dies and is buried in the Stratford Cemetery but the exact location of his grave or his grave marker is not known (Barker and Tetz 2016; Find-A-Grave 2016).

October 30, 1840 A fire does considerable damage to the interior of the paper mill, which is repaired and improved and returns to operation within three months (Lytle 1908).

1841 John Hoyt, Superintendent of the paper mill, names the growing community of mills and worker houses "Stratford," in honor of Stratford-on-Avon, England (Lytle 1908). This name appears on the first county atlas (Figure 4). The cemetery first appears on the 1866 atlas, and is shown again on the 1875 atlas (Figure 5).

May 29, 1843 Patience Meeker, the first wife of Col. Forrest Meeker dies at age 72 and is buried in the Stratford Cemetery (Find-A-Grave 2016).

July 4, 1844 The Stratford Methodist Episcopal Church is dedicated. It is built by the local community with local stone and materials donated by mill owners Judge Hosea Williams and Hiram (H.G) Andrews on land 1000 ft northeast of the Stratford Cemetery. The land was provided to the Methodists by Col. Meeker (Forry 1958; Lytle 1908).

Fall 1844 Caleb Howard sells his interest in the paper mill to H. G. Andrews (Lytle 1908).

April 25, 1845 Col. Meeker and his second wife Sivona (a.k.a. Livonia, Loevina, Levina, and Lavina), sell their property in Stratford to George Bieber, and move to the City of Delaware (SEC 2016).

1846-1847 Rev. H.E. Pilcher holds popular revivals at the Stratford Methodist Church, which soon has more members in its congregation than any other religious organization in Delaware County (Forry 1958).

ca. 1848 George Bieber builds the Garth Oberlander stone barn near the Stratford Cemetery (Delaware Historical Society 2016).

1849 The paper mill near the cemetery is converted to making wrapping paper, producing about one-half ton per day. It is a leader in paper production at this time (Lytle 1908).

March 16, 1849 Col. Meeker dies at age 80 and after a memorial service at the Stratford Methodist Episcopal Church is buried in the Stratford Cemetery (Forry 1958).

October 30, 1849 The paper mill burns down but is soon rebuilt (Lytle 1908). Five individuals are buried in the Stratford Cemetery in 1849. This is the highest number recorded for any year at the cemetery, which averages less than one recorded burial per year from 1816 to 1888 (Barker and Tetz 2015).

1850 Judge Hosea Willams and H.G. Andrews lay out the settlement at Stratford, which consisted of 17 lots (Barker & Tetz 2016). The size of the congregation at the Stratford Methodist Episcopal Church is in excess of 100 people. The Village of Stratford post office opens (Forte 2016).

1851 The Cleveland-Columbus-Cincinnati Railroad comes to the area and Bunty Station is built. The paper mill is converted to run on steam power derived from coal brought to the area by the railroad (Lytle 1908).

February 27, 1857 The paper mill burns again and is replaced with a 2-story stone structure (Forry 1958).

March 1862 Peter Kroninger, the only Civil War Veteran documented in the Stratford Cemetery dies. Peter enlisted Oct. 1, 1861 as a Private in Company B, 48th O.V.L. and was mustered out March 15, 1862 (Sheppard 2016).

1866 F.W. Beers' (1866) *Atlas of Delaware County* includes a map of Stratford Village with 19 separate parcels (Figure 6). The map shows the church, houses, businesses, and the paper mills owned by Hiram Andrews & Norman Perry. The approximate location of the Stratford Cemetery is indicated on the county-wide atlas but not on the Stratford Village map.

By 1867 Industrial competition and growth in both Columbus and Delaware City lead to a series of lawsuits over water rights and the dams on the Olentangy River. This, combined with economic losses due to fires and difficulties obtaining cheap labor, negatively impacts manufacturing at the Village of Stratford. There is a decline in work and in the local population; the minister at the Stratford Methodist Church leaves his parsonage due to a declining congregation. Subsequent preaching for the people remaining in Stratford was done by retired ministers, itinerant preachers, laymen, or students from Ohio Wesleyan University (Forry 1958).

