110- Geophysical and Archaeological Survey of Lake Bluff Park, St. Joseph, Michigan

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Geophysical and Archaeological Survey of Lake Bluff Park, St. Joseph, Michigan

Michael Nassaney and William Sauck

Reports of Investigations No. 110

Prepared by:
Department of Anthropology
Western Michigan University
Kalamazoo, MI 49008

February 2007
Geophysical and Archaeological Survey of Lake Bluff Park, St. Joseph, Michigan

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Presented to:

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ABSTRACT

Geophysical and archaeological surveys were conducted in a segment of Lake Bluff Park immediately west of Lake Boulevard in St. Joseph, Michigan during Fall 2005. The surveys were conducted because background research had indicated the potential for archaeological remains in the project area, particularly the construction of Fort Miami in the vicinity in 1679 and encounters with human burials along the bluff edge in the nineteenth century. The City of St. Joseph requested the survey to avoid disturbing potentially significant subsurface remains during excavations to replace utility lines beneath Lake Boulevard.

Sixteen geophysical blocks were surveyed, comprising approximately 35% of the project area. Magnetometry and ground penetrating radar detected a range of subsurface anomalies including utility lines, near surface ferrous objects, and geological disconformities. A total of 52 shovel test pits, six 1-x-1 m excavation units, and one 1-x-1.5 m trench were located to ground truth many of these anomalies and to ensure even coverage over the project area. Archaeological excavations revealed that the project area has been landscaped and considerable fill has been brought in over the past century. In addition to artifacts associated with these secondary deposits, evidence related to the activities that took place in the park since it was established in the 1830s is preserved in the form of brick foundations of former buildings and accidental loss and discard of materials that reflect the park’s passive recreational use.

Evidence of activities or artifacts that predate the park is limited. A few flakes and some fire-cracked rock may relate to ancient (i.e., pre-Contact) Native American occupation and two artifacts—a clay pipe bowl and a hand-blown bottle—are similar in form to objects that were produced and used in the late 18th–early 19th century. No objects that date to the period of Fort Miami were identified.
Despite the extent of modern disturbance and the limited material evidence of pre-1830s activities, the project area has yielded artifacts and features that can inform about land use practices over the past 170 years. Further subsurface testing is needed to evaluate the artifacts and features that were encountered and to rule out the presence of human burials or artifacts associated with Fort Miami, particularly if the fort was located nearby, as sources seem to suggest.
ACKNOWLEDGEMENTS

We appreciate the invitation of the City of St. Joseph to conduct this work in an area that could contain important material traces of past human activity. Were it not for the support of John Hodgson (Assistant City Manager) and Kenneth Pott (Executive Director, The Heritage Museum and Cultural Center) the project probably would not have been conducted. Various members of the community shared their knowledge of the history of Lake Bluff Park, most notably Tom MacFarlane and other affiliates of The Heritage Museum and Cultural Center. Tom MacFarlane provided several historical photographs that we have incorporated into this report. Members of the Geosciences and Anthropology departments conducted the geophysical survey including Jorge L. Porsani and Nathan Brandner. Members of the Anthropology Department who conducted the archaeological fieldwork include LisaMarie Malischke (field supervisor), Stephanie Barrante, Mike Carpentier, Jeremy Floyd, Aya Hasimoto, Chandler Herson, Cynthia Nostrand, Celene Sotkowy, and Brendan Weaver. Malishke washed the artifacts and assisted with the artifact inventory. Stephanie Barrante photographed the artifacts illustrated in this report. We appreciate the comments of William Cremin, John Hodgson, and Kenneth Pott who reviewed a draft of this report.
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INTRODUCTION

This report documents the background research and the methods and results of a geophysical and archaeological survey of a portion of Lake Bluff Park in St. Joseph, Michigan. The purpose of the survey was to identify and document archaeological remains in the park. The City of St. Joseph contracted the services of Western Michigan University to conduct the survey because the area was thought to have the potential to contain archaeological materials and construction was planned to install new utility lines beneath the adjacent Lake Boulevard in Spring 2006. This construction activity could have an adverse impact on historically significant archaeological materials. For example, a state historical marker indicates that Fort Miami, the oldest European site in Michigan’s Lower Peninsula, was established in the vicinity of the park in 1679. There are also reports that human burials have been found along the bluff.

A three-stage process consisting of background research, fieldwork involving geophysics and subsurface testing, and monitoring of backhoe work was proposed to identify archaeological remains. The background research began in August 2005 and the fieldwork was conducted from late September through early November. Due to scheduling constraints and the preliminary results of the fieldwork, city administrators determined that monitoring of backhoe work in conjunction with construction activities the following spring was unnecessary.

In the remainder of this report we describe the background research (Nassaney) and the methods and results of the geophysical (Sauck) and archaeological (Nassaney) surveys. The final section of the report (Nassaney) presents a summary of survey findings and recommendations for future work.
BACKGROUND RESEARCH

The following section of this report discusses the background research conducted prior to the fieldwork. The background research was limited to one day in the local library, consultation with Mr. Kenneth Pott of The Heritage Museum and Cultural Center (formerly the Fort Miami Heritage Society), examination of materials he provided, and discussions with local consultants, including Mr. Tom MacFarlane, during the course of fieldwork. A summary of the environmental, historical, and archaeological context of the project area is based on this work.

Environmental Setting

The project area is located above a steep bluff west of Lake Boulevard (formerly Front Street) in the City of St. Joseph, Michigan. It extends from Lake Boulevard on the east to the edge of a steep slope on the north and west, and from an arbitrary line parallel with Market Street on the south to Port Street on the north (Figure 1). The project area varies from 16 to 22 m in width (E-W) and is approximately 460 m in length (N-S). The St. Joseph River flows into Lake Michigan about 400 m northwest of the project area. In the 18th and early 19th centuries the river flowed beneath the bluff immediately west of the project area.

The area has been maintained as a city park since the 1830s (Hatch 1994). A concrete walkway extends the entire length of the park and the area contains numerous large trees, bushes, some flowerbeds, supports for swings, a state historical marker for Fort Miami (Figure 2), and a number of commemorative monuments, including a stone marker dedicated to LaSalle in 1902 (Figure 3) (Woodruff 1999:10). The area is well groomed and generally devoid of modern surface artifacts.
Figure 1. Map of the project area (Titus 1873).
Figure 2. Fort Miami historical marker (photo by Michael Nassaney).
Figure 3. La Salle monument (photo by Michael Nassaney)
The bluff is a stable landform that was probably formed in early post-glacial times. Though generally level today, several hand-drawn lithographs from the late 19th century show that the bluff was marked by gullies likely formed through erosion. Within the project area, the gully west of Elm St. necessitated a bridge (Figure 4). Further information on the soil characteristics in the project area is discussed along with the archaeological results later in this report.

Figure 4. 1895 lithograph showing gullies, stairways, a bridge, and other features. (Courtesy of The Heritage Museum and Cultural Center).
Historical Context

Southwest Michigan has a long history of human occupation, beginning over 10,000 years ago (Halsey 1999). The region’s plant and animal resources have attracted human settlement to various locations suitable for exploitation throughout the region. It is not uncommon to find evidence of human occupation along many streams, rivers, ponds, and springs in southwest Michigan (Cremin and Quattrin 1987). As a result of large-scale demographic processes, the area was relatively devoid of human occupation in the seventeenth century when Europeans first entered the region. The predecessors of the Potawatomi and other indigenous peoples had been displaced by Iroquois raids from the east in search for slaves and raw materials. Some of these groups reoccupied the area in the late seventeenth century, but not until the area was generally pacified and alliances were formed with the French who provided military, political, and economic support (Nassaney et al. 2007). Throughout the 18th century the St. Joseph River valley supported a large population of Native peoples, many of whom interacted closely with the French (Sleeper-Smith 2001). Source materials do not place this population at the mouth of the river, however.

While there is some debate concerning the identities of the first Europeans to visit the mouth of the St. Joseph River (cf., Cremin and Nassaney 1999; Ellis 1880; Morton 1929), historical accounts consistently indicate that St. Joseph was the location of the first European site in the Lower Peninsula. In late summer 1679, Rene Robert Cavalier de La Salle, accompanied by three friars, 10 French men, and a Mohican hunter, left Green Bay in four large canoes for the mouth of the St. Joseph River, then known as the “River of the Miamis” (Cunningham 1961:49). They reached the mouth of the river on November 1, 1679 where they waited for the Griffin (also know as the Griffon), the first ship on the Great Lakes, which had left Green Bay laden
with a cargo of furs, on her ill-fated voyage. In anticipation of her arrival, La Salle and his companions selected an area on the bluff above the river and “cleared away the timber from a place large enough to build a fort and provide a cleared space about it” (Morton 1929:12). According to Father Hennepin, they took three weeks to build the fort of hewn logs, 40 x 80 feet in dimension (Cunningham 1961:52). When the Griffin failed to appear, the fort was abandoned with the onset of winter and then reoccupied the following spring when La Salle returned from the Illinois Country. There he met two men that he had sent to Michilimackinac to learn what had become of the Griffin. La Salle again left the fort, this time to travel cross-country to Canada. When he returned the following fall he found that Fort Miami had been burned by some of his own men who had deserted. He left a small party at the ruined fort and the men rebuilt it in his absence and cleared a considerable area of ground for planting in the following spring of 1681 (Cunningham 1961:55-56).

There is little documentary evidence of activity at the mouth of the river for more than a century after 1681, although French activities in the valley 20 leagues upriver at Niles have often been confused with the history of Fort Miami. For example, Reber (1924:4) places the St. Joseph mission at the mouth of the river. He also transposes the history of French settlement at Niles to the mouth of the river, claiming that “the fort at St. Joseph was visited by Charlevoix [and] . . . was subsequently captured and destroyed by Pontiac’s Indians in 1763, and from that date the bluff site reverted to a wilderness” (Reber 1924:5; our emphasis). Webster and Krause (1990) have similarly conflated these histories. They claim that Charlevoix had actually visited and described a Native Fort Oola at Niles and did not stop at Fort St. Joseph at the river’s mouth. Peyser’s (1992) work, supported by the recent discovery of French artifacts associated with European-style buildings in Niles, has laid these spurious claims to rest (Nassaney and Cremin
2002; Nassaney et al. 2003). In any event, it is unfortunate that documentary sources are silent on the fate of Fort Miami, why it was finally abandoned, and even exactly where it was located. From the historical descriptions, however, it seems likely that this short-lived fort was established in proximity to the project area.

Various authors have speculated on the location of Fort Miami. Reber (1924:4) matter-of-factly stated that the “fort stood a little north and west of what is now the Elk’s Club House.” Cunningham (1961:49) offered that the historical marker is positioned because of its prominence, whereas the stone monument (La Salle’s marker?) further south on Lake Boulevard is presumed to be the site, because of the cemetery having been found there. While he does not specify the cemetery in question, presumably he is referring to the burials that were reputedly found while early settlers were grading the bluff in the nineteenth century. Morton (1929:12) opined that the fort “was probably on the bluff where the Whitcomb [Hotel] now stands, for that location gave them a view out over the mouth of the River and the Lake and also a certain amount of protection from the Indians.” According to Webster and Krause (1990:31), archaeological evidence of the fort may have been found in 1928 or 1929 when workers excavating at the site of the Whitcomb Hotel encountered buried pilings with pointed ends, enclosed in clay beneath a layer of sand. Furthermore, the tops of the posts were burned. The description and provenience of these finds are consistent with material evidence of Fort Miami. Unfortunately, no other archaeological remains were discussed nor collected during these construction activities.

