# APPENDIX D
## GEOSPATIAL ANALYSIS

# Geospatial Data Collection and Integration for the City of Austin's Historic Cemetery Master Plan

## Summary Report

### I. Introduction

As a component of the City of Austin's Master Planning process for management of their five historic cemeteries, AmaTerra Environmental, Inc. (AmaTerra) has completed its collection, analysis, and integration of geospatial data relevant to Austin Memorial Park (AMP), Evergreen Cemetery, Oakwood Cemetery, Oakwood Cemetery Annex, and Plummers Cemetery. Per the stipulations of the project's initial scope and Request for Proposals (RFP) Item 3.2.2, under this task, AmaTerra gathered new GPS locations for surface features such as irrigation hydrants, storm sewer entry points, structures, mausoleums, roads, and more. They additionally gathered, scanned, georeferenced, and digitized relevant information from historic maps and drawings of the historic cemeteries. This brief report is intended to provide background and summary information to serve as a reference for the project geodatabase that has been produced. Electronic metadata, prepared in accordance with City of Austin guidance, is included with the geodatabase as well.

### II. Methods

GPS Survey Data

AmaTerra began fieldwork gathering general surface infrastructure and irrigation-related GPS points in May of 2014. All data was gathered using Trimble GeoXH sub-meter accuracy GPS units, which utilize Global Navigation Satellite System (GLONASS) signal processing, enabling greater real time accuracy in situations where the sky is partly obscured by structures or tree canopy. AmaTerra prepared a dedicated data dictionary to allow surveyors to provide relevant attribute values for each recorded point, area, or line feature. For building corners, AmaTerra surveyors used offset measurements, actual GPS positions, and 6-inch-accuracy aerial photographs.

Figure 1: AmaTerra surveyor collecting attribute and locational information for a Rainbird at Austin Memorial Park.

Concurrently, AmaTerra was also conducting an intensive tree inventory/survey throughout the five cemeteries as another Master Plan task. These two survey crews each utilized GeoXH units as well. For their tree attribute data collection, tree survey crews used a data dictionary prepared by the City of Austin's Urban Forestry Department. All tree data was collected as individual points.

For this project, AmaTerra field-collected 7,526 individual data points, lines, and polygons within the five investigated cemeteries.

Data was post-processed and differentially-corrected for enhanced accuracy using Trimble Pathfinder Office 5.0 and exported to geodatabase format. Following post-processing, roughly 75 percent of AmaTerra's field-collected data had a positioning accuracy of +/- 50 centimeters (19 inches) or below (see **Figure 2**). Field abbreviations were replaced with standard nomenclature and other textual corrections were made at that time.
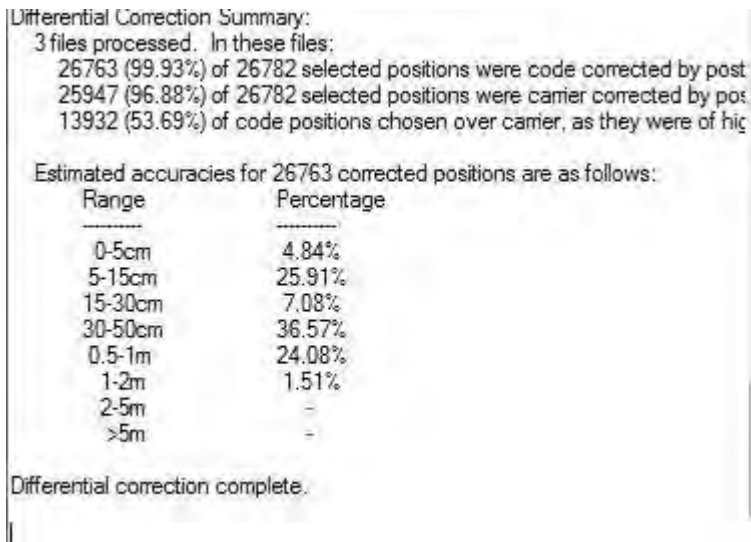
```
Differential Correction Summary:
  3 files processed.  In these files:
     26763 (99.93%) of 26782 selected positions were code corrected by post
     25947 (96.88%) of 26782 selected positions were carrier corrected by pos
     13932 (53.69%) of code positions chosen over carrier, as they were of hic

  Estimated accuracies for 26763 corrected positions are as follows:
        Range              Percentage
       ---------           ----------
        0-5cm                4.84%
        5-15cm              25.91%
        15-30cm              7.08%
        30-50cm             36.57%
        0.5-1m              24.08%
        1-2m                 1.51%
        2-5m                   -
        >5m                    -

Differential correction complete.
```

**Figure 2:** Screen capture of differential correction accuracy summary from one day of tree survey.  This is typical of the project as a whole.