By 1871 J.H. Mendenhall buys into the Andrews and Perry paper mills. These mills continue to manufacture print and book papers as well as wrapping papers on the site of Col. Meeker's former flouring mill, but they continue to struggle economically (Lytle 1908).

By 1875 V.T. and C. Hills take over the paper mills at Stratford, but most of the mill working jobs have gone, and most residents in the surrounding area return to farm work (Forry 1958).

1876-1877 James and Henry Bieber (sons of George Bieber) build a 3 ½ story stone mill (the Bieber Mill), which houses a saw mill on the first floor. The second and third floors are supposed to be used for other milling activities but these upper floors are never used. Remains of this mill are still standing today.

1877 The Hills Paper Company is formed and operates the paper mill for five more years (Lytle 1908).

1882 The Hills Paper Company sells the business and property to the Columbus, Delaware, and Marion Railway, who converts the paper mill into a power house (Lytle 1908).

1888 **"**Bauder, Infant, d. Oct. 1888" is the last recorded burial in the Stratford Cemetery, after which the cemetery is apparently no longer used. Nevertheless, it has been estimated by Barker and Tetz (2016) that over 70% of the identified burials at this cemetery date between 1844 and 1888, and they probably involved burial services performed in conjunction with the Stratford Methodist Episcopal Church (Barker and Tetz 2015).

March 9, 1889 The Bieber Mill is auctioned off to satisfy debts incurred by James Bieber, and while it has a series of subsequent owners the former mill never operates again; manufacturing activities in the Village of Stratford go into sharp decline.

By 1896 Milling and manufacturing activities come to an end at the Village of Stratford.

1900 The US Post Office at Stratford closes after 50 years of operation (Forte 2016).

May 9, 1914 A lawsuit is filed with the Court of Common Pleas, Delaware County by the Plaintiff (Olentangy Valley Chapter of the Sons of the American Revolution) concerning the status of the Stratford Cemetery located on a 50-acre tract owned by the Defendant (landowner, F.F. Greene). The Plaintiff claims the cemetery is a public burial ground, while the Defendant denies that the alleged graveyard was, or ever had been, a public burying ground. The Sons of the American Revolution want to restore the graves of veterans from the Revolutionary War and War of 1812 in the cemetery, but are denied access by the landowner to do this (Barker and Tetz 2016).

March 2, 1915 An answer is filed with the Court of Common Pleas, Delaware County that the Stratford Cemetery is and will remain a private burial ground (Barker and Tetz 2016).

January 17, 1916 The Court of Common Pleas, Delaware County denies that the Plaintiff (Olentangy Valley Chapter of the Sons of the American Revolution) is entitled to relief damage for the Court's overrule of a petition for a new trial. No subsequent appeals are filed, so the Stratford Cemetery's status remains officially as a private burial ground (Barker and Tetz 2016).

1933 The Columbus, Delaware & Marion Railroad goes out of business, and the former 3½ story mill/power house is bought by a plastics company (Forgotten Ohio 2016).

1936-1938 The Stratford Methodist Episcopal Church is completely closed due to structural deficiencies, a dwindling congregation, and the lack of a permanent minister (Forry 1958).

January 15, 1939 The Stratford Methodist Episcopalian Church re-opens after being remodeled and electrified, and religious services are once again held there (Forry 1958).

ca. 1939 The Depression Era Works Progress Administration (WPA) Historical Records Survey (HRS) conducts a survey and produces a map of the "Cole" (Stratford) Cemetery (Figure 7).

1940s During and immediately after World War II, there is a revival of sorts of the congregation at the Stratford Methodist Episcopal Church. The property undergoes a series of improvements and the congregation is led by a series of ministers (Forry 1958). In spite of this there is no indication that the Stratford Cemetery was used for any church functions or burials during this period.

1941 Garth Oberlander, an Ohio Wesleyan University graduate, buys the former property of Col. Meeker and George Bieber. Oberlander farms the land and eventually opens a very successful antique business in Stratford in the early 1950s (Delaware County Historical Society 2016).