After nearly a 150-year hiatus, Euro-American settlers reoccupied the area south of the St. Joseph River mouth in 1829-30. In March of 1834, the village of Newberryport (later named St. Joseph) was incorporated by the territorial council of Michigan; the village comprised 27
houses, most of which stood under the bluff (Webster and Krause 1990:1). The project area at this time was shown as the “side hill” on the original plat of the village and was devoid of standing structures. A large landholding and forward-thinking citizen, Junius H. Hatch, donated to the village the parcel today known as Lake Bluff Park (Hatch 1994). The original deed, dated 29 July 1834, transferred the property to the village, with the stipulation that the side hill “forever remain a public common and not be converted to any other use.”

Subsequent land-use patterns have met these conditions. A careful examination of 19th and early 20th-century lithographs, maps, and photographs shows various features in the project area such as bridges, stairways, band shells, fountains, restrooms, and a gazebo that reflect passive recreational use (see Figure 4). Some of these features are extant and some have been removed, whereas other modern monuments have been added throughout the 20th century. Secondary sources also indicate that landscaping on the bluff in the 19th century exposed many skeletons with silver brooches (Reber 1924:5). Some interpreted these remains as evidence for a French cemetery that they believed exists on the bluff (e.g., Webster and Krause 1990). Others noted that while silver brooches may have given the impression that the remains were those of mission priests and settlers, trade ledgers of the time show that brooches were commonly traded to Native peoples and jewelry frequently accompanied Native Americans in mortuary context (Quimby 1966; Reber 1924:5-6).

By the late 19th century, numerous hotels, commercial buildings, and residences lined the east side of Lake Boulevard, then called Front Street. These buildings likely had an adverse impact on any archaeological sites that were located there. The excavation of trenches for subsurface electrical utility lines and water and sewer pipes would have also disturbed material
remains. Developments in the project area to the west were generally more ephemeral and less likely to cause subsurface disturbance.

Archaeological Overview

Prior to the survey, there had been no systematic archaeological investigations conducted in the project area and there are no sites listed on the National Register of Historic Places. Reports of pre-1834 evidence of human activity consist of the previously mentioned pilings beneath the Whitcomb Hotel and human burials encountered while grading the bluff. According to one undocumented newspaper source in the local Herald Press (1932) found in the Maud Preston Palenske Memorial Library, “no tribe ever made the land of the lower [St. Joseph] river a permanent home or ever had a village at the mouth of the river.” It is unknown whether this statement is based on historical evidence or merely a justification for Euro-American settlement almost a century after the founding of the village. Areas immediately adjacent to Lake Michigan and the lower reaches of the river were probably not very attractive for permanent human settlement in ancient times, given the lack of biodiversity along the lake and the high probability of annual flooding along the lower course of the river. More favorable settlement locations can be found away from the main branch of the river or near permanent sources of water such as springs. However, the bluff top may have been a desirable place for Native groups to bury their dead, even if they did not occupy the project area permanently. The bluff would have also met La Salle’s criteria for a site to welcome the Griffin.

In sum, there are no recorded archaeological sites in the project area and no collections of ancient artifacts such as stone tools or Native American pottery have been identified at The Heritage Museum and Cultural Center or the public library. The environmental setting was not
conducive for ancient Native American habitation and the urban/commercial/recreational use of the vicinity did not lend itself to encounters with material relics in the way that agricultural activities typically would.

GEOPHYSICAL AND ARCHAEOLOGICAL SURVEY METHODS AND RESULTS

The following section is devoted to a discussion of the geophysical and archaeological survey methods that were employed in the field. Given the size of the project area, we thought it prudent to try to detect subsurface features using ground penetrating radar and magnetometry, two methods that provide relatively rapid coverage. We then selected a number of anomalies to test to determine if they might be of potential archaeological interest. Prior to the geophysical surveys, we established a datum point (N0 W0) at the junction of the curb and crosswalk on the west side of Lake Boulevard opposite Market Street (NW corner of the intersection) (Figure 5). We then began laying out geophysical survey blocks measuring 10 m (N-S) and extending from the edge of the road to the edge of the bluff. These varied in width (E-W) from 12-20 m. They were located in areas relatively free of physical obstacles, and magnetic obstacles such as monuments, benches, and posts were particularly avoided. The blocks were labeled 1 – 16 from south to north, and indexed by the N coordinate of the first (southern) line of each. (Table 1 lists the southeast coordinates and size of each survey block.) The geophysical survey covered approximately 35% of the total park area—16 blocks x 10 m each, or 160 m, out of a total park length of 460 m.
Figure 5: Map of the project area showing the survey grid and the 16 geophysical survey blocks.
### Table 1. Coordinates and size of geophysical survey blocks.

<table>
<thead>
<tr>
<th>Block</th>
<th>SE Coordinates</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0N 0W</td>
<td>10 x 16 m</td>
</tr>
<tr>
<td>2</td>
<td>45N 0W</td>
<td>10 x 14 m</td>
</tr>
<tr>
<td>3</td>
<td>74N 0W</td>
<td>10 x 16 m</td>
</tr>
<tr>
<td>4</td>
<td>100N 2W</td>
<td>10 x 16 m</td>
</tr>
<tr>
<td>5</td>
<td>115N 2W</td>
<td>10 x 18 m</td>
</tr>
<tr>
<td>6</td>
<td>130N 2W</td>
<td>10 x 18 m</td>
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<tr>
<td>7</td>
<td>198N 1W</td>
<td>10 x 12 m</td>
</tr>
<tr>
<td>8</td>
<td>214N 1W</td>
<td>10 x 18 m</td>
</tr>
<tr>
<td>9</td>
<td>247N 1W</td>
<td>10 x 16 m</td>
</tr>
<tr>
<td>10</td>
<td>263N 1W</td>
<td>10 x 18 m</td>
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<td>11</td>
<td>281N 1W</td>
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<td>12</td>
<td>308N 1W</td>
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<td>13</td>
<td>346N 1W</td>
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<td>14</td>
<td>361N 1W</td>
<td>10 x 18 m</td>
</tr>
<tr>
<td>15</td>
<td>426N 1W</td>
<td>10 x 18 m</td>
</tr>
<tr>
<td>16</td>
<td>441N 1W</td>
<td>10 x 14 m</td>
</tr>
</tbody>
</table>

**Geophysical Survey Procedures**

We used both magnetometry and ground penetrating radar (GPR) to survey each of the blocks along E to W lines with a N-S separation of 0.5 m. The purpose of a geophysical survey is to detect subsurface anomalies that may be of archaeological interest, namely material evidence of human activity such as artifacts and landscape modifications.

The magnetometer responds to steel or iron objects, as well as to rock or soil that is enriched in the mineral magnetite. Some soils modified by the addition of organic matter (e.g., middens) may acquire additional magnetization via the formation of a secondary mineral, maghemite. Finally, fire-heated objects such as ceramics, bricks, hearths, and burn pits also acquire additional magnetization via recrystallization of magnetite or reorientation of the permanent magnetization component of magnetite.
The GPR system responds to physical boundaries in the earth where there are abrupt changes in electrical conductivity, dielectric constant, or magnetic permeability. Normally, in surveying over soils and sediments, it is the changes of dielectric constant that are mapped. Because water has a far greater dielectric constant than any other natural material, it is the subtle changes in water content that are being detected by the GPR. Thus, soil horizons containing different grain sizes, such as transitions from sand to clay, can be discriminated because the clay retains more water than the sand. Similarly, hidden trenches can be inferred when normal stratigraphic or soil layering is interrupted. Buried objects of sufficient size may be seen directly if they are electrically conductive (metallic) or present a sub-horizontal flat surface. Cavities also appear on the GPR transects, as the dielectric contrast between an air-filled cavity and moist soil is considerable. The effect of conductive soils is to absorb the signal and decrease the penetration depth. The effect of greater water content is to decrease the velocity of the radio wave. In soils above the water table, the wave velocity is typically between 1/3 to 1/4 of the velocity of light in air or a vacuum. Because the system measures reflection times, velocity must be known or estimated to convert the raw reflection time data to depths.

Unfortunately, in an urban environment there is commonly an abundance of modern near-surface artificial debris that will be detected by both methods. Features such as utility lines and other recent materials such as reinforced concrete will also give very strong responses, though they may not be of historical interest.
Geophysical Equipment and Methodology

**Magnetometer**

The GEOMETRICS G-858 Cesium vapor magnetometer was used in the vertical gradiometer mode. Effectively, this consists of two magnetometers operating simultaneously, with one sensor fixed about 0.75 m above the other. The sensors are held at the end of an aluminum staff about a meter in front of the operator, while the console and batteries are held by a shoulder harness. The instrument was operated in the pre-defined map mode, wherein the coordinates of the SW and NE corners of a rectangular block were entered, along with the line spacing and the mark interval (2 m). Upon starting a line, readings were taken at a rate of 10 per second, with precision of 0.01 nanoTeslas (nT or $10^{-9}$ T). The nominal magnetic field strength at the site was about 55000 nT. The sensors were carried above fiberglass tapes and marked ropes at normal walking speed, and the “mark” button pressed every 2 m. At normal walking speeds, about 10 to 13 readings were taken per meter, thus giving a data interval of 10 cm or less along the line. Cross-line positioning was easily within $\pm$5 cm. The data were stored in digital memory with associated N and E coordinates, as well as date and time to the nearest 0.01 second. At the end of each day, or periodically on site, the data files were transferred to a computer.

Because there are temporal fluctuations in the earth’s magnetic field, a magnetometer base or reference station was used every day. A reading was taken at the base at the beginning and end of the survey of each block, and occasionally midway during the survey, to provide a measure of quality control. This procedure provided the data necessary to correct the magnetometer data in the event of any severe magnetic disruption such as those due to solar flare activity. Fortunately, during the course of this survey, no large disruptions were registered, and only the normal smoothly changing diurnal effect (with minimum at solar noon) was observed.
with amplitude of 20 – 30 nT. Since the primary data used for the magnetic maps was the difference signal between the upper and lower sensors, this diurnal effect was cancelled out (same at both sensors) and no correction processing was needed.

Of course, other precautions were made to avoid human-induced magnetic disruptions. Two adjacent blocks of the street were blockaded during the surveys, so that passing cars would not cause transient effects, or parking cars would not cause step offsets in the observed magnetic field (Figure 6). Surveying was also paused for passing trains along the tracks at the base of the bluff.

Figure 6. Blockade used during the geophysical survey (photo by William Sauck).

Ground Penetrating Radar (GPR)

We used the Geophysical Survey Systems, Inc., SIR System 10A+ for the GPR surveying. The 500-MHz dual (bistatic) antenna system was chosen with one antenna to transmit and one to receive the reflected signals. The console and display units were on a cart at
a fixed position, while the antenna system, attached to a long cable, was pulled along the tapes and marked ropes defining the lines. This was done along the same lines as the magnetometer survey of each block. The system sends a very short, but high-voltage pulse to the transmit antenna, and the adjacent receiver antenna detects the very weak reflection signals.

Acquisition settings were: 40 scans/second; range or measure time of 60 nanoSeconds; 16-bit digitization at 512 samples per scan; running average of 3 scans for horizontal smoothing; high-cut filter at 1080 MHz; low-cut filter at 150 MHz. The data were stored on the hard disk of the field unit for later downloading and post-processing. Marks were inserted into the record at 2 m intervals, just as for the magnetometer profiling. Final horizontal scaling for the GPR profiles was 50 scans/meter, or a complete reflection waveform every 2 cm along the profiles. Maximum depth corresponding to the 60nS measuring time varied from 2.5 to 3 m, as differences in soil moisture caused the velocity of the radio pulses to vary from block to block.