Raster Imagery

A selection of 49 plan drawings and maps from large collection archived by the City of Austin's Cemeteries Division at Austin Memorial Park and other archival sources were scanned to a minimum of 400 dots-per-inch (dpi) and orthorectified to real-world locations with Economic and Social Research Institute's (ESRI's) ArcMap 10.2.2 georeferencing tools using known points from GPS survey and the most recent high-resolution aerial imagery available.  Thirteen high resolution historic aerial, photos dated from 1952 to 1973, were obtained from United States Geological Survey (USGS) Earth Explorer and orthorectified as well to provide an historical glimpse of the cemeteries throughout the past 60 years and to detect changes in each cemetery over time.  Finally, detailed legal survey maps recently acquired for Austin Memorial Park were georeferenced and incorporated into that cemetery's boundary file (among others).

Geodatabase Layer Preparation

Additional layers were created from field GPS data, existing layers provided by the Parks and Recreation Department (PARD), Travis County, and the City of Austin.  These layers were refined, clipped, and / or supplemented where necessary to provide a dataset tailored to the five historic cemetery properties.  Irrigation-related data was digitized from orthorectified imagery to provide approximate locations of buried waterlines where possible. Included in the geodatabase are 1,131 point and line features within two layers digitized from orthorectified maps.

Twenty data layers were created from existing data, field-collected data, and orthorectified maps and drawings.

# Sample Imagery from City of Austin Historic Cemetery Master Plan Geodatabase

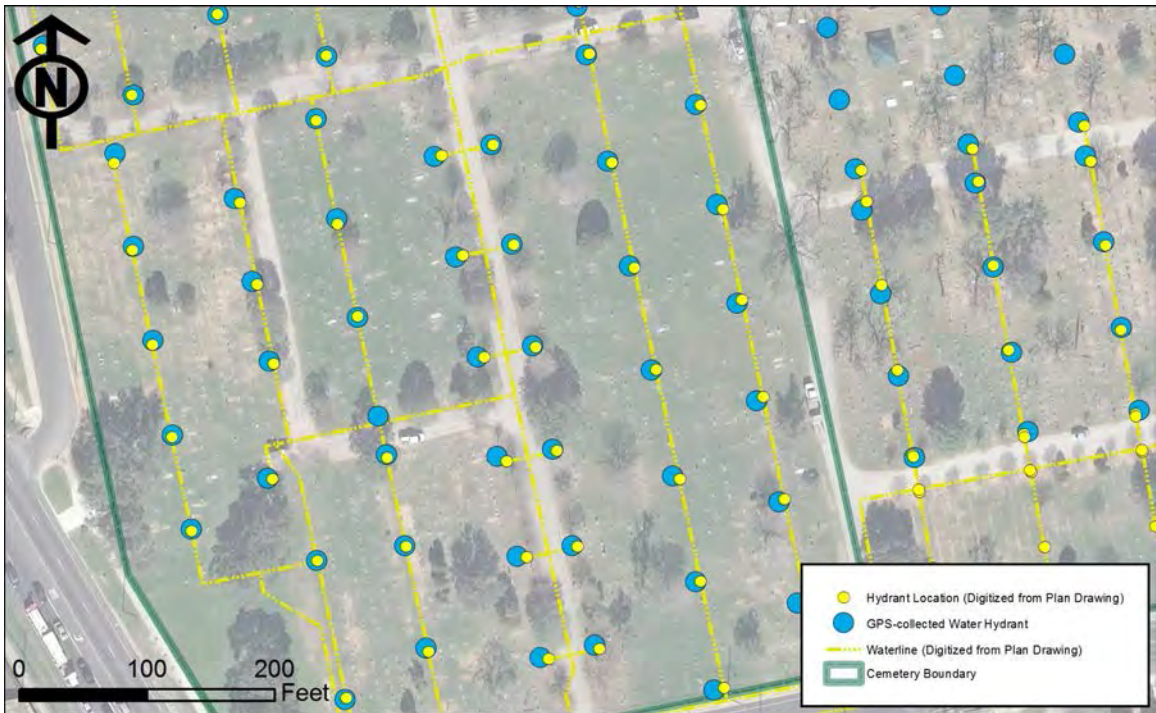Sample of 1928 survey overlaid on Austin Memorial Park aerial imagery.