1953 Galen Francis Oman purchases 236 acres of pasture, farmland, and orchard from the Oberlander family in Liberty and Delaware Townships, including the Stratford Cemetery, with the intent of establishing an upscale development and golf course. Health issues prevent Oman from proceeding, so he turns to preserving the land. The pasture and orchard were allowed to succeed to forest, while the tillable ground continues to be farmed (SEC 2011; Scott 2016). The scale of the orchard is evident in a 1960 aerial photo (Figure 8, top), and its return to forest is clear in a 1988 photo (Figure 8, bottom).

1956 Carl and Florence Main document 46 burials at the Stratford Cemetery probably by inventorying inscriptions on headstones (Barker and Tetz 2016). Discussions are held to merge the Stratford Methodist Episcopalian Church with St. Paul's Methodist Church in the City of Delaware to address issues of structural deficiencies and small congregations at both churches (Forry 1958).

1958 The last worship services are held at the Stratford Methodist Episcopalian Church. Stratford Methodist Episcopalian Church merges with the St. Paul's Methodist Church and builds a new church half way between the City of Delaware and the unincorporated Village of Stratford (Forry 1958).

1972 Esther Weygandt Powell of Akron, Ohio compiles tombstone inscriptions and records for the Stratford Cemetery from Delaware County records that were copied in the 1940s (Barker and Tetz 2016).

September 1974 As per a written document**,** Galen F. Oman estimates the size of the Stratford Cemetery to be about 75 feet by 110 feet, though the area is not fenced in or clearly marked at that time (Barker and Tetz 2015).

1980 The plastics company near the former 3½ story mill burns down and goes out of operation (Forgotten Ohio 2016).

September 26, 1986 Gale Warner, granddaughter of Galen Francis Oman, drafts a step-by-step plan for creating a non-profit educational center, originally called the "Buttonwood Project" to preserve the family farmland, which leads to the formation of the Stratford Ecological Center, a non-profit educational organic farm and nature preserve (Warner 2011).

1987 The Division of Natural Areas and Preserves of the Ohio Department of Natural Resources (ODNR) proposed placing a conservation easement on 95 acres of the forest and buttonbush swamps, to be designated the "Stratford Woods State Nature Preserve" (Warner 2011).

1990 Arthur Ten Eyck (1990) produces a map of the extant buildings and ruins in the Village of Stratford that are eligible for listing on the National Register of Historic Places (NRHP); however, the Stratford Cemetery is not depicted on this map, nor is it considered eligible for nomination to the NRHP (Delaware County Historical Society 2016).

October 1990 Articles of Incorporation for the Stratford Ecological Center are filed with the State of Ohio (Warner 2011). The Stratford Ecological Center begins maintenance of the formerly abandoned Stratford Cemetery (Klein 2016).

1991 Chester A. Kroninger (1991), a decedent of Peter Kroninger, authors a report titled, *Stratford on the River,* which documents the Stratford Cemetery as covering .2 acre with 126 gravesites and an estimated 45 burials (Sheppard 2016). The Stratford community, including the remnants of the log, grist, and paper mills in the area as well as extant farms, are listed on the National Register of Historic Places (NRHP). However, the Stratford Cemetery is not included with this NRHP listing (Barker and Tetz 2016).

March 1991 The Stratford Ecological Center receives official 501(c)(3) status (SEC 2012). Mary and Galen Francis Oman contribute 236 acres of land as well as funds for the Center's educational building. The Stratford Ecological Center becomes the second privately owned nature preserve in the State of Ohio (Platt 2016; Warner 2011).

October 21, 1993 The first group of school children visit the Stratford Ecological Center to learn where their food and fiber come from, and to reconnect with the wonders of the natural world (Warner 2011).

November 1994 George and Marilyn Cryder, Larry Dulin, Crystal Kohler, Dee Tiberi, and Rachel Zook copy information from extant grave makers at the Stratford Cemetery (Barker and Tetz 2016).

Fall 2013 Stratford Ecological Center volunteers, John Tetz and Liz Barker begin compiling research on the Stratford Cemetery in preparation for a cemetery restoration project (Klein 2016).

Fall 2014 John Tetz and Liz Barker (Barker and Tetz 2015) note that less than 15 gravestones in the Stratford Cemetery are legible. However, they also note that some gravestones have been broken or have fallen over while others may be covered up that could still be legible.