Geophysical Survey Results

General

The surveys identified numerous subsurface anomalies, but certainly not all of these are of archaeological interest based on their size, intensity, and orientation. A series of maps (electronic and hard copy) showing magnetic anomalies were produced and examined (see Appendix A for a complete inventory); the GPR data were examined digitally by viewing vertical slices, as well as horizontal slices at various depths, derived from 3-D data volumes.

The most conspicuous magnetic anomalies consist of linear patterns of alternating high and low magnetic readings extending N-S beneath the concrete sidewalk (first several blocks), and between the sidewalk and curb (blocks 4 – 16). Other significant disturbances were over the
curb adjacent to the road. The latter probably represent iron rebar used to reinforce the concrete curb, whereas the former are probably one or more buried pipes that extend the length of the park. These pipes were confirmed with the GPR that detected as many as five separate features oriented N-S between the sidewalk and the curb. We did not excavate in search of these pipes because they were located beneath the sidewalk in Blocks 1-3, did not appear to be of archaeological interest, and their installation would have destroyed any in situ archaeological features. Other linear alternating magnetic patterns are also likely to be utility lines associated with drinking fountains or drainage features. More discrete dipoles proved to be large pieces of iron, including signposts and miscellaneous iron fragments. A magnetic anomaly also encircled the La Salle monument in Block 8. According to Tom MacFarlane (personal communication, 2006), a fence once surrounded the monument. Figure 7 shows a fence, though it appears in front of the monument. Excavations south of the monument (see below) yielded a piece of iron rebar that may have been a part of a different fence in this vicinity.

The GPR detected many subtle anomalies ranging in depth from immediately below the surface to greater than 2 m. In many of the blocks we identified several stratigraphic boundaries at approximately 1, 1.5, and 2 m below surface (BS). The W-E oriented pipes cutting through various blocks (as shown on the magnetic maps) were not visible on the GPR records, as the antennae coupled best with pipes that were crossed perpendicularly by the GPR survey lines, i.e., the N-S pipes.
Interpretations of the Geophysical Data

Magnetic Survey. Appendix A contains for each block an ASCII magnetometer data file, Blkxx.stn, that can be read with NotePad or WORD. It includes Surfer maps of the field measured at the lower sensor, Blkxxbot.srf, and another map of the vertical magnetic gradient obtained from the difference between the bottom and top sensors, Blkxxvg.srf. For those who do not have the Surfer software, we have converted each of these maps to a Windows meta file, or Blkxxbot.wmf. These can be imported into Windows documents as pictures, or can be opened directly with the Windows Picture and Fax Viewer (in Windows XP).

The magnetic surveys of all 16 Blocks are dominated by a S-N system of buried iron or steel pipes at about the 4-6 meters W coordinate. In Blocks 01 – 03 this is beneath the sidewalk.

Figure 7. Fence shown to the east of the La Salle monument (after 1902).
As the curb and sidewalk deviate about 2 m to the west between Blocks 03 and 04, this system of pipes lies between the sidewalk and curb in all the remaining blocks to the north (Blocks 04 – 16).

While there appear to be as many as five pipes (see GPR sections), the magnetic pattern is dominated by one or two of the largest pipes. The typical magnetic pattern of a steel pipeline is an alternating series of magnetic high and low closures on a contour map. Each segment of pipe retains a strong permanent magnetization from the time it cooled in the mill, with a positive pole on one end and a negative pole on the other. Depth estimates to the pipes can be done much more accurately on the GPR sections, so that will not be attempted with the magnetic data. The east edge of all the magnetic survey blocks is also strongly affected by reinforcing bar in the concrete curb.

Isolated magnetic bulls-eye patterns are commonly due to shallow vertical steel objects, at this site ranging from cutoff steel posts to smaller items such as large nails or spikes. Whether these are mapped as magnetic highs or as lows depends upon which pole of the object was oriented upward.

An isolated pair of connected magnetic high and low patterns (dipole) is typically due to a horizontal or nearly horizontal steel or iron object, in which each end of the object has opposite magnetic polarities, i.e., positive and negative poles.

A note about coordinates: the magnetic maps show distance west from the N-S reference of base line. The GPR profiles show increasing coordinates east from the west limit of each block. The lines and blocks covered with each method were the same, but operating system software for the GPR only allowed increasing coordinates.
Ground Penetrating Radar (GPR). The GPR survey was done along the same lines as the magnetic survey, with lines also spaced at a half meter. The GPR data in Appendix A contains the individual processed lines, with file names corresponding to their N coordinate, but lacking the decimal; e.g., LN0155.DZT is the processed line at 15.5 meters N. A viewing program (from Geophysical Survey Systems, Inc. or GSSI) is provided, and is named RADVIEW.EXE. It can be used to view any of the LNxxxx.dzt files, which display a vertical radar slice through the upper 3 m of the earth below each survey line. The tic marks across the top are at 2 m intervals. Alternatively, all (normally 21) of the GPR lines in each block are also provided in Appendix A as a PowerPoint file, Blockxx.ppt, in which the viewer can scroll through the profiles or vertical slices with two per slide. This display program shows the profiles with half-meter tic marks and labels every 2.5 meters, starting at the left (west side) of each line. These data were further processed, “migrating” the sloping features, such as the umbrella or hyperbola-shaped responses of pipes so that the reflection energy is concentrated at the true location. These were then displayed as 3D rectangular blocks, and a few snapshots are shown as Slicexxx.jpg files that can be viewed with any photo viewer, or pasted into Windows documents as pictures. In these file names, xxx refers to the depth in centimeters.

Block 01 Magnetic Survey. The east half of the magnetic map of Block 01 is dominated by the system of pipes under the sidewalk, and by the re-bar in the street curb along the right margin of the map. This block also shows a steel pipe along the top of the bluff, at the west edge of this map (Figure 8). There is a sharp monopolar high at 10W, 20N that is probably due to a sub-vertical piece of steel. At 11.7W, 18N there is a small subhorizontal object with its long axis E-W, a typical dipolar anomaly. Another is located at 10.3W, 17.8N, and its long axis is NW-SE.
Another is at 11.6W, 12N, along the south edge of the Block, with its axis oriented E-W. These small magnetic bodies are at or near the surface and are probably not of any further interest.

Figure 8. Magnetic gradient map of Block 01. The east margin is the edge of the curb. Alternate survey lines are shown.

*Block 01 GPR Survey.* The profiles on the Block01.ppt file clearly show two pipes, a shallow one at 10mE and a deeper one at 11mE (corresponding to 6mW and 5mW on the magnetic maps). The shallow one is at about 35 cm and the deeper at 60 cm depth. Figure 9 shows a pair of lines from one of the ppt slides.
Figure 9. Example of GPR profiles from Block01 at 18.0 (bottom) and 18.5 mN (top). The right edge is at the curb, or 0W field coordinate.

These un-migrated profiles show the pipes (and many other discrete objects) as hyperbolas. They also show the disturbance caused by a very shallow pipe along the W edge of the profiles (see also the magnetic map). These profiles show an undulating stratigraphic boundary or interface at about 1 meter depth. Some of the profiles show another discontinuous reflector at about 2.6 meters. The upper boundary resembles the base of a fill zone, perhaps overlying the original land surface. This would be a reasonable target depth for archaeological excavations in this Block. The deeper boundary is probably a geologic feature related to a change in sediment type or grain size.

Figure 10 is an example of one of the horizontal slices through the 3D GPR volume display. In this case, the migration process has collapsed the original hyperbolic pattern of a pipe
to a more focused pattern at the crest of the hyperbola. This view is looking down to the NE, east being to the right.

Figure 10. Step or chair display of the 3D volume display (migrated) of Block01 GPR survey. This horizontal slice is at the depth of the lower pipe (60 cm) at the 11mE coordinate.

In sum, recent features such as pipes or utility conduits dominate the GPR survey of Block01. Some stratigraphic features can be traced over much of the area of the block. A few profiles (13.0 and 13.5N) show multiple weak shallow hyperbolae that may be large tree roots. Some profiles show a band of low frequency ringing that extends from near the surface to the bottom of the GPR profile. An example is at 11.6mE on Line 16.0. This is caused by the antenna lifting over a surface irregularity (decoupling), or by the antenna passing over a near surface object of high conductivity.

Block 02 Magnetic Survey. Again, the east half of this block (Fig. 11) is overprinted by the magnetic effect of the continuous S-N pipes and by the re-bar in the curb. Even so, there are two monopolar highs strong enough to show in this area, one at 1.3W, 46N, and the other at 4.6W,
53.5N. These are small near-surface sub-vertical steel objects. At 7.5W, 52.5N, there is an inclined dipolar anomaly with the negative pole closer to the surface than the positive pole. In the western half of the block, there are two shallow monopolar magnetic highs, a very small object at 10W, 54N, and another at 13.2W, 45.5N. The most interesting magnetic anomaly in this block is probably the smooth monopolar high at 10W, 48.8N, because it is not at the surface, but probably about a meter in depth. The pipe at the west edge of Block01 does not enter this block.

Figure 11. Magnetic gradient map of Block 02. W-E lines are at 0.5 meter spacing. The large anomalies between 4-6mW are from the S-N system of pipes.

*Block 02 GPR Survey.* The GPR profiles in this block show two pipes clearly, but only about 0.5 m apart, although still at different depths. The profiles clearly show the first layer base (possible base of fill) at about 1 m deep, as well as an eastward-dipping boundary at 1.5 to more than 2 m deep (see Fig. 12).
Figure 12. GPR profile of Line 46.5N showing pipes at 8.5 and 9mE coordinates. Boundary at 1 m depth and E-dipping boundary beginning at the west edge at 1.5 m are also apparent.

The GPR profile of Line 49N (in Appendix A) shows a shallow hyperbola and an enhancement of the reflection on the 1m-deep boundary, at 4mE. This coincides with the monopolar magnetic high (10W magnetic coordinate) mentioned above.

Figure 13. Fully processed GPR 3D view of Block 02, showing a very shallow slice.
Examples of horizontal GPR slices are shown here. Fig. 13 above is a surficial slice only a few cm deep. It clearly shows the sidewalk and an oval feature (old garden bed?) west of the sidewalk.

Fig. 14 below is a deeper slice at 73 cm and shows clearly the second or deeper pipe. There is also a pair of subtle NW alignments of reflective points in the west half of the slice whose origin is unknown.

Figure 14. GPR 3D view of Block 02 at the 73 cm level.

Block 03 Magnetic Survey. This block has far more localized magnetic anomalies than the previous block. Between the curb anomalies and the large pipe anomalies (4 – 6m W), there are quite a number of shallow dipolar anomalies due to iron and steel objects (Fig. 15). The western half of the map is also very disturbed magnetically, but again mostly with near-surface dipolar features. An exception is the broad, smooth monopolar high, centered at 14.7W, 76.5mN and elongated to the NE. This feature is similar to one mapped at the Fort St. Joseph site in Niles, MI, which proved to contain a large concentration of baked clay (Nassaney et al. 2002-2004).
Figure 15. Magnetic gradient map of Block03.