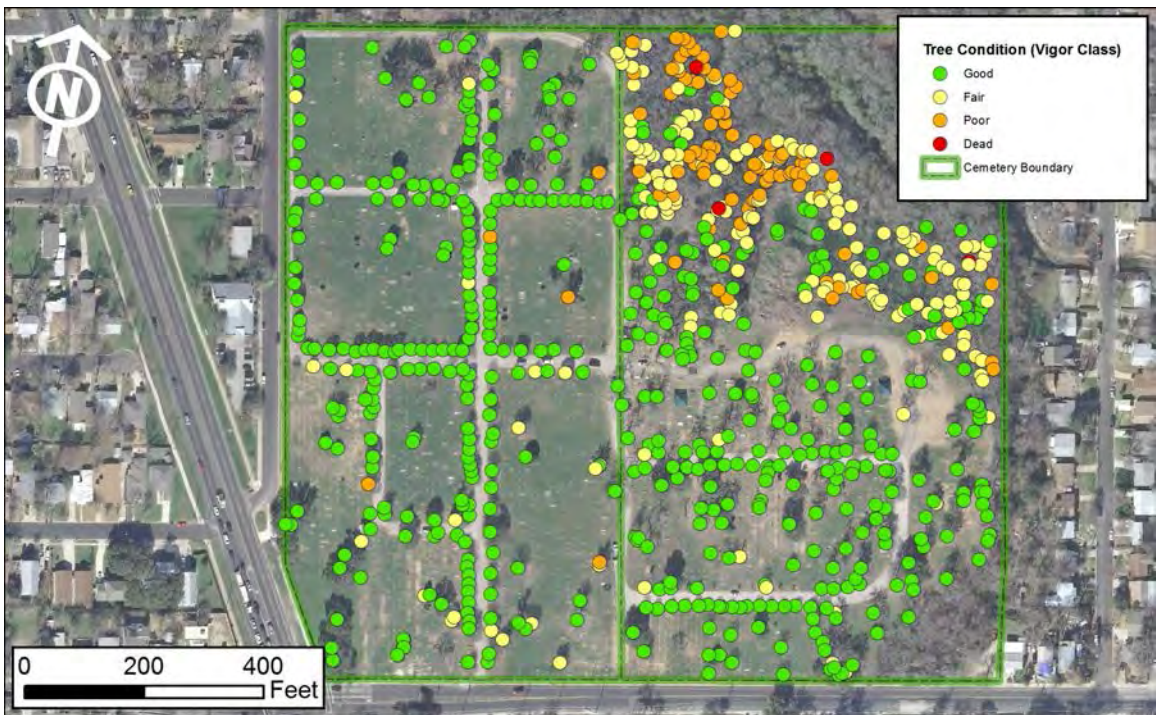Sample of irrigation features (digitized and field-collected) from Austin Memorial Park.

Sample of 1938 survey overlaid on Evergreen Cemetery aerial imagery.


Sample of general infrastructure map from Evergreen Cemetery.

Sample of irrigation features (digitized and field-collected) from Evergreen Cemetery


Distribution of tree conditions (Vigor Class) at Evergreen Cemetery.

Sample of 1911 map of Oakwood Cemetery grounds overlaid on modern aerial imagery.



Sample of irrigation features (digitized and field-collected) from Oakwood Cemetery.