September 28, 2015 Peg Duffy and John Tetz (2015) conduct another cursory reading of 23 headstones at the Stratford Cemetery.

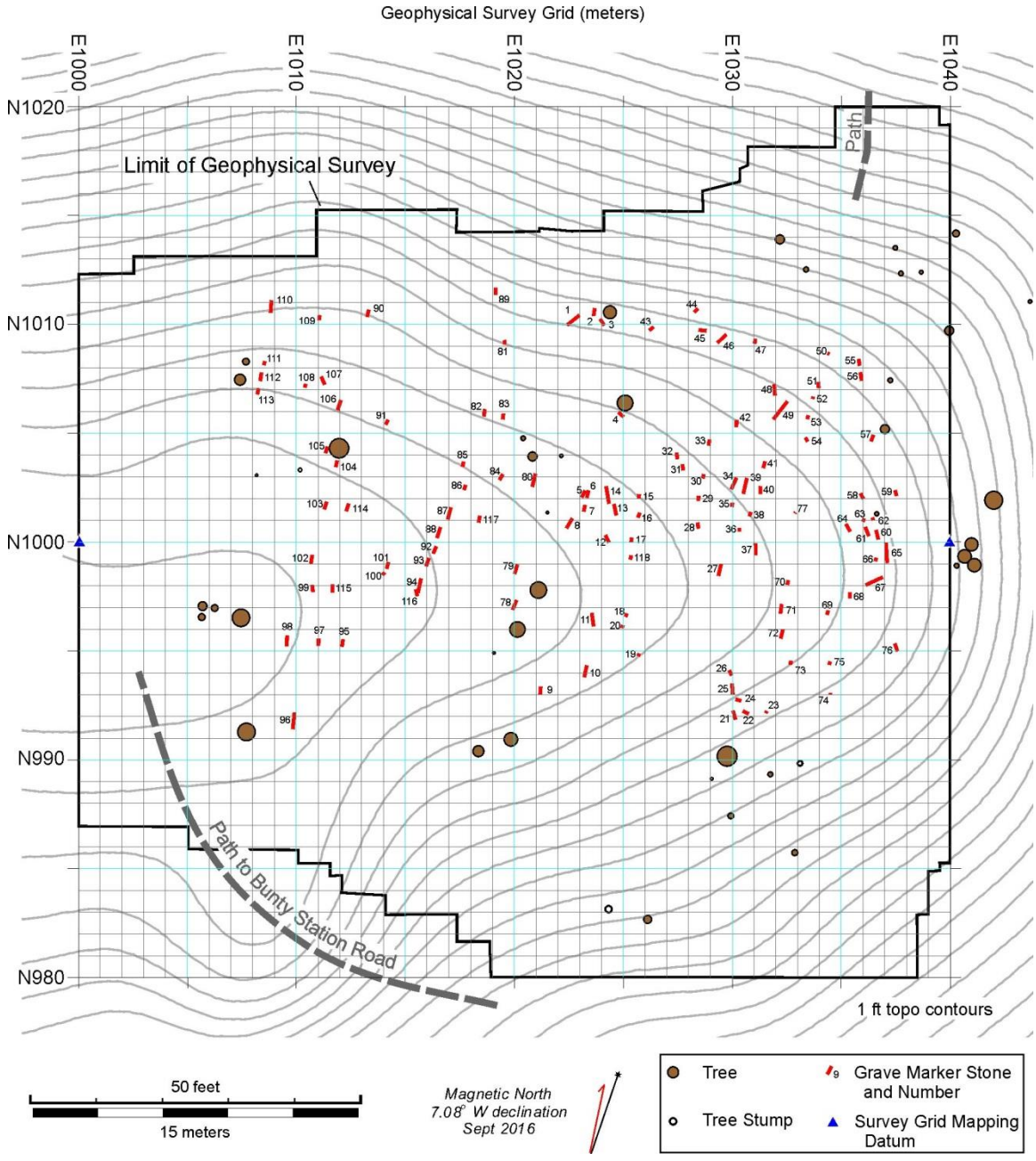
October 9, 2015 Liz Barker and John Tetz (2015) identify three iron stakes at the corners of the Stratford Cemetery measuring 60 feet by 103 feet (Barker and Tetz 2015).