**Block 03 GPR Survey.** The GPR profiles in this block do not all show the pipe system clearly, and maximum depth of penetration is less than in the 2 blocks to the south. In this block, there is not much coherent reflection energy from below 1.5-2.0 meters (Fig. 16). This is apparently due to increasing electrical conductivity of the soils, which decreases penetration of the radio pulse. The profiles in Fig. 16 show the reflections associated with the monopolar magnetic anomaly mentioned above in the SW corner. They are at the 1.0-2.5mE coordinate (13.5-15mW on magnetic map), and are strongest in the depth interval of 50-130 cm.

These GPR profiles also show easterly dips of layers in the central portion. Further, there are a series of deeper, strong reflectors in the central area, commencing at about 80 cm and extending to at least 170 cm.
The fully processed and migrated 3D slice display (Fig. 17) shows the oval area in the SW corner that is coincident with the monopolar magnetic anomaly. It also shows some of the high amplitude reflections in the south-central area of the block that are visible on the profiles above.
Figure 17. GPR fully processed 3D Block 03 rendition with horizontal slice at 85 cm.

*Block 04 Magnetic Survey.* The magnetic map shown in Fig. 18 again shows the strong response of the cluster of pipes between the 4-6mW coordinates. Note that the street curb shifted west by about 2 m between Block 03 and Block 04; hence the right edge of this and all subsequent maps begins at the 2mW coordinate. The pipe cluster continued straight north at 4-6mW. The sidewalk shifted west to maintain a constant distance from the curb.
Due to this change, the anomalies due to the re-bar in the curbing nearly converge on the pipe anomalies, literally obstructing any possible weak anomalies that might be of archaeological origin in the eastern third of the block. The west part of this block shows many small, shallow dipolar anomalies that are most likely small steel and iron articles at very shallow depths and related to recent use of the park. A slightly larger, deeper object may be at line 104 at the 14.5mW coordinate, or 3.5m E of the west side of the block.

**Block 04 GPR Survey.** The 21 GPR transects over this block show the pipe system more clearly than in Block 03, perhaps because the pipes are no longer below the sidewalk. Coherent GPR reflections appear to die out at about 2 m depths (Fig. 19). This figure also shows the disturbance at about 0.5 m depth at the 3.5mE coordinate that was mentioned in the magnetic
discussion above. It is also visible on the 103.5N and 105N lines (see CD ROM). Several hyperbolae from pipes are visible between 12 – 14mE.

Figure 19. GPR transect 104.5N (top) and 104.0N (bottom).

The fully processed 3D data block (Fig. 20) shows 2 of the pipes at the 80 cm depth slice. It also shows a subtle large oval feature just west of the pipes. This feature can also be seen on the 52 cm slice (Appendix A).
Figure 20. GPR 3D volume rendering of Block 04, with horizontal slice at 80 cm.

*Block 05 Magnetic Survey.* The magnetic map shown in Fig. 21 shows the street curb anomalies along the right margin, and the usual strong anomalies due to the pipe complex between 4 – 6mW. The remainder of the map shows a broad background trend whose axis is about 25 degrees east of north (as did several other blocks to the south). This effect is most likely due to large-scale geological depositional patterns, too pervasive and deep to be of any archaeological interest.
Once again, the western 2/3 of the map is covered with dozens of small shallow monopolar and dipolar magnetic anomalies, all of which can be attributed to recent trash such as nails and bits of wire. There are three somewhat more substantial anomalies; at 115N, 14.5W, at 115.5N, 10mW, and at 124N, 9.7mW. These are apparently due to pipe fragments, signpost bases, etc. One of those along the bottom of the map can be seen on the GPR profile.

**Block 05 GPR Survey.** The unmigrated GPR profiles show several of the pipes in the 3 – 6mW zone, and also appear to have increased penetration to about 2 m once again (Fig. 22). Many of the profiles show at least 2 semi-continuous undulating surfaces; the uppermost may represents the base of fill or top of a buried ground surface. There is a hyperbola below the magnetic anomaly on line 115.0N at the 10m GPR coordinate, but no GPR indication below the magnetic anomaly at 5.5m (GPR coordinate). However, there are some strong radar returns at the 7-8m
GPR coordinate. The 3D rendering shows 4 slices (Appendix A), but none show noteworthy features, other than the N-S pipes.

Block 06 Magnetic Survey. This block shows, in addition to the usual N-S pipes at 4 – 6mW, some pipes crossing in the E-W direction, as can be seen by the alternating magnetic high and low patterns in Fig. 23 at 135.5N. There is a drinking fountain (large magnetic low) at the 135.5N, 9mW coordinate, obviously connected to the E-W pipe.
Once again, the surface and near-surface installations dominate over half the area of this magnetic map. The area between 130-134N, and west of the -8 coordinate has a sprinkling of the shallow monopole and dipole anomalies like those of Block 05.

**Block 06 GPR Survey.** The unmigrated GPR profiles clearly show the upper boundary, which begins at about 70 cm on the W edge of the block, and deepens to about 100 cm at the E edge (see Fig. 24). The lower stratigraphic reflector is much more irregular on this figure, starting near 100 cm on the west and abruptly deepening to about 180 cm about 3 m from the W edge of the block. These profiles also show the ringing (from top to bottom) due to the metal pipe of the drinking fountain at 10.5mE (9.5m W magnetic coordinate). Line 135.5N shows at 6.5mE a strong discrete reflector right on top of the interpreted original soil layer.
Lines 139N and 139.5N (see Appendix A) show numerous close-spaced shallow hyperbolae 3 to 8 m E of the W side of the block. These are probably the shallow roots of a large tree.

Another GPR line shown on Fig. 25 illustrates the shallow disturbances at 4.5 and 6.0 m E that coincide with the pair of positive magnetic anomalies at this position.

Figure 24. GPR profiles on Lines 135.5N (top) and 135.0N (bottom) – unmigrated.

Figure 25. GPR Line 137.5N.
**Block 07 Magnetic Survey.** This magnetic survey (Fig. 26) shows the usual large N-S pipe and curbing features along the eastern 1/3 of the map. The center of the map is also occupied by strong E-W anomalies, in this case probably due to electrical conduit, as there is a public telephone at 9mW, 201.5N, and a utility pole flanked by two steel posts just off the west side of the map, also at 201.5N. This leaves only a few mostly monopolar anomalies near the N and S edges of the map. These are clearly surficial in nature. The telephone installation causes a strong dipolar anomaly with extremely steep gradient between the high and low, as is expected for a surface source.

![Magnetic Gradient Map of Block 07](image)

**Figure 26. Magnetic gradient map of Block 07.**

**Block 07 GPR Survey.** The unmigrated GPR profiles again show the base of what is presumed as a fill layer at depths of about 70 cm, but a very undulating surface, as can be seen in Fig. 27.
This figure shows profiles in an area where the magnetic response is overwhelmed by strong surface anomalies. From 0 to 4mE on both Lines 200.0 and 200.5, the interface is very disrupted, which could indicate trenching at some unknown time. Just to the east of this, between 5 and 7.5mE, there is a very (un-naturally?) flat surface. At 9 – 10 mE the pipe and or conduit complex appears again.

![Figure 27. GPR Lines 200.5mN (top) and 200.0N (bottom); filtered but not migrated.](image)

**Block 08 Magnetic Survey.** This survey block contains the LaSalle Monument, between 221N – 223N, so there are 2-meter gaps in those lines blocked by the statue and base. Not visible at the surface, but very apparent on this map (Fig. 28) is a ring of positive magnetic anomalies,
probably old (wrought) iron in a former foundation of a previous monument, or the foundation of a previous fence around this area. The response is different from modern steel re-bar or pipe, in that the anomalies are all positive. The broad positive anomaly at the bottom center of the map is somewhat unique, and it appears to link with another similar positive anomaly that extends off the west side of the map. Perhaps this is the signature of some fill material (filling a small ravine?) that has a higher magnetic susceptibility than the native soil. Pipe and curb anomalies occupy the eastern ¼ of the map.

Figure 28. Magnetic gradient map of Block 08.

Block 08 GPR Survey. Examples of the unmigrated GPR profiles are shown in Fig. 29. For this block, GPR profiles were only done on Lines 214 – 220, as the monument and bushes precluded the possibility of doing complete profiles on the eight northern lines. The profiles again show two principal reflecting boundaries, undulating as in earlier blocks, nominally at 100 and 160 cm depths. There are at least three major pipes/conduits between 13.5 – 15.5m E coordinate. At 13.7mE, one pipe is almost directly below the other.
The 3D view in Fig. 30 shows the undulating and irregular nature of the reflectors below about 1 m depths. Also clear on this slice are the two upper pipes near the east edge of the block at 80 cm depth.

Figure 29. GPR on Lines 215.5N (top) and 215.0N (bottom).
Figure 30. Fully processed and migrated 3D rendering of Block 08 GPR with horizontal slice at 80 cm.

*Block 09 Magnetic Survey.* This magnetic map of Block 09 (Fig. 31) is rich in buried artificial features, mostly modern. The ever present N-S anomalies near the E side of the map are the pipe complex, with the curb re-bar at the very right edge of the map. It also shows a large transverse or E-W pipe at the 251.5N coordinate, clearly marked by the alternating high and low magnetic patterns. Near the west side of the map, this impinges upon, or cuts through, an older structure. This appears to be a rectangular foundation, with narrow positive magnetic anomalies and almost no sign of negative anomalies. This probably pre-dates 1945 and may be wrought iron or heavy wire in a foundation, as contrasted with the different anomalies caused by more modern rolled-steel reinforcing bars.
Superposed on this map is also the position of the sidewalk. Outside of the large magnetic features already mentioned, there are only a few tiny single-contour weak, shallow anomalies due to surficial debris.

**Block 09 GPR Survey.** The GPR profiles in this block also show a wealth of features. The northernmost nine lines show numerous shallow hyperbolae that are interpreted as roots of a large tree (beech?). Fig. 32 shows some of these features. East of the sidewalk, at least five pipes or conduits are visible. About 1.5 m from the W edge of the map is the GPR manifestation of the N-S magnetic object mentioned above, buried approximately 40 cm. A GPR reflector is shown on these two lines at 8m E, but this has no expression on the magnetic map (hence it is not steel).
Figure 32. GPR Lines 253.0N (top) and 252.5N (bottom); arrows probably indicate tree roots.

The feature 1.5 m from the west side of the map is shown clearly on the 3D view of the GPR data (Fig. 33). A subtle NW–trending feature exits the N edge of the volume at about 3.5m E, but is not visible on the individual profiles or on the magnetic map.

Figure 34 is another 3D view, but with a deeper slice shown, in which three of the pipes east of the sidewalk are clearly visible. Recall that the migration process (done before the 3D rendering) collapses the hyperbolae into a much smaller area at the crest of the former hyperbola.
Figure 33. Fully processed 3D rendering, Block 09 GPR data with horizontal slice at 36 cm.
Figure 34. Fully processed 3D version of GPR Block 09, showing horizontal slice at 50 cm.

*Block 10 Magnetic Survey.* The magnetic survey (Fig. 35) of this block also contains the large anomalies due to the N-S system of pipe and conduit E of the sidewalk. Just to the east of this are the curb anomalies at the east edge of the map. A single strong anomaly occurs in the center of the map, but this is clearly a near-surface piece of steel. A deeper dipolar anomaly with W-E polarity can be seen on the W edge of the map between 267 and 268mN. The remaining area has quite a number of very weak and small surface anomalies.