Sample of 1928 survey of Oakwood Annex (modified in 1974 for irrigation features).
Note how incredibly accurate the drawing/construction was.
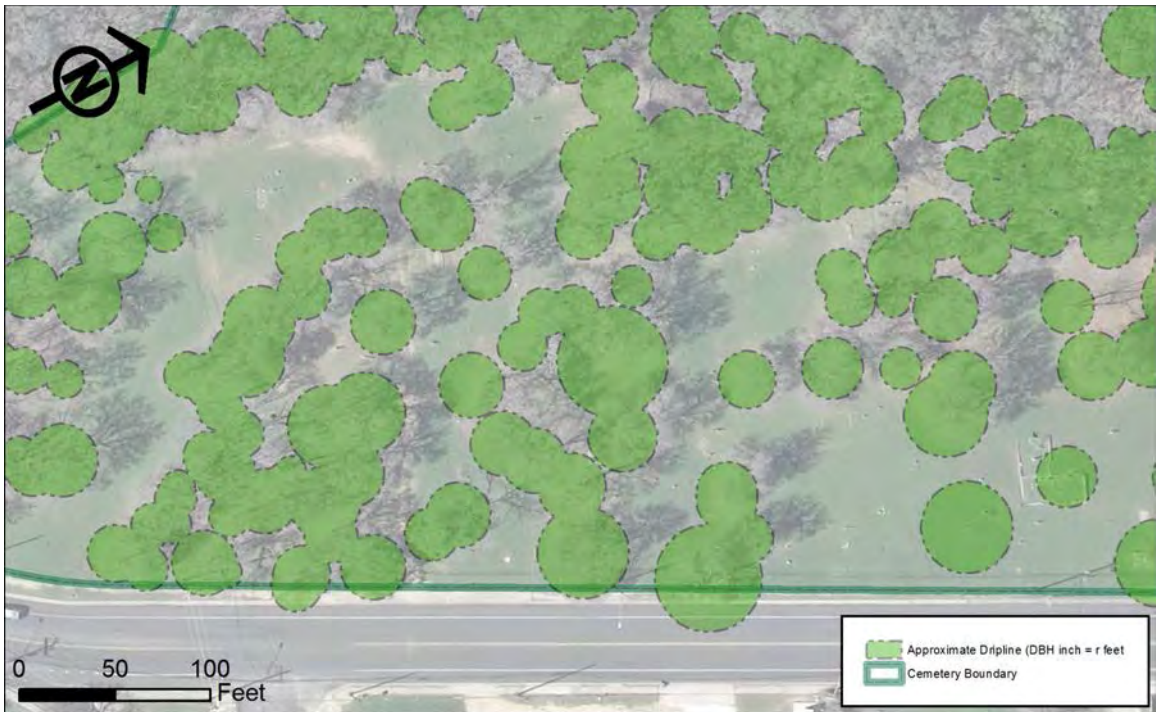


Approximated tree drip lines from tree survey field data at Plummers Cemetery.

# Geodatabase File List

Part of the City of Austin Historic Cemeteries Master Plan involved providing the City with better electronic mapping tools, which will enable the Parks and Recreation Department to monitor and record changes to cemetery infrastructure, as well as natural and physical resources. A set of digital maps were developed using Geographic Information Systems (GIS, for short), a tool that analyzes data in order to tie non-geographic information to a geographic location.

The resulting maps allows users to visually identify patterns that would be difficult to see otherwise. The Cemetery Master Plan team is assembling all of the existing data from sources such as the Travis County Appraisal District, boundary maps, an earlier tree survey, historic aerial photographs, and U.S. Geological Survey maps. They also generated new data, including the new tree survey and the location of infrastructure items such as irrigation system sprinkler heads, pipes, and faucets.

The following electronic map geodatabase files were collected by AmaTerra for the Cemeteries Master Plan effort and delivered to the Parks and Recreation Department in electronic format. These include the source documents and images as well as the deliverables created with them.

### *Georeferenced Source Documents and Images*

The following source documents and images (hard copy maps, drawings, and historic-age aerial photographs relevant to each of the cemeteries) were scanned and imported into the GIS system.