Fall 2015 Stratford Ecological Center Volunteer Bill Swoager clears about 20 trees, honeysuckle, and poison ivy from the Stratford Cemetery in preparation for geophysical survey (Klein 2016).

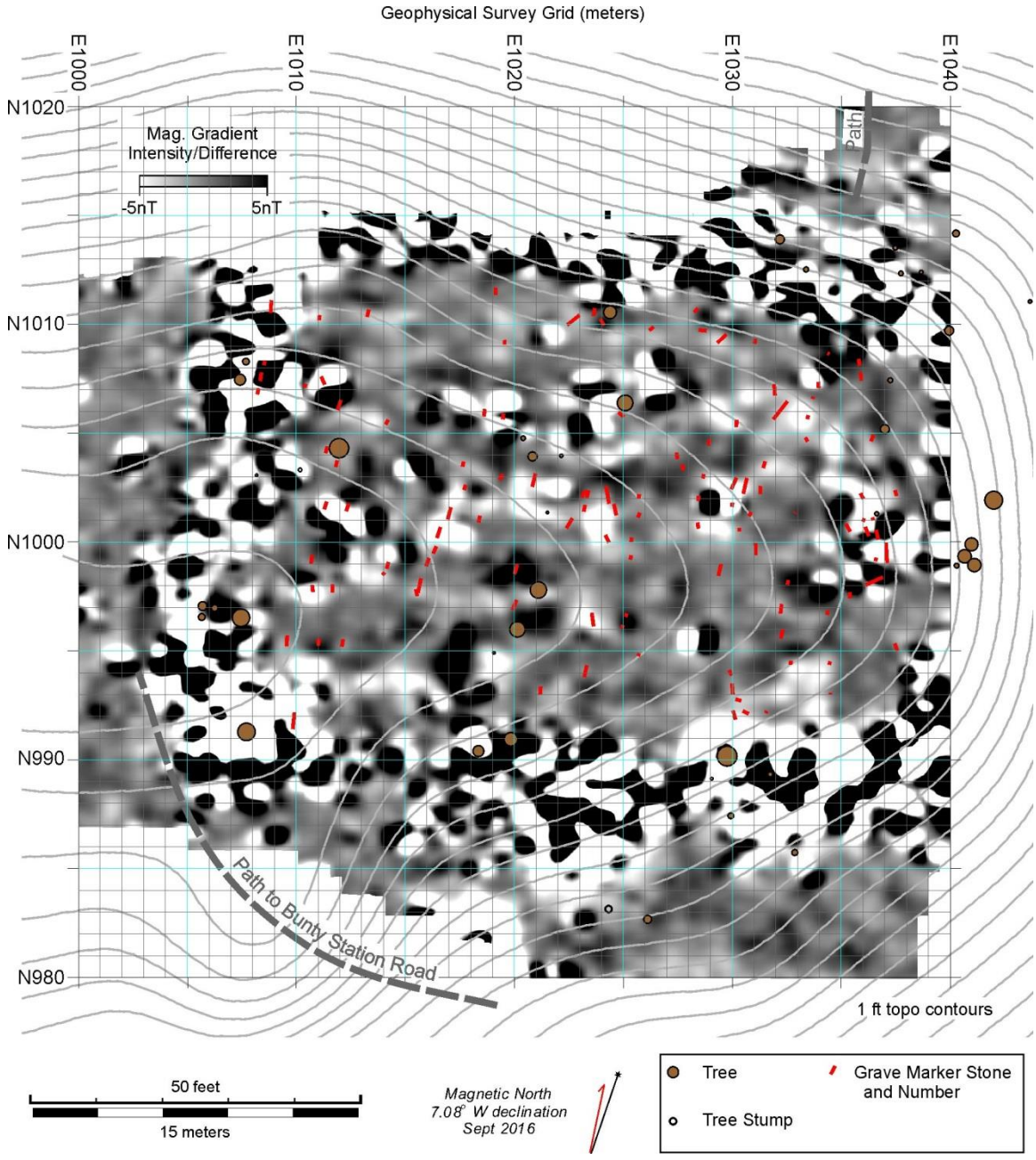
2016 Laurel Sheppard, Ohio Genealogical Quarterly (OGSQ) Assistant Editor, provides a total estimate of 59 burials at the Stratford Cemetery, which she compiled from multiple sources with death dates ranging from 1816-1888 (Sheppard 2016). In contrast, The Find-A-Grave website (2016) lists 68 burials for the Stratford Cemetery.