![Magnetic Gradient Map of Block 10](image)

*Figure 35. Magnetic gradient map of Block 10.*

*Block 10 GPR Survey.* The GPR profiles in Fig. 36 show at least five pipes or linear conductors E of the sidewalk. There is also a zone of strong, irregular reflections between 2 and 7 mE, at depths beginning at about 70 cm. Some discrete objects are circled on those profiles, and an arrow shows a probable root reflection hyperbola.
Fig. 37 is the 3D rendering of the fully processed (and migrated) GPR data. It shows two of the pipes E of the sidewalk, as well as the lower-amplitude shadow below the sidewalk. In the central and west areas, there are some diagonal high and low amplitude bands of unknown origin.

![Figure 36. GPR profiles along lines 270.0N (top) and 269.5N (below); unmigrated.](image-url)
Figure 37. 3D view of fully processed Block 10 GPR data, with horizontal slice at 70 cm.

*Block 11 Magnetic Survey.* The vertical gradient map of Block 11 (Fig. 38) contains the same large S-N anomalies due to the pipes or other buried utilities east of the sidewalk as do all the other blocks. The re-bar in the curbing defines the E edge of the map. The NE corner of this block is in the sidewalk ramp at the S side of Pleasant St. At the 287.5E coordinate there is a lateral (E-W) pipe extending to the W edge of the map. The broad partial magnetic low at 9W, 279N at the bottom of the map is probably due to the park bench just off the map to the S.
**Figure 38.** Magnetic gradient map of Block 11.

**Block 11 GPR Survey.** The GPR survey of Block 11 shows some of the features that are apparent on the magnetic map, such as the pipe/utility complex just E of the sidewalk. There are also many features that do not show on the magnetic map, as illustrated in Fig. 39. Conversely, the E-W pipe does not show on the E-W GPR profiles, as the antenna orientation precludes coupling with a long object parallel to the survey lines. A single N-S GPR profile was done over this block (see Appendix A, Block11.ppt presentation, last slide), and it verified the presence of the E-W pipe at a depth of about 30 cm.

Some discrete, or very localized strong reflections are indicated by the oval overlays on Fig. 39. The profiles also show that the sidewalk has a noticeable shadow effect, or decrease in the amplitudes of underlying features, probably due to higher conductivity of this portion of the sidewalk. Fig. 40 shows other noteworthy GPR anomalies, indicated with ovals.
Figure 39. GPR profiles along Lines 287.0N (top) and 286.5N (below); unmigrated.

Figure 40. GPR profiles along Lines 282.0N (top) and 281.0N (below).
Figure 41. 3D rendering of the fully processed GPR data of Block 11, showing the 140 cm horizontal slice.

The 3D view of the GPR data, shown in Fig. 41, displays one of the deeper S-N pipes, as well as an oval area of higher amplitudes west of the sidewalk in the center of the block. This is the deepest part of a larger, highly reflective zone that shows on shallower slices.

Block 12 Magnetic Survey. The vertical gradient map (Fig. 42) shows that the underground utility system E of the sidewalk continues N through this block as well as all previous blocks. Signposts and a fire hydrant further complicate the zone between the sidewalk and curb. The NW corner of the map has a complex distribution of sizable steel objects, and there are also two strong anomalies along the S edge of the map. The remainder of the map (yellow area) has only a scattering of small surface magnetic debris.
The anomalies in the SW corner appear to be monopolar and are somewhat deeper (broader and smoother); hence possibly of more interest. They can be examined on the GPR profiles.

*Block 12 GPR Survey.* The profiles from the GPR survey of Block 12 show many details and anomalous areas (Fig. 43). At the east side, at least five pipe hyperbolae are evident. On Line 315.5N, there are some strongly reflecting disturbed areas near the center, as indicated by the deepest oval marker, approximately 1.5m deep.

Fig. 44 shows the GPR anomalies to the left that coincide with the magnetic anomaly in the SW corner mentioned earlier. All four of the profiles on these figures show a central zone of stronger GPR reflections, as well as highly irregular layering (disturbed?).
Figure 43. GPR profiles of Lines 316.0N (top) and 315.5N (bottom).

Figure 44. GPR profiles of Line 310.0N (top) and Line 309.5N (bottom).
**Block 13 Magnetic Survey.** The magnetic map for this block is almost totally dominated by large pipes, to the point that there is very little area left to look for archaeological signatures (Fig. 45). Additionally, this block contained a storm drain grate, a large manhole cover, a drinking fountain, and nearby light pole.

Figure 45. Magnetic gradient map of Block 13.

One could interpret two crossing pipes, one going straight west at 352m N, and the other oriented about N50W, exiting the N edge of this map near the maple tree at 13m W coordinate. Also, there is evidence for what is probably a wire-reinforced concrete storm drain going west at the 347m N coordinate. The GPR section discusses this block further.

**Block 13 GPR Survey.** The GPR profile (Line 347.0N) shown on Fig. 46 was apparently nearly along the axis of a large-diameter pipe, crossing it at a small angle such that increasing lateral
offset is shown on the section as a deeper reflection to the west (rather than as a slant reflection). This feature is also seen on Line 347.5 (see CD-ROM, Block13.ppt).

Figure 47 shows numerous shallow hyperbolae that are most likely tree roots, as these lines are very close to a large tree on line 350N. Strong reflections from what appear to be four pipes are shown to the right, two pipes above the other two pipes. Near the west end of Line 350 there appear to be a possible filled excavation.

Figure 46: GPR profile along Line 347.0 N, showing a large pipe that diverges from the survey line to the west.
Block 14 Magnetic Survey. The vertical gradient magnetic map of Block 14 (Fig. 48) continues to show the high-amplitude pipe complex and curb anomalies to the east of the sidewalk. Also, a lateral pipe departs the main pipe at about 369.5N and strikes about N75W, leaving the N edge of this map at about the 10mW coordinate. This leaves the majority of the map area free to look for weaker features of possible archaeological significance.
Some possible deeper features of interest are the two located at 14.5W, 363.3N and at 14W, 368N. Both are monopolar highs, with gentle gradients and depth estimators that place their sources below about 1 m.

*Block 14 GPR Survey.* The W-E GPR profiles show numerous features, but neither of the gentle magnetic highs mentioned just above have any expression on the GPR profiles. Similarly, the pipe striking off to the WNW is not seen on the profiles, because it is nearly parallel to the GPR transect, and because it is probably a small diameter pipe.

Fig. 49 shows tree roots (arrows), and a group of (perhaps three) pipes near the east end. At the west central area a disturbed zone is marked by the oval. It changes gradationally to the east to a smooth planar reflector at about 80 cm depth.
Fig. 50 shows a reflective disturbed zone in the middle of both profiles, as well as at least four pipes to the right. The start of the WNW pipe is the dipping feature below the sidewalk.

Figure 49. GPR profiles along Lines 365.0N (top) and 364.5N (below). Arrows show probable tree roots.
Block 15 Magnetic Survey. Block 15 is just to the north of the fountain; the S edge being about 1 m N of the outer edge of the circular sidewalk. The magnetic gradient map (Fig. 51) shows an area dominated by the S-N pipes, and two lateral pipes going westerly from the S-N pipes. Additionally, there is an area of concentrated iron and steel at the SW edge of the map. This is probably the base or foundation of an earlier structure, such as the moving stairway. The very strong positive anomaly in the SE corner is largely due to the antique cast iron light post at 427N. Outside of these overwhelming features, there are no subtle features that might indicate archaeological remains.

Figure 51. Magnetic gradient Map of Block 15.
Block 15 GPR Survey. Figure 52 shows lines 427.5N and 428.0N. They both show the high amplitude reflections apparently caused by the same feature as the strong magnetic anomaly at the west ends of these lines. At about 10E on Line 428, there is a disruption of the nearly planar reflecting surface, and a broad hyperbola fills the break. This could be the lateral pipe crossing the GPR line at a small angle, as shown on the magnetic map and mentioned above. Several of the S-N pipes cause strong hyperbolae near the E end of these profiles. The other profiles show a few other discrete features (see Appendix A, Block15.ppt). Undulating boundaries can be seen near 80 cm depth and a second one at 160-170 cm, as has been common in most of the blocks.

Figure 52. GPR profiles along Lines 428.0N (top) and 427.5N (below).

Block 16 Magnetic Survey. The magnetic map of this block (Fig. 53) is relatively free of the overprints of pipes and foundations, except for the pipe/utility system E of the sidewalk. For this
block, even the curb has no apparent effect, which may suggest that a different contractor who did not use re-bar installed it. The remaining area, west of the sidewalk, appears to show only a scattering of small near-surface debris. The hanging swing, with its heavy steel chains, was removed before the magnetic survey was done. The wooden posts and crossbar had no effect on the magnetometer.

Figure 53. Magnetic gradient map of Block 16.

**Block 16 GPR Survey.** Most of the profiles show the normal pair of stratigraphic reflectors, the upper near 100 cm, and the lower at variable distances below. The upper frame of Fig. 54 shows these, which are marked with arrows. The S-N pipes, at least three, are apparent near the E ends
of the profiles. Near the W end, there are shallow hyperbolae that are aligned on at least six adjacent GPR profiles. It has no magnetic expression, and is thus probably a plastic pipe, or else copper wiring in aluminum conduit.

Fig. 55 shows the northernmost two lines of this project. They show some ‘bright’ disturbances about 2 – 5 m from the W end, and at depths of about 60 cm. On these profiles, the stratigraphic markers are not shown clearly. The ubiquitous S-N pipes show clearly, however.

Figure 54. GPR profiles of Lines 442.0N (top) and 441.5N (below); unmigrated.
In sum, the magnetic and ground penetrating radar surveys showed many discrete anomalies, far too many to excavate. However, most of these have their origin in the upper meter of soil. The GPR surveys also appeared to show at least two extensive (stratigraphic?) boundaries. In retrospect, after test excavations, the upper boundary is likely the base of landscaping fill used to level the site. Hence, any future investigations should focus on anomalous features that are at and below this GPR reflection or boundary. The area between the sidewalk and curb is dominated by strong magnetic anomalies and GPR reflections from a system of N-S pipes, as well as the curbing.
Archaeological Survey Methods

After the geophysical survey was completed, we began conducting subsurface investigations to collect contextual data on archaeological materials in the project area. We excavated a total of 52 shovel test pits (STPs), six 1 x 1 m excavation units, and one 1 x 1.5 m trench (Figure 56). Three criteria guided the placement of our excavations. First, we chose to examine those near-surface geophysical anomalies that had the potential to be of archaeological interest. Anomalies thought to be deeper than 1 m were excluded from our search, with one exception, because excavations were not feasible to this depth. Second, we purposefully avoided anomalies that were consistent with modern features such as utility lines. Third, we placed STPs systematically across the project area in order to ensure even coverage.

We had few a priori ideas about the nature of the soil stratigraphy, the degree of disturbance, or landscape modification in the project area. Soil surveys are not helpful because they do not usually contain information on soils in urban areas. Not surprisingly, excavations demonstrated that there is considerable variation in the soils in the project area. Most of this is due to the landscaping activities and the presence of fill that was likely brought in to create a level surface. Some of the project area is relatively undisturbed. In these areas excavations revealed that the soil stratum consists of a layer of sod underlain by a dark brown loam (A horizon) of varying depth averaging about 20-25 cm as observed in N22 W10 (see Figure 57). This is underlain by yellow brown sand (B horizon). This zone generally becomes lighter and coarser with depth. These coarse sediments, sometimes as shallow as 52 cm, were probably deposited by post-glacial floodwaters in the early Holocene.
Figure 56. Location of excavations in the project area. Shovel test pits designated by •; larger excavation units designated by open squares.
Figure 56 (continued).
Figure 56 (continued).
Figure 57. Schematic soil profile based on excavations. Soil horizons designated A, B, and C; F represents artificial fill. Note that the profile is facing west, broken up into three segments with some overlap (continued below), and the vertical scale is exaggerated.

