# Northeast Historical Archaeology

Volume 44 *Special Issue: War of 1812* Article 6

2015


# Geospatial Data on Parade: The Results and Implications of the GIS Analysis of Remote Sensing and Archaeological Excavation Data at Fort York's Central Parade Ground


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*This article presents a case study on the application of geographical information systems (GIS) in the context of military archaeology at the Fort York National Historic Site (AjGu-26) in Toronto, Ontario. By employing GIS to amalgamate data from historic mapping, ground penetrating radar, LiDAR, and 30 years of archaeological investigation, the authors reconstruct the historic landscape at the central parade ground of this national historic site. In doing so, they identify the remains of an early 19th-century vice-regal building that served as the official residence of the lieutenant governors of Upper Canada before the American forces burned it down in 1813—an important event that later provided the justification for the British destruction of the White House. With the successful application of GIS to amalgamate multiple lines of evidence, the article serves as another case for the broader acceptance of digital data technologies into the standard methodological toolkits of archaeologists.*

*Cet article présente une étude de cas sur l'usage du système d'information géographique (SIG) dans une contexte d'archéologie militaire au lieu historique national du Fort York (AjGu-26) à Toronto, en Ontario. En combinant le SIG aux données provenant de cartes historiques, de géoradar, de lidar et de 30 ans de recherches archéologiques, les auteurs ont pu reconstruire le paysage culturel du champ de parade central de ce lieu historique national. Cela leur aura permis d'identifier les vestiges d'un édifice datant du début du 19ième siècle qui servait de résidence officielle aux lieutenants gouverneurs du Haut-Canada. Les américains mettront le feu à cette résidence en 1813, un événement important qui justifiera plus tard la destruction de la Maison Blanche par les britanniques. Cet article présente un autre exemple de l'usage du SIG pour combiner une variété de données et illustre bien que les technologies axées sur les données numériques font de plus en plus partie de la trousse de l'archéologue au même titre que les méthodologies plus standard.*

## Introduction

While the use of geographical information systems (GIS) and geophysical survey is not new to archaeology, their application in day-to-day archaeological projects is still regrettably uncommon. This article hopes to overturn this pattern by discussing a recent investigation of the central parade ground at the Fort York National Historic Site (AjGu-26) in Toronto, Ontario. During this exercise, the researchers used GIS to organize historical mapping, geophysical survey data, and 30 years of excavations. The work identified the remains of Government House, the first official residence of the lieutenant governor of Upper Canada, the wanton destruction of which led British commanders to retaliate by burning down the White House in Washington, D.C. (Hitsman 1999: 244–245). The incorporation of GIS into the standard toolkit enabled archaeologists to carry out their study and speak more confidently about the interpretation of their results.

## Project Background

In July 2011, YAP Films retained Archaeological Services, Inc. (ASI), to carry out a research-based archaeological investigation to identify the remains of Government House on the grounds of the Fort York National Historic Site (AjGu-26) within the city of Toronto (FIG. 1). The archaeological fieldwork tied together the storyline of the documentary film, *Explosion 1812*, that Yap Films released in June of 2012 (ASI 2012b). While four previous archaeological investigations and several episodes of geophysical survey carried out in the 1970s and 1980s identified the possible remains or debris from Government House, the complex social history of Fort York made the task of identifying another segment of this significant 1800 structure difficult.

The approach for the 2011 investigation compiled all available information from multiple sources within a geographical information systems (GIS) package, including the information from the past and current archaeological