Appendix B. Data and interpretation maps with a 1-meter grid overlay.

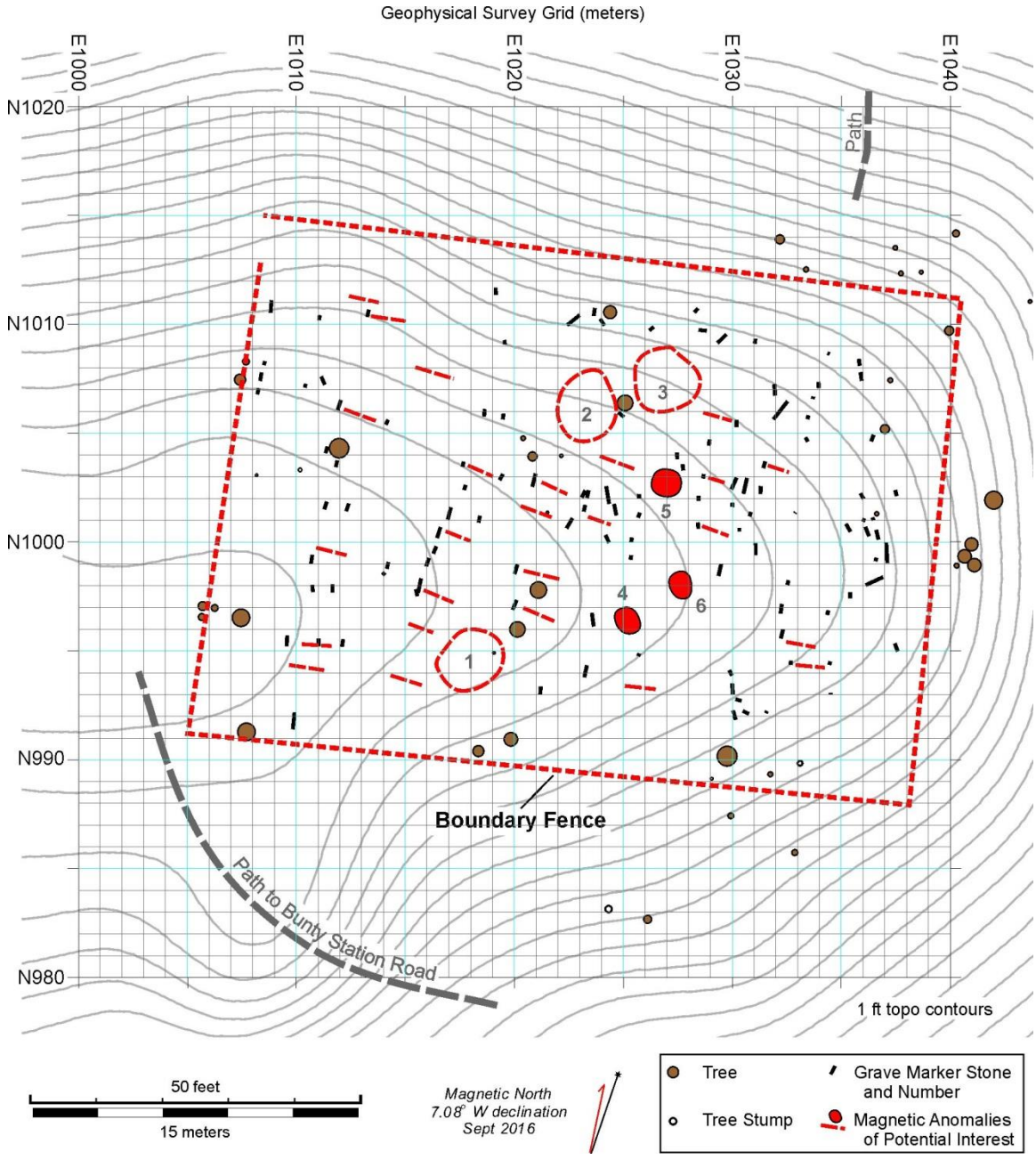
Numbered Stones Map