Figure 57 (continued).
In some areas that we tested, a thin layer of fill buried what was otherwise a natural soil sequence (e.g., N47 W14). Multiple fill zones were noted in many areas, often in association with late 19th–early 20th century artifacts (e.g., N95 W10). Several STPs dug between N285 and N368 particularly near the edge of the bluff revealed a 10-30 cm layer of gray clay, sometimes mixed with gravel (e.g., N312 W15.5). This zone appears to have been deposited to stabilize the bluff top and deter erosion. The prevalence of fill throughout the project area is clearly shown in Figure 57, a schematic cross-section of the bluff along a N-S axis based on our excavations.

In addition to the fill that we encountered in many excavations in the project area, we also identified a number of features. Some of these features coincide with geophysical anomalies. However, most of the features proved to be of 19th and early 20th century origin and of limited archaeological interest. Table 2 lists our shovel test pit and excavation unit coordinates, the type of anomaly investigated (when relevant), and our findings. For example,
excavators encountered an iron pipe (N27 W15), a ceramic pipe (N37 W15) (Figure 58), a plastic sprinkler head (N110 W16), electrical wires (N47 W14), and PVC pipes (N17 W15, N27 W15, N254.5 W16). A strong shallow dipolar anomaly at N76 W11 proved to be the base of a metal signpost (Figure 59). Immediately to the west at N76 W15 the excavators investigated a high monopole and identified electrical wires and a small concentration (ca. 60 by 50 cm) of coal and charcoal at about 24 cm BS. This apparent pit or fill zone also contained a bone, several pieces of glass, and two white ware sherds, one of which is possibly blue, shell edged. This subsurface deposit probably accounts for the magnetic anomaly.

Figure 58. Ceramic pipe exposed in excavation at N37 W15 (photo by Michael Nassaney).
Figure 59. Sign post exposed in N76 W11 at 13 cm BS (photo by Michael Nassaney)
Table 2. Summary of excavations and ground truth results.

<table>
<thead>
<tr>
<th>Date</th>
<th>STP/EU</th>
<th>Dimensions</th>
<th>Block</th>
<th>Type of Anomaly</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/15/05</td>
<td>N12 W10</td>
<td>40 x 40 cm</td>
<td>1</td>
<td>none</td>
<td>shallow fill underlain by A/B</td>
</tr>
<tr>
<td></td>
<td>N22 W10</td>
<td>40 x 40 cm</td>
<td>N of Bl. 1</td>
<td></td>
<td>A/B sequence</td>
</tr>
<tr>
<td></td>
<td>N37 W10</td>
<td>40 x 40 cm</td>
<td>N of Bl. 1</td>
<td></td>
<td>A/B sequence</td>
</tr>
<tr>
<td></td>
<td>N42 W10</td>
<td>40 x 40 cm</td>
<td>N of Bl. 1</td>
<td></td>
<td>A/B sequence</td>
</tr>
<tr>
<td></td>
<td>N52 W10</td>
<td>40 x 40 cm</td>
<td>2</td>
<td>none</td>
<td>A/B sequence</td>
</tr>
<tr>
<td></td>
<td>N52 W7.5</td>
<td>40 x 40 cm</td>
<td>2</td>
<td>low monopole</td>
<td>A/B sequence</td>
</tr>
<tr>
<td></td>
<td>N76 W11</td>
<td>40 x 40 cm</td>
<td>3</td>
<td>dipole</td>
<td>metal sign post</td>
</tr>
<tr>
<td></td>
<td>N17 W15</td>
<td>40 x 40 cm</td>
<td>1</td>
<td>linear dipole</td>
<td>fill, A/B, PVC pipe</td>
</tr>
<tr>
<td></td>
<td>N27 W15</td>
<td>40 x 40 cm</td>
<td>N of Bl. 1</td>
<td></td>
<td>iron pipe, PVC pipe</td>
</tr>
<tr>
<td></td>
<td>N37 W15</td>
<td>40 x 40 cm</td>
<td>N of Bl. 1</td>
<td></td>
<td>fill, A/B, ceramic pipe</td>
</tr>
<tr>
<td></td>
<td>N47 W14</td>
<td>40 x 40 cm</td>
<td>2</td>
<td></td>
<td>fill, A/B, live wires</td>
</tr>
<tr>
<td></td>
<td>N76 W15</td>
<td>40 x 40 cm</td>
<td>3</td>
<td>high monopole</td>
<td>fill, live wires</td>
</tr>
<tr>
<td>10/16/05</td>
<td>N76 W14.5</td>
<td>1 x 1 m</td>
<td>3</td>
<td>high monopole</td>
<td>charcoal, ash, fill</td>
</tr>
<tr>
<td></td>
<td>N81 W13.5</td>
<td>40 x 40 cm</td>
<td>3</td>
<td>discrete, high mag</td>
<td>fill?</td>
</tr>
<tr>
<td></td>
<td>N85 W10</td>
<td>40 x 40 cm</td>
<td>N of Bl. 3</td>
<td></td>
<td>Fill</td>
</tr>
<tr>
<td></td>
<td>N95 W10</td>
<td>40 x 40 cm</td>
<td></td>
<td></td>
<td>fill, numerous artifacts</td>
</tr>
<tr>
<td></td>
<td>N105 W10</td>
<td>40 x 40 cm</td>
<td></td>
<td></td>
<td>Fill</td>
</tr>
<tr>
<td></td>
<td>N90 W14</td>
<td>40 x 40 cm</td>
<td>N of Bl. 3</td>
<td></td>
<td>Fill</td>
</tr>
<tr>
<td></td>
<td>N100 W14</td>
<td>40 x 40 cm</td>
<td>4</td>
<td>weak dipole</td>
<td>A/B sequence</td>
</tr>
<tr>
<td></td>
<td>N110 W16</td>
<td>40 x 40 cm</td>
<td>N of Bl. 4</td>
<td></td>
<td>sprinkler head</td>
</tr>
<tr>
<td></td>
<td>N115 W10</td>
<td>40 x 40 cm</td>
<td>5</td>
<td>weak dipole</td>
<td>iron rebar</td>
</tr>
<tr>
<td>10/30/05</td>
<td>N132.5 W12.5</td>
<td>40 x 40 cm</td>
<td>6</td>
<td>weak monopole</td>
<td>large, metal artifact</td>
</tr>
<tr>
<td></td>
<td>N147 W12</td>
<td>40 x 40 cm</td>
<td>N of Bl. 6</td>
<td></td>
<td>fill underlain by B horizon</td>
</tr>
<tr>
<td></td>
<td>N219 W14</td>
<td>40 x 40 cm</td>
<td>8</td>
<td>strong dipole</td>
<td>iron rebar</td>
</tr>
<tr>
<td></td>
<td>N136.5 W19.5</td>
<td>40 x 40 cm</td>
<td>6</td>
<td>high monopole</td>
<td>artifacts and fill</td>
</tr>
<tr>
<td></td>
<td>N218.5 W10</td>
<td>40 x 40 cm</td>
<td>8</td>
<td>low monopole</td>
<td>A/B sequence</td>
</tr>
<tr>
<td></td>
<td>N247 W16</td>
<td>1 x 1 m</td>
<td>9</td>
<td>high linear mag</td>
<td>A/B sequence</td>
</tr>
<tr>
<td></td>
<td>N254.5 W16</td>
<td>1 x 1 m</td>
<td>9</td>
<td>high linear mag</td>
<td>A/B, PVC pipe</td>
</tr>
<tr>
<td>11/5/05</td>
<td>N268.5 W11.5</td>
<td>40 x 40 cm</td>
<td>10</td>
<td>high monopole</td>
<td>fill underlain by B horizon</td>
</tr>
<tr>
<td></td>
<td>N285 W15</td>
<td>40 x 40 cm</td>
<td>11</td>
<td>none</td>
<td>Fill</td>
</tr>
<tr>
<td></td>
<td>N308 W15.5</td>
<td>40 x 40 cm</td>
<td>12</td>
<td>dipole?</td>
<td>metal sign post</td>
</tr>
<tr>
<td>11/5/05</td>
<td>N312 W15.5</td>
<td>40 x 40 cm</td>
<td>12</td>
<td>weak monopole</td>
<td>clay, gravelly fill</td>
</tr>
<tr>
<td></td>
<td>N324 W10</td>
<td>40 x 40 cm</td>
<td>N of Bl. 12</td>
<td></td>
<td>fill underlain by B horizon?</td>
</tr>
<tr>
<td></td>
<td>N271.5 W14</td>
<td>40 x 40 cm</td>
<td>10</td>
<td>GPR anomaly</td>
<td>fill underlain by A/B concentration of several stones</td>
</tr>
<tr>
<td></td>
<td>N271.5 W14</td>
<td>1 x 1 m</td>
<td>10</td>
<td>GPR anomaly</td>
<td>Fill</td>
</tr>
<tr>
<td></td>
<td>N329 W15.5</td>
<td>40 x 40 cm</td>
<td>N of Bl. 12</td>
<td></td>
<td>Fill</td>
</tr>
<tr>
<td></td>
<td>N282 W11</td>
<td>40 x 40 cm</td>
<td>11</td>
<td>none</td>
<td>fill, brick concentration</td>
</tr>
<tr>
<td></td>
<td>N282 W10</td>
<td>40 x 40 cm</td>
<td>11</td>
<td>none</td>
<td>fill, brick concentration</td>
</tr>
<tr>
<td></td>
<td>N308 W10</td>
<td>40 x 40 cm</td>
<td>12</td>
<td>weak dipole</td>
<td>fill, nails, slag</td>
</tr>
<tr>
<td></td>
<td>N317.5 W18</td>
<td>40 x 40 cm</td>
<td>12</td>
<td>discrete dipole</td>
<td>gravelly fill</td>
</tr>
</tbody>
</table>
A weak dipole was examined at N115 W10 in Block 05 where a piece of iron rebar was found. A stronger dipole was also examined at N219 W14 immediately south of the La Salle monument. This block was dominated by a series of magnetic anomalies that seemed to encircle the monument. Excavations identified a piece of iron at about 36 cm BS that may relate to the magnetic signature. According to Tom MacFarlane, photographic evidence exists for a fence that once encircled the monument in the late 19\textsuperscript{th}-early 20\textsuperscript{th} century. The fence in Figure 7 appears immediately east of the monument.