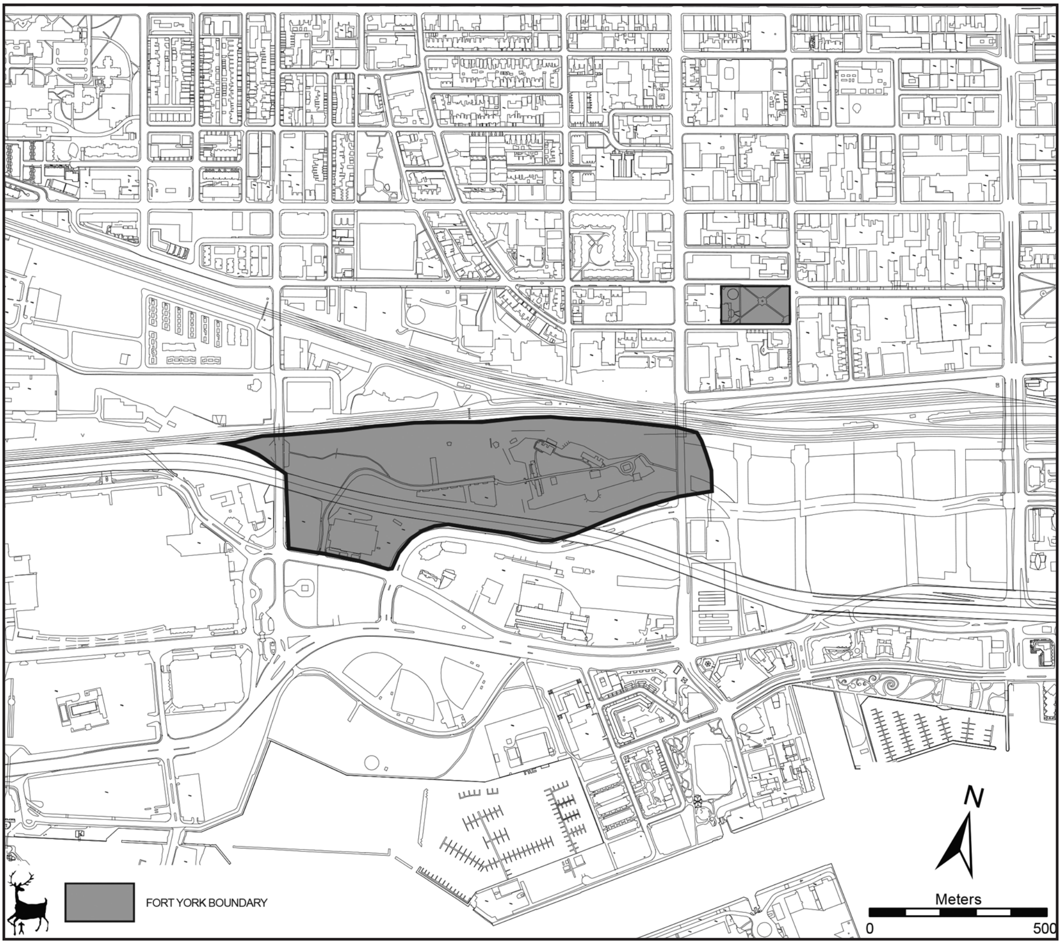


Figure 1: The Fort York National Historic Site (AjGu-26) within the city of Toronto. (Map by Anatolijs Venovcevs, 2012; courtesy of Archaeology Services, Inc.)

investigations, archival research, LiDAR hillshade data, and geophysical survey information. Organizing all the separate lines of evidence geographically allowed not just for the identification of the intact deposits relating to Government House, but also to place the excavation within the broader historical landscape. This provided the researchers with a more accurate archaeological understanding of the cultural and military history of one of Ontario's most important heritage sites.

## Government House and the Central Parade Ground

The Lake Ontario tablelands around Fort York have a long and complicated history that has produced a complex stratigraphic record. Ontario's native people occupied the area for millennia before the arrival of the Europeans. While the subsequent European occupation destroyed much of the earlier evidence, excavations at the site produced precontact lithic material in secondary deposits (ASI 2013: 126).

The European-Canadian utilization of Fort York's central parade ground dates back to 1793, when Colonel John Graves Simcoe commissioned the construction of 30 log cabins to serve as winter quarters for the regiment of Queen's Rangers that came with him to establish the new settlement of York. This first version of Fort York consisted of these "Simcoe Huts" built from green wood at ground level and configured in a triangular shape on the site of the present-day fort (Benn

1993: 28). Previous excavations at Fort York produced evidence of these ephemeral structures in some of the lowest cultural layers; stone and brick hearths are the only significant features that remained (Webb 1991: 63–64, 99, 1994: 30–31).