Austin Memorial Park Cemetery

- Maps and drawings, dated 1928–2008 (19)

- Aerial photographs, dated 1952, 1966, and 1973 (3)

Evergreen Cemetery

- Maps and drawings, dated 1926–2004 (15)

- Aerial photographs, dated 1952, 1966, 1967, and 1973 (4)

Oakwood Cemetery

- Maps and drawings, dated 1911–1976 (5)

- Aerial photographs, dated 1952 and 1966 (2)

Oakwood Cemetery Annex

- Maps and drawings, dated 1930–1976 (10)

- Aerial photographs, dated 1952 and 1966 (2)

Plummers Cemetery

- Map, dated 1974 (1)

- Aerial photographs, dated 1952, 1966, 1967, and 1973 (4)

### *Geodatabase Deliverables*

A total of 8,663 electronic geodatabase shapefiles (points, lines, and polygons) were generated for the project through field collection with GPS and/or through digitization (digital tracing to real-world locations) using referenced maps.

All tree survey points from the selected survey areas (5,685)

General cemetery data (738)

- Section and row markers

- Section boundaries

- Drainages (polygon)

- Historical grave markers

- Monuments (non-grave markers)

- Signage

- Trash cans

- General element points, such as fence corners, posts, bollards, etc.

Irrigation and Utilities (2,169)

- General points digitized from scanned drawings (sprinklers, junctions, hydrants, etc.)

- Waterlines digitized from drawings

- Water/wastewater non-hydrant general points (valves, access points, cover plates, etc.

- Storm sewer points (inlets, caps, etc.

- Utility poles

- Water hydrant points

Structures, Roads, and Property Boundaries (71)

- Cemetery boundaries

- Fence lines

- Mausoleums

- Structures

- Roads and sidewalks

Austin Cemeteries


Monuments-Statues     Point Feature, Label 1 = Material, Label 2 = Condition
   Material           Menu, Normal, Normal
      M-Aluminum/Tin
      M-Steel
      M-Brass/Copper/Bronz
      S-Granite
      S-Marble
      S-Limestone
      Plastic/PVC
      Concrete
      Wood
   Condition          Menu, Normal, Normal
      Good
      Fair
      Poor
   Notes              Text, Maximum Length = 50
                      Normal, Normal


Public Benches        Point Feature
   Material           Menu, Normal, Normal
      M-Aluminum/Tin
      M-Steel
      M-Brass/Copper/Bronz
      S-Granite
      S-Marble
      S-Limestone
      Concrete
      Plastic/PVC
      Wood
   Condition          Menu, Normal, Normal
      Good
      Fair
      Poor
   Notes              Text, Maximum Length = 50
                      Normal, Normal


Trash Cans            Point Feature
   Material           Menu, Normal, Normal
      M-Aluminum/Tin
      M-Steel
      M-Brass/Copper/Bronz
      S-Granite
      S-Marble
      S-Limestone
      Concrete
      Plastic/PVC
      Wood
   Condition          Menu, Normal, Normal
      Good
      Fair
      Poor
   Notes              Text, Maximum Length = 50
                      Normal, Normal