A high linear magnetic anomaly was examined at N247 W16. Although the origins of the anomaly could not be determined, excavations identified bone, glass, a four-holed glass button, a three-tined metal fork, a gaming piece, and some brick. Of particular interest were the presence of charcoal and a small concentration of eight pieces of fire-cracked rock at 38 cm BS in apparently undisturbed context. The form and provenience of these latter materials are consistent with expectations for an ancient Native American occupation. However, neither stone tool

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Size</th>
<th>Value</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>11/11/05</td>
<td>N351 W16.5</td>
<td>40 x 40 cm</td>
<td>13</td>
<td>weak high mag A/B sequence</td>
</tr>
<tr>
<td></td>
<td>N376 W15</td>
<td>40 x 40 cm</td>
<td>N of Bl. 14</td>
<td>clay fill underlain by B horizon</td>
</tr>
<tr>
<td></td>
<td>N440 W15</td>
<td>40 x 40 cm</td>
<td>S of Bl. 16</td>
<td>fill underlain by A/B</td>
</tr>
<tr>
<td></td>
<td>N440 W17</td>
<td>40 x 40 cm</td>
<td>S of Bl. 16</td>
<td>fill underlain by A/B</td>
</tr>
<tr>
<td></td>
<td>N443 W17</td>
<td>40 x 40 cm</td>
<td>W of Bl. 16</td>
<td>fill underlain by A/B</td>
</tr>
<tr>
<td></td>
<td>N427 W18.5</td>
<td>1 x 1 m</td>
<td>15</td>
<td>large mag dipole large piece of iron</td>
</tr>
<tr>
<td></td>
<td>N363 W15</td>
<td>40 x 40 cm</td>
<td>14</td>
<td>weak mag high root at 5 cm</td>
</tr>
<tr>
<td></td>
<td>N368 W15</td>
<td>40 x 40 cm</td>
<td>14</td>
<td>weak mag high clayey fill</td>
</tr>
<tr>
<td></td>
<td>N430 W10</td>
<td>40 x 40 cm</td>
<td>15</td>
<td>none root at 5 cm</td>
</tr>
<tr>
<td></td>
<td>N435 W8</td>
<td>40 x 40 cm</td>
<td>15</td>
<td>none A/B sequence</td>
</tr>
<tr>
<td></td>
<td>N440 W10</td>
<td>40 x 40 cm</td>
<td>S of Bl. 16</td>
<td>A/B sequence</td>
</tr>
<tr>
<td></td>
<td>N443 W10</td>
<td>40 x 40 cm</td>
<td>16</td>
<td>none shallow pit feature?</td>
</tr>
<tr>
<td></td>
<td>N365 W10</td>
<td>40 x 40 cm</td>
<td>14</td>
<td>none fill underlain by A/B</td>
</tr>
<tr>
<td></td>
<td>N380 W10</td>
<td>40 x 40 cm</td>
<td>N of Bl. 14</td>
<td>A/B sequence</td>
</tr>
<tr>
<td></td>
<td>N430 W18.5</td>
<td>1 x 1 m</td>
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<td>none</td>
</tr>
<tr>
<td></td>
<td>N440 W3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/12/05</td>
<td>N445 W9.5</td>
<td>40 x 40 cm</td>
<td>16</td>
<td>none A/B sequence</td>
</tr>
<tr>
<td></td>
<td>N443.75 W9.5</td>
<td>50 x 50 cm</td>
<td>16</td>
<td>none A/B sequence</td>
</tr>
<tr>
<td></td>
<td>N448.5 W11</td>
<td>1 x 1.5 m</td>
<td>16</td>
<td>deep GPR anomaly gravel stratum @ 1.62 m</td>
</tr>
</tbody>
</table>
debitage (i.e., production and maintenance debris) nor Native American pottery was found in this area. Nevertheless, this is the best evidence for Native American activity in the project area, along with three isolated flakes that were also recovered.

The base of what appeared to be a second metal signpost was identified 2 cm BS at N308 W15.5 where a possible dipole was detected. A GPR anomaly was examined at N271.5 W14. A small concentration of stones was identified and mapped at 45 cm BS in proximity to a scatter of charcoal. A broad range of artifacts including glass, ceramics, brick, mortar, charcoal, metal, bone, ceramics, nails, clinkers, and a 1905 Barber dime were collected; the deposits in this area appear to be fill.

A large concentration of brick was recovered from two adjacent STPs at N282 W10 and N282 W11. Over 500 pieces of brick and mortar were recovered, even though there was no clear signature of higher magnetic susceptibility. The bricks and mortar, which extended to at least 71 cm BS, likely represent the remains of the foundation of the gazebo or band shell that was once located in this area.

A 1x 1-m excavation unit was placed at N427 W18.5 to investigate a large magnetic dipole. At 21 cm BS a large piece of iron at least 6 cm thick was noted in the unit and extended into the west wall (Figure 60). A large slab of concrete was exposed in the northeast corner running diagonally through the unit. These materials may be related to the movable stairway that transported people up (and down?) the bluff in the early 20th century.

Excavations at N443 W10 encountered a dark brown sandy loam underlain by yellow brown sand. Numerous artifacts were recovered to a depth of 52 cm BS including container glass, ceramics, a quahog shell, a shell button, brick fragments, and 27 machine cut nails. At the base of the excavations we recovered a hand-blown glass bottle fragment with a hand-tooled lip
Figure 60. Iron and concrete in N427 W18.5. This may represent remnants of the movable stairway in use during the early 20th century (photo by Michael Nassaney).

(Figure 61). The bottle resembles forms that were produced in the late 18-early 19th century; however, it appears to have been deposited in a small pit or depression no earlier than the latter half of the 19th century based on the associated artifacts.

Another dense deposit of artifacts was noted nearby at N443.75 W9.5. This unit yielded numerous materials from 14-67 cm BS including ceramics, glass, nails, a clay smoking pipe fragment, brick, coal, clinkers, and a Civil War token. Although the stratigraphy appeared to be undisturbed, the high frequency of artifacts likely represents a deposit of fill from the late 19th-early 20th century.

A 1 x 1.5 m excavation trench was placed at N448.5 W11 to examine a deep GPR anomaly. The upper horizon consisted of a dark brown loam underlain by yellow brown sand, orange brown sand, tan sand, and gray sand. At 108 cm BS we encountered coarser sediments with clay and gravel from 132-162 cm BS. Most of the artifacts were found in the upper 44 cm,
including nails, brick, container glass, a clay pipe stem, one unburned bone, coal, and two possible chert flakes. The deep layer of gravel may represent a disconformity that was detected by the GPR.

In sum, some areas of Lake Bluff Park are relatively undisturbed; beneath a layer of sod there is a dark brown sandy loam (A horizon) underlain by yellow brown sand (B horizon) that becomes increasingly coarse with depth. Lenses of clay and gravel also occur from 1-1.62 m below surface. Artifacts tend to be found in the upper 30 cm in these areas. Much of the project area exhibits clear evidence of landscape modification, most of which probably occurred over the past 100-150 years. Trenches were dug to install utility lines and fill was brought in to create level surfaces. In some areas where there is fill, artifacts were found to a depth of 71 cm BS (e.g., N282 W11). Although it was often difficult to distinguish fill from undisturbed soil horizons,
many artifacts associated with domestic activities (e.g., ceramics, coal, clinkers), particularly those deeper than 30 cm, represent secondary deposits. In the following section a more detailed discussion of the artifact types recovered from the project area is presented.

Artifact Descriptions

A total of 2280 artifacts were recovered from the project area. The artifacts vary by raw material, age, and function (see Appendix B). By examining the materials by functional type, the activities that took place in the project area can be discerned. Function is an important dimension of variation because it related to the primary purpose for which an object was made and the principal way in which it was used (Stewart-Abernathy 1986:54). The classification framework used in this study is comprised of major categories (e.g., personal, household, occupational), all of which can be subcategorized as needed (see Table 3). In some instances, the age of an artifact can also be determined, which can assist in establishing a deposit’s *terminus post quem*. Modern artifacts such as plastic and recent debris (e.g., bottle caps, fragments of Styrofoam) were not collected. With few exceptions, the majority of the artifacts appear to be no older than the mid-nineteenth century. No artifacts can be definitively dated to the seventeenth century and none is associated with the Fort Miami occupation. Furthermore, we did not find evidence of human burials in the project area, though we did recover one human tooth.
Table 3. Functional categories used to classify artifacts (modified from Stewart-Abernathy [1986:54-55]).

I. Personal
   A. Clothing
      1. Buttons, snaps, and fasteners
      2. Shoe parts
      3. Accouterments
   B. Health and Grooming
      1. Containers
      2. Hair items
      3. Dental
   C. Adornment
   D. Recreation
      1. Marbles
      2. Doll parts
      3. Metal toys
      4. Tobacco accessories
      5. Alcohol containers

II. Household
   A. Foodways
      1. Kitchenwares
         a. glass vessels
         b. stoneware vessels
         c. coarse earthenware
         d. cutlery
      2. Tablewares
         a. glass vessels
         b. ceramic vessels
         c. cutlery
         d. utensils
   B. Furnishings
   C. Facilities
      1. Lighting
         a. lamp chimney glass
         b. light bulbs
      2. Cooking
         a. iron stove parts
      3. Fuel related
         a. clinker
         b. coal
         c. slag
   D. Maintenance and Repair
      1. Sewing items
      2. Household repair

III. Built Environment
A. Construction Material
   1. Shingles
   2. Mortar/Plaster
   3. Wood
   4. Concrete
   5. Window glass
   6. Brick
   7. Drainage pipe
B. Fencing
C. Hardware
D. Fasteners
   1. Nails
   2. Threaded fasteners

IV. Occupational
A. Agricultural
B. Hunting
C. Other

V. Exchange
A. Commerce
   1. Coins and tokens
B. Communication
   1. Writing implements
C. Transportation
   1. Animal related
   2. Vehicle related

VI. Miscellaneous
A. Subsistence remains
   1. Plant
   2. Animal

VII. Native American Artifacts

VIII. Other

Personal Artifacts

Artifacts of a personal nature representing clothing, health, adornment, and recreation were recovered from the project area (see Figure 62). Clothing-related objects include three four-holed glass buttons, two two-holed shell buttons, one four-holed plastic button, a bone button with a metal stud, and a wood button with shell inlay. A patent medicine bottle fragment and the base of a melted glass vial relate to health and grooming. Objects like toothbrushes and combs are conspicuously lacking. Items of adornment include a metal (copper alloy?) finger ring and a
metal fox head effigy with an inset glass or stone eye. According to local residents, the project area has been the site of an art fair since the 1960s where jewelry similar to that recovered was sold. We also recovered a fragmentary black glass bead, a metal brooch with a pin, a brass buckle, and a rusty metal buckle. Park strollers likely lost these objects over the past two centuries.

Recreational artifacts include two clay marbles, a glass doll’s eye, a ceramic doll fragment, a metal gaming piece, and the handle from a toy porcelain cup (Figure 63). Fourteen clay pipe stem and bowl fragments were recovered, 10 of which were found in relatively undisturbed contexts. The form of one ceramic pipe bowl is similar to specimens that were made
Figure 63. Recreational artifacts. Top (l-r): two clay marbles. A glass doll’s eye, a metal gaming piece. Bottom (l-r): white ceramic pipe bowl, white ceramic pipe stem (photo by Stephanie Barrante).

and used in the late eighteenth and early nineteenth century and may be among the oldest artifacts in the collection.

Although alcohol is currently prohibited in the park, some glass containers may relate to recreational alcohol consumption. One large glass bottle fragment found at ca. 52 cm BS in a shallow pit (N443 W10) is free-blown with a hand-tooled lip (Figure 60). Based on similarities to other specimens in dated contexts and its pronounced patina, this bottle probably dates to the late eighteenth or early nineteenth century. However, the presence of associated square nails and other contemporaneous artifacts suggest that this bottle was re-deposited at this location no earlier than the mid-nineteenth century.
Household and Built Environment-Related Artifacts

Some objects associated with household activities such as food ways, furnishings, and facilities were recovered in the project area. In general, the low relative frequency of objects in this class is consistent with the passive recreational use of the project area for the past 170 years. Nevertheless, ceramics and other household-related objects were deposited in the project area, in many instances as a result of the fill that was brought in. Some possible kitchen wares that were recovered include brown, green, turquoise, and clear glass; a white canning jar lid fragment; a three-tined metal fork; a terra cotta sherd; and several fragments of large, stoneware storage vessels (see Figures 64-65). Most ceramic tableware types in use from the late nineteenth to twentieth centuries were recovered from the project area, with a predominance of white wares. A possible white ware plate displays a partial maker’s mark (Figure 65). Other types found include porcelain, hand painted, transfer printed ware, blue shell-edged, brown glazed, yellow glazed, brown and yellow glazed earthenware, blue glazed earthenware, flow blue, and two sherds of possibly delft and pearl ware. Most of this pottery is very fragmentary and probably associated with secondary deposits.