The Simcoe Huts did not last long, and additional military buildings were erected in the subsequent years. Many of these stood on the opposite side of Garrison Creek, and the focus of York's garrison shifted eastward for the first two decades of the town's history. The Simcoe Huts were all but decayed when the construction of Government House began in 1800 (Benn 1993: 39).

From the 1800 schematic drawing by Captain Pilkington and a sketch by Sempronius Stretton drawn in 1803, it is known that Government House was a one-story, U-shaped, wood-frame structure that served as the official residence of the lieutenant governor of Upper Canada (FIG. 2). Correspondence kept by the military indicates that the military built additional "conveniences" for the structure that included a root house, stables, a large fenced garden, and a well; the location of most of these structures is unknown (Laverton 2009). Lieutenant General Peter Hunter first occupied the residence, followed by Sir Francis Gore, Sir Isaac Brock, and Sir Roger Sheaffe. The building also served to lodge visiting officers and other dignitaries visiting the settlement (Benn 1993).

In the first decade of the 19th century, the military neglected the garrison itself. However, in early 1811 and 1812, when war between the United States and Britain seemed likely, the garrison installed additional gun batteries. One of these would later become the large circular battery on Fort York's southern ramparts. The renovation work also included a dry moat that later was incorporated into the western wall of Fort York (Benn 1993: 44–45).

The United States declared war on 18 June 1812, but after a year of crushing defeats and setbacks the Americans needed an easy political and strategic victory. They saw the poorly defended town of York as an appropriate target (Benn 1993: 45–49). In a quick battle on 27 April 1813, the Americans captured the town from the badly outnumbered British and Canadian garrison and their Mississauga and Ojibwa allies stationed in the area. A six-day occupation followed and involved several instances of looting, vandalism, arson, and the release of inmates from the town jail. Then, on 1 May 1813, the occupying American forces looted and burned Government House and withdrew from the town the next day.

York lay undefended for much of the rest of the year, and the Americans returned on 31 July, took the town without a fight, burned the rest of the fortifications, and left the next day (Benn 1993: 68). The rebuilding of the fort began on 26 August 1813, when military engineers cleared away the charred remains of Government House. Excavations in the Fort York ramparts revealed that some of the debris from Government House was deposited in a crater left by the detonation of the Grand Magazine, which the British blew up during the Battle of York (ASI 2012a). In addition to site clearing, the military built new earthworks, batteries, and blockhouses over the area previously occupied by Government House and the Simcoe Huts. These buildings laid the foundations for the modern Fort York. The area on which Government House stood was incorporated into the fort's central parade ground (Benn 1993: 69–70).

In the first few decades after the fort's reconstruction, several buildings stood in the vicinity of the former Government House and contributed to the complex stratigraphy of the parade ground. These included a carpenter's shop and a barracks for the sappers and miners who were the combat engineers of the British military. The Carpenter's Shop appears on only two maps from 1814 and 1815, suggesting that it was probably an ephemeral structure related to the reconstruction of the fort. The sappers' and miners' barracks was a more substantial 16-man brick barracks that stood between the Stone Magazine and Blockhouse No. 2 between 1813 and 1822 (Webb 1994: 37). Furthermore, a series of splinter-proof soldiers' barracks and a Cook House extended along the south wall of the fort. The military tore these down in 1848 and incorporated the area into the parade ground (Webb 1994: 38).