Row Marker            Point Feature
   Material           Menu, Normal, Normal
      M-Aluminum/Tin
      M-Steel
      M-Brass/Copper/Bronz
      S-Granite
      S-Marble
      S-Limestone
      Brick
      Concrete
      Plastic/PVC
      Wood
   Condition          Menu, Normal, Normal
      Good
      Fair
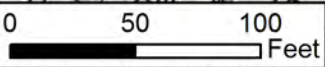      Poor
   Notes              Text, Maximum Length = 50
                      Normal, Normal

```
Mausoleum            Point Feature, Label 1 = Corner
   Material          Menu, Normal, Normal
      M-Aluminum/Tin
      M-Steel
      M-Brass/Copper/Bronz
      S-Granite
      S-Marble
      S-Limestone
      Concrete
      Plastic/PVC
      Wood
   Condition         Menu, Normal, Normal
      Good
      Fair
      Poor
   Corner            Menu, Normal, Normal
      N
      NE
      E
      SE
      S
      SW
      W
      NW
   Notes             Text, Maximum Length = 50
                     Normal, Normal

Building             Point Feature, Label 1 = Type
   Material          Menu, Normal, Normal
      M-Aluminum/Tin
      M-Steel
      M-Brass/Copper/Bronz
      S-Granite
      S-Marble
      S-Limestone
      Brick
      Concrete
      Plastic/PVC
      Wood
   Condition         Menu, Normal, Normal
      Good
      Fair
      Poor
   Corner            Menu, Normal, Normal
      N
      NE
      E
      SE
      S
      SW
      W
      NW
   Type              Text, Maximum Length = 30
                     Normal, Normal
   Notes             Text, Maximum Length = 50
                     Normal, Normal

Signs                Point Feature, Label 1 = Sign Says:, Label 2 = Type (if applicable)
   Material          Menu, Normal, Normal
      M-Aluminum/Tin
      M-Steel
      M-Brass/Copper/Bronz
      P-Plastic/PVC
      S-Granite
      S-Marble
      S-Limestone
      Wood
   Condition         Menu, Normal, Normal
      Good
      Fair
      Poor
   Type (if applicable)    Menu, Normal, Normal
      Stop
      Yield
      One-Way
   Sign Says:        Text, Maximum Length = 30
```

```
                        Normal, Normal
   Notes                Text, Maximum Length = 50
                        Normal, Normal


Historical Marker      Point Feature, Label 1 = Title, Label 2 = Year Placed
   Type                Menu, Normal, Normal
      OTHM
      HTC
      Cenntenial
      RTHL
   Title               Text, Maximum Length = 50
                        Normal, Normal
   Year Placed         Numeric, Decimal Places = 0
                        Minimum = 0, Maximum = 2014, Default Value = 0
                        Normal, Normal
   Material            Menu, Normal, Normal
      Metal - Stand Alone
      Metal - Plaque
      Stone


Power Pole             Point Feature
   Condition           Menu, Normal, Normal
      Good
      Fair
      Poor
   Notes               Text, Maximum Length = 50
                        Normal, Normal


Culvert                Point Feature
   Material            Menu, Normal, Normal
      Metal
      Concrete
   Condition           Menu, Normal, Normal
      Good
      Fair
      Poor
   Notes               Text, Maximum Length = 50
                        Normal, Normal


Utilities              Point Feature, Label 1 = Type
   Type                Menu, Normal, Normal
      Water
      Power
      Phone
      Cable
      Fiber-Optic
      Storm Sewer
   Notes               Text, Maximum Length = 50
                        Normal, Normal


Irrigation Point       Point Feature, Label 1 = Type, Label 2 = Base Material
   Type                Menu, Normal, Normal
      Rainbird
      Sprinkler
      Hose Bib
   Material            Menu, Normal, Normal
      M-Aluminum/Tin
      M-Steel
      M-Brass/Copper/Bronz
      P-Plastic/PVC
   Base Material       Menu, Normal, Normal
      Concrete
      Metal
      PVC
   Condition           Menu, Normal, Normal
      Good
      Fair
      Poor
   Notes               Text, Maximum Length = 50
                        Normal, Normal
```

BLK No 2

221

N

222

| Legend | |
|---|---|
| ○ (yellow) | Hydrant Location (Digitized from Plan Drawing) |
| ● (blue) | GPS-collected Water Hydrant |
| ⋯⋯ (yellow dashed) | Waterline (Digitized from Plan Drawing) |
| ▭ (green) | Cemetery Boundary |