A ceramic fragment that did not relate to the preparation and serving of food was found in N443 W10. This clear glazed sherd of white ware appears to be the rim of a chamber pot, though it is too fragmentary to identify it with certainty (Figure 66). Six fragments of what appears to be graphite were recovered from different units in the project area. These are similar in form to broken battery cores, through their identification remains uncertain.

While light bulbs and stove parts were not found in the project area, there were copious amounts of coal and clinker, with a few pieces of slag. Coal and clinker were not as common as
they may be on domestic sites, and were probably incidental intrusions in the fill that was deposited in the project area.

Figure 64. Stoneware storage containers (photo by Stephanie Barrante).

Figure 65. Household-related artifacts. Top (l-r): yellow glazed ware, transfer printed ware, white ware with partial maker’s mark, large porcelain container. Bottom: three-tined fork (photo by Stephanie Barrante).
Likewise, objects related to the built environment were not as frequent as one might find on a domestic site. Nevertheless, mortar, concrete, window glass, and a drainage pipe fragment were recovered. The most common object in this class was brick. Several concentrations of brick probably relate to buildings that once stood in the project area, such as the gazebo and the band shell. Mortar and other artifacts in this class such as nails may also derive from the buildings that once stood in the project area. Nails were represented by both square machine cut and wire types; no hand-wrought nails typical of the 17th and 18th centuries were identified. Other fasteners and hardware include two screws, a possible hinge, a washer, a bracket, and two connected bolts.
Occupational and Exchange-Related Artifacts

Given that the project area was not the site of production, it comes as no surprise that there are so few objects from these categories. No agricultural artifacts were recovered. Eight gun shell casings of small, medium, and large caliber were found (Figure 67); these probably relate less to hunting than perhaps to the firing of ceremonial salutes in this commemorative park. Nassaney et al. (1996) recovered several shell casings that were associated with a salute commemorating the planting of a class tree by the Massachusetts Agricultural College’s Class of 1878. A somewhat unusual artifact that may relate to occupation is a metal alloy police badge in

Figure 67. Occupational and exchange-related artifacts. Top (l-r): Four shell casings of various sizes. Bottom (l-r): police badge, 1865 Indian Head cent, 1905 Morgan dime, 1863 Civil War token (photo by Stephanie Barrante).
the shape of an apparent star (Figure 67). While a policeman who patrolled the park may have worn the badge, it may also be a toy replica.

Several coins and tokens were found in the project area (Figure 67). These include an 1865 Indian Head penny and a 1905 Barber dime. A rather unusual find was a penny-sized copper token with the inscription “THE CONSTITUTION MUST AND SHALL BE PRESERVED.” The reverse depicts a ship with the word “MONITOR” below; the words above are not legible. Numerous private mints produced tokens to serve as a medium of exchange during the Civil War when currency was in short supply. With the end of the war, these tokens were no longer accepted in exchange and they quickly went out of circulation. Many of these tokens included patriotic slogans, such as the one inscribed on the object recovered in our excavation. According to various sources, the Monitor was the first ironclad ship built for use in the Civil War. After defeating the USS Virginia in the James River in 1862, she was headed south when she was caught in a storm off the coast near Cape Hatteras and sank on December 31, 1862. Today, there are hundreds of known designs of these so-called “Civil War tokens” and they are highly collectible by numismatists and others. Many tokens extol the virtues of the constitution and the union during a time of deep political crisis.

A small fragment of red glass may be from an automobile’s taillight. This was the only vehicle-related object found in the project area; automobile maintenance and repair would have surely been frowned upon in Lake Bluff Park.

Miscellaneous Artifacts

Several objects collected in the project area do not fit neatly into any of the aforementioned categories. Some subsistence remains were identified in the collection, unburned
animal bones being the most common. These were mostly small fragmentary remains; some
exhibit saw marks along their margins. They are likely food remains that were consumed outside
of the project area. Alternatively, the park may have been the site for picnics or other activities
that involved the use and discard of animal bones. At least three quahog shells (*Mercenaria
mercenaria*) were also collected (Figure 66). These were of small to moderate size and derive
from the eastern seaboard from southern Maine to Long Island Sound. These shells are likely
food remains that were transported by rail from the Atlantic coast to Michigan and perhaps
consumed in the hotel restaurants along Lake Boulevard. Another object of note is the tooth that
was recovered from N440 W17 (Figure 66). Physical anthropologist Charles Hilton (personal
communication, 2006) has identified it as a human tooth, specifically a third mandibular right
molar. The origins of this isolated find cannot be determined; it may derive from the human
burials that were reported along the edge of the bluff in the 19th century or it may have just been
lost sometime over the past 170 years. This is the only possible evidence that was recovered that
can be linked to human burials in the project area.

Material evidence of ancient human activity in the project area is also limited. Only five
chert flakes (two are questionable) and several pieces of fire-cracked rock were found (Figure
66). The flakes, which derive from the production and maintenance of stone tools, were found in
the northern half of the project area in no apparent concentration. Of the two flakes collected
from N448.5 W11, one is a bifacial thinning flake and the other exhibits cortex. Eight pieces of
fire-cracked rock (FCR) weighing over 318 g were collected from a depth of 44 cm BS in a 1-x-1
m unit at N247 W16. Although the FCR was found in associated with a yellow brown B horizon
that appeared to be undisturbed, other artifacts from the same depth include brick, a three-tined
fork, a glass button, various colored container glass, and a metal gaming piece. Moreover, the
FCR were not associated with chipping debris from the production of stone tools or low-fired earthenware (Indian pottery), which would allow us to infer their antiquity. However, their depth and formal characteristics are consistent with materials that have been frequently found on sites that were occupied by Native Americans prior to European contact throughout eastern North America. The low frequency of chert flakes and FCR, and the absence of any low-fired earthenware (Indian pottery), suggest that the project area was not used intensively prior to European settlement in the 17th century.

All of the artifacts collected during the project are permanently stored at The Heritage Museum and Cultural Center in St. Joseph.

In sum, excavations recovered a broad range of artifacts in the project area. Various functional categories were identified that relate to personal, household, built environment, occupational, exchange, and subsistence activities. However, many of the artifacts were found in secondary deposits; i.e., they do not represent activities that originally took place in the project area. Many of the recovered objects reflect the passive recreational use that the project area experienced since the 1830s. A larger sample from undisturbed contexts is needed to further evaluate this preliminary observation.

SUMMARY AND RECOMMENDATIONS

This report presents the results of background research and a geophysical and archaeological survey conducted in a portion of Lake Bluff Park in St. Joseph, Michigan. The purpose of the work is to determine if potentially significant archaeological deposits exist in the project area. This information can be used to make decisions about the potential adverse impact that construction activity in or near the project area might have on the archaeological record.
Background research indicates that the project area has been a city park since the 1830s. Documentary sources also indicate that Fort Miami was constructed near if not in the project area in 1679. In addition, several burials were reportedly identified in the project area along the bluff in the 19\textsuperscript{th} century. While local residents and visitors have intensively used the city park for decades, there have been few permanent buildings constructed in the park (e.g., a gazebo, rest rooms) and activity there has been generally confined to passive recreational use.

A geophysical survey identified a number of previously unidentified features, particularly utility lines that are oriented N-S. Geological disconformities were also detected over 1 m beneath the modern ground surface. Finally, a number of dipolar and monopolar magnetic anomalies represent near surface ferrous objects (e.g., sign posts). Most of these anomalies are of relatively recent origin and not of archaeological interest, though we were not able to evaluate all of them. Furthermore, the presence of modern features like benches, drinking fountains, concrete walkways, and utility lines compromise the results of the survey by potentially obscuring the signatures of more subtle features that may be more deeply buried or of archaeological interest.

Subsurface testing verified the nature of several anomalies. While some of these are objects that were recently abandoned, others are related to nineteenth century features and activities. Indeed, most of the archaeological evidence in the project area is associated with late nineteenth and twentieth century deposits. Twentieth-century landscaping activities have led to the deposition of fill throughout much of the project area. The fill derives from back-filling utility trenches, the in filling of gullies and ravines, and the stabilization of features caused by erosion along the bluff edge. Invariably, much of this fill contains artifacts that were used outside of the project area and represent secondary deposits.
In addition to this introduced material, there is also archaeological evidence of activities that took place in the project area. For example, excavations detected the remains of several features that once stood in the project area. The presence of brick concentrations may represent the foundations of former buildings such as the gazebo and the band shell that also appear in photographs (Figure 68). Other isolated artifacts that were likely lost or abandoned during passive recreational use of the park include coins, a token, clay pipe fragments, clay marbles, toys, doll parts, shell and glass buttons, and jewelry and other objects of personal adornment.

Figure 68. View of Lake Bluff Park facing northwest across Lake Boulevard showing park benches and a gazebo (ca. 1895).

Despite the constraints of the geophysical survey and the limited excavations, the project area retains the potential to yield archaeological materials of historical significance. Although we did not encounter any 17th century artifacts or intact human burials, at this stage in the study we cannot rule out the possibility that Fort Miami was located in close proximity to the project area.
Evidence of ancient and early European and Euro-American activities may still exist along the bluff. This evidence may be quite ephemeral and require more intensive testing to identify any material traces, especially in the northern half of the project area where numerous artifacts were recovered or in areas where fill has buried old land surfaces. It is recommended that further subsurface testing be conducted in the project area to ensure better coverage and evaluate the context of previous finds before initiating any construction activities in the area that may have potentially adverse impacts. Moreover, the types of archaeological evidence that may exist in and near the project area are likely to be subtle and can only be identified by trained observers.

Management Summary

1. A geophysical and archaeological survey was conducted in Lake Bluff Park from Market to Port streets following background research.
2. Geophysical anomalies appear to be near surface disturbances and utility lines; deeper anomalies are likely geologic in origin.
3. The project area yielded very limited archaeological evidence of Native American use. Several flakes and some FCR may represent evidence of ancient (i.e., pre-Contact) activities in the project area.
4. No late 17th century artifacts such as gunflints, musket balls, hand-wrought nails, or imported ceramics and glass were recovered. With the exception of the flakes and the FRC, the oldest artifacts recovered are a white clay pipe bowl and a hand-blown bottle (late 18th-early 19th century). Their contexts indicate they may have been deposited after the 1830s.
5. Most artifacts are consistent in age with the post-1830s settlement on the east side of Lake Boulevard (formerly Front Street). Many artifacts reflect the passive recreational use of the
project area and bringing in fill to landscape and level the park beginning in the early 20th century.

6. More intensive excavations may identify 17th century activities in the project area, especially if Fort Miami was located where the Whitcomb Hotel now stands. The project area has the potential to yield materials dating to the seventeenth and eighteenth centuries, and possibly earlier, as indicated by the recovery of a late eighteenth century glass bottle, a clay smoking pipe bowl, and FCR in strata that may date prior to European Contact.

7. Future activities that involve subsurface disturbance in the park should only proceed after the results of the geophysical survey are consulted. Excavation should be monitored to identify and record material traces of past human activity that were not located in this survey.

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APPENDIX A. COMPLETE GEOPHYSICAL DATA (CD ROM)

APPENDIX B. ARTIFACT INVENTORY (CD ROM)