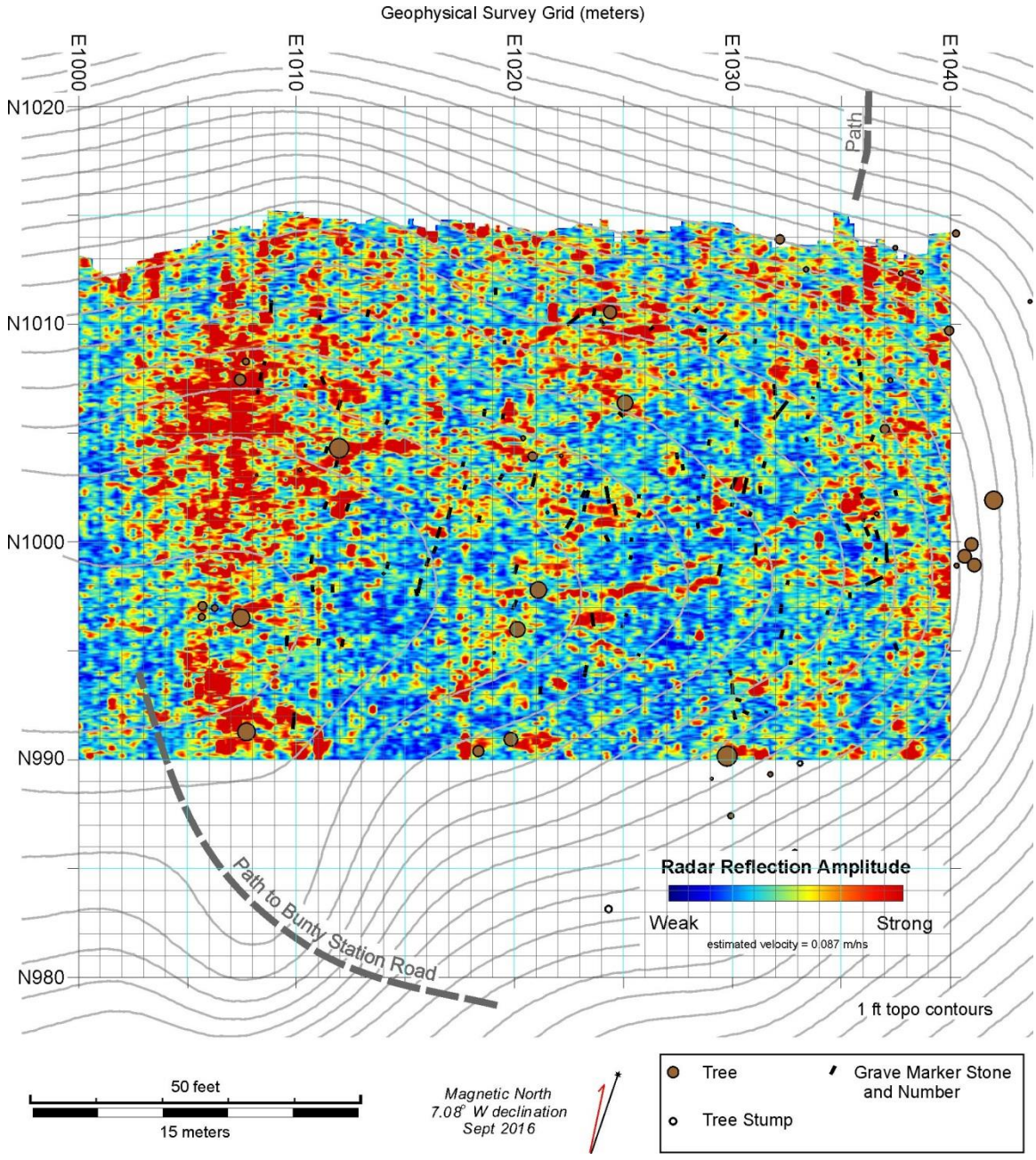
Magnetic Survey Results



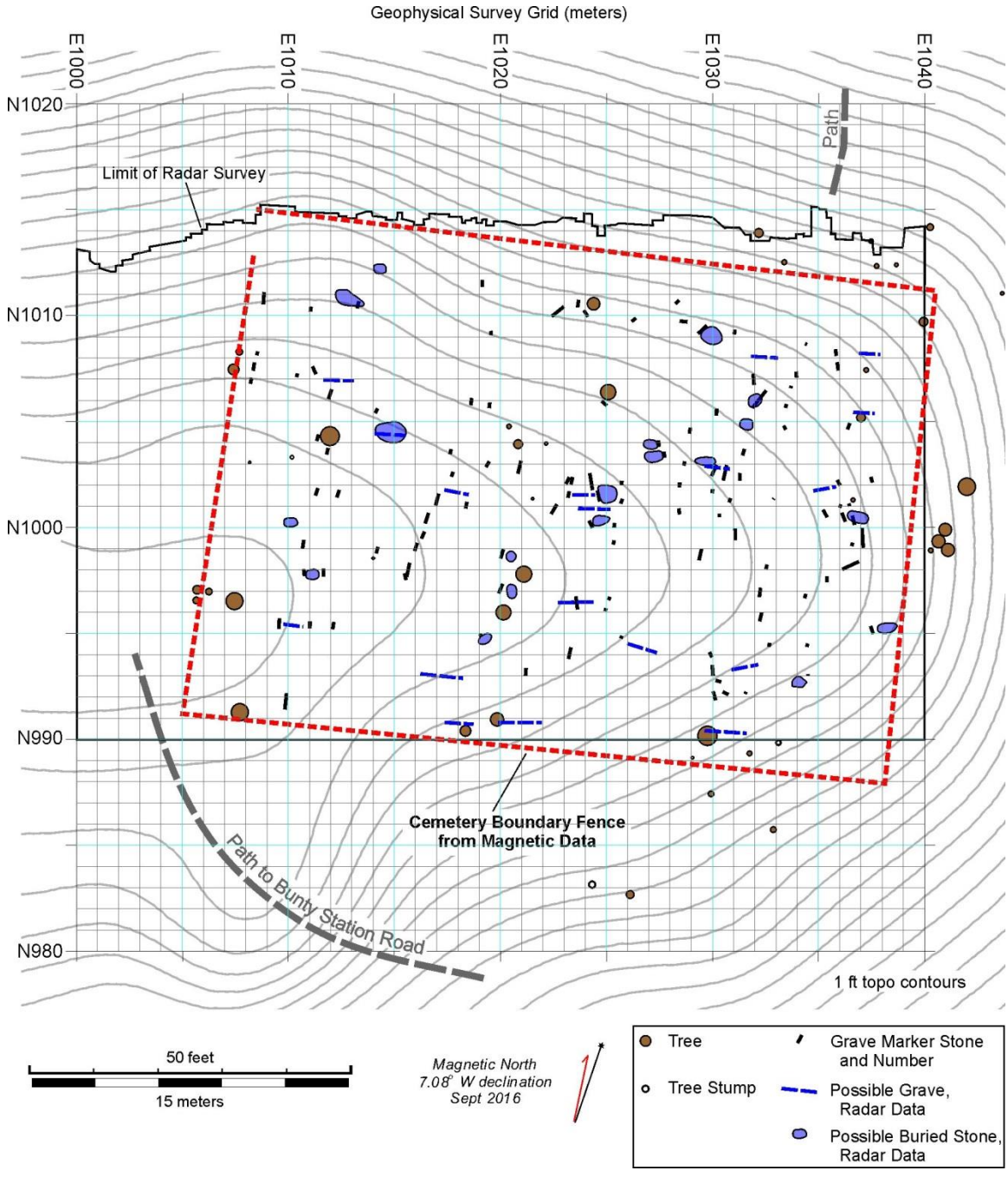
Magnetic Anomalies of Potential Interest



Radar Amplitude Slice Map (60-70 cm below surface)



Radar Anomalies of Potential Interest



All Geophysical Anomalies of Potential Interest