In general, this area, as well as the fort itself, went through successive periods of use and misuse by the British and Canadian militaries in response to the changing domestic and international political climate (Benn 1993). The central parade ground was paved over in the 1840s, but grass was later allowed to cover the area in the 1870s (Vaccarelli 1997: 91). Later,

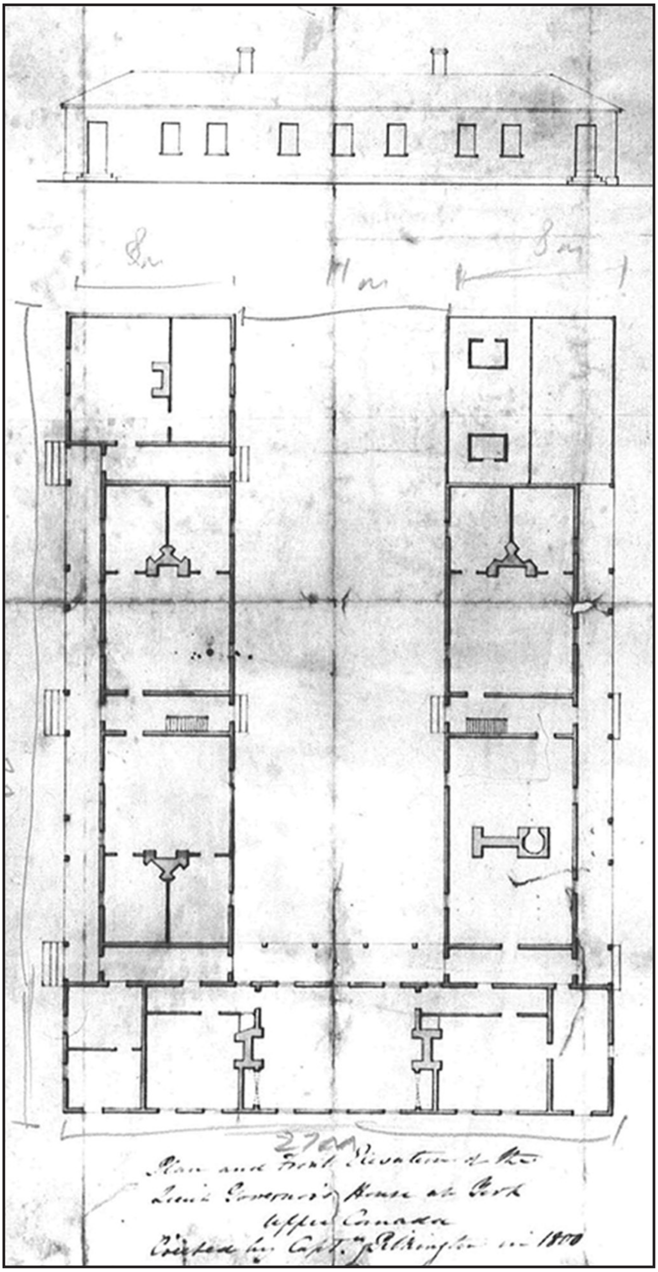

Figure 2. *Plan and Front Elevation of the Lieutenant Governor's House at York, Upper Canada, erected by Captn. Pilkington in 1800.* (Pilkington 1800; courtesy of Library and Archives Canada.)

with the renovations and refurbishments within the fort associated with its new role as a National Historic Site, the park staff laid several utility lines across the central parade ground.

## Historical-Map Review

The researchers reviewed the known historical maps of the fort before conducting archaeological fieldwork. While a variety of documentary sources exist, only one, the George Williams map of 1813 (FIG. 3), provides an approximate location of Government House. Presented on this map with a dotted line, Government House is directly north of the circular battery, a feature that, with some modification, is still present at the fort today. The dotted outline represents its approximate location, as the American forces destroyed it earlier that year. It is important to point out that the house dimensions seen in this map contradict the 1800 architectural plan drawn by Captain Pilkington, as the latter depicts much longer, narrower wings.

Overlaying this map on the modern landscape is difficult, given the scarcity of common anchor points. George Williams only produced a quick sketch of the fort in late 1813, and it is not a military-grade survey. Additionally, most of the buildings depicted on that map are absent from the modern landscape; the fort, as