0    100    200
Feet

WALK

AVENUE N 80 40 3 B 396 13

WALK

| 189 | 136 | 135 | 82 | 81 | 28 | 27 | 190 | 189 | 130 | 135 | 82 | 81 | 28 | 27 |
| 188 | 137 | 134 | 83 | 80 | 29 | 26 | 191 | 188 | 137 | 134 | 83 | 80 | 29 | 26 |
| 187 | 138 | 133 | 84 | 79 | 30 | 25 | 192 | 187 | 138 | 133 | 84 | 79 | 30 | 25 |
| 186 | 139 | 132 | 85 | 78 | 31 | 24 | 193 | 156 | 139 | 132 | 85 | 78 | 31 | 24 |
| 185 | 140 | 131 | 86 | 77 | 32 | 23 | 194 | 195 | 140 | 131 | 86 | 77 | 32 | 23 |
| 184 | 141 | 130 | 87 | 76 | 33 | 22 | 195 | 184 | 141 | 130 | 87 | 76 | 33 | 22 |
| 183 | 142 | 129 | 88 | 75 | 34 | 21 | 196 | 183 | 142 | 129 | 88 | 75 | 34 | 21 |
| 182 | 143 | 128 | 89 | 74 | 35 | 20 | 197 | 182 | 143 | 128 | 89 | 74 | 35 | 20 |
| 181 | 144 | 127 | 90 | 73 | 36 | 19 | 198 | 181 | 144 | 127 | 90 | 73 | 36 | 19 |
| 180 | 145 | 126 | 91 | 72 | 37 | 18 | 199 | 180 | 145 | 126 | 91 | 72 | 37 | 18 |
| 179 | 146 | 125 | 92 | 71 | 38 | 17 | 200 | 179 | 146 | 125 | 92 | 71 | 38 | 17 |
| 178 | 147 | 124 | 93 | 70 | 39 | 16 | 201 | 178 | 147 | 124 | 93 | 70 | 39 | 16 |
| 177 | 148 | 123 | 94 | 69 | 40 | 15 | 202 | 177 | 148 | 123 | 94 | 69 | 40 | 15 |
| 176 | 149 | 122 | 95 | 68 | 41 | 14 | 203 | 176 | 149 | 122 | 95 | 68 | 41 | 14 |
| 175 | 150 | 121 | 96 | 67 | 42 | 13 | 204 | 175 | 150 | 121 | 96 | 67 | 42 | 13 |
| 174 | 151 | 120 | 97 | 60 | 43 | 12 | 205 | 174 | 151 | 120 | 97 | 66 | 43 | 12 |
| 173 | 152 | 119 | 98 | 65 | 44 | 11 | 206 | 173 | 152 | | | | | |
| 172 | 153 | 118 | 99 | 64 | 45 | 10 | 207 | 172 | 153 | | | | | |
| 171 | 154 | 117 | 100 | 63 | 46 | 9 | 208 | 171 | | | | | | |

WALK  MAIN

223

0   50   100
Feet

C4
C5
B1
K
No Pets
D2
D3
A
J
G
Speed
Limit 15
D1
311
Information
Undeveloped
Evergreen
Cemetery
Hours

N

0    100    200
Feet

224
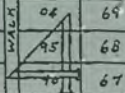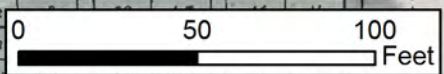
**Sign**
**Trash Can**
**Section**
**Road / Sidewalk**
**Structure**
**Cemetery Boundary**

Legend:
- Hydrant Location (Digitized from Plan Drawing)
- GPS-collected Water Hydrant
- Waterline (Digitized from Plan Drawing)
- Cemetery Boundary

N

0    100    200
Feet

225

DIOSDAN



N

Jas. Martin 1870

Vacant

Haldeman

L.F. Miller

Robert F. Matthews 1884

Tressler

Chas. D. Kinney

Deen

Randolph

Old Battered Stones

Adolph Schutze

F.A. Scott

Metz

(Reissig) Hofheinz

Seven U.S. Soldiers Graves

Donnan

Limbach

Michael Ziller

C.S. Metz

Brinkman & Rapp

Vacant

Harris

Blunn

Few Buttered Grave Stones

Jurgensen

W.A. Dougherty

Duffau

Elizabeth Dixon

Mrs. Beadles

Ford

J.D. Dowy 1839

Geo. P. Assmith

226

Philips

Bremond

Chester Firebaugh 1891

Drury Wilson

Old Altmon

0    25    50
Feet

6" PVC  6" PVC  6" PVC  6" PVC

DRIVEWAY

6" PVC

2" GATE VALVE
IN METER BOX

2"

PLAT BOOK 5,
PAGE 38

PLAT BOOK 5,
PAGE 172

PLAT BOOK 5,

3" PVC

3" PVC

2" PVC

3" PVC

PARKWAY
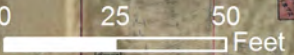
GATE VALVE
IN METER BOX

EXIST 30 METER

2" GATE VALVE
IN METER BOX

Serv One Inch Meter

227

0    50    100
Feet

N

Legend:
- **GPS-collected Water Hydrant** (blue circle)
- **Hydrant Location (Digitized from Plan Drawing)** (yellow circle)
- **Waterline (Digitized from Plan Drawing)** (yellow dashed line)
- **Cemetery Boundary** (green outline)

228

0    100    200
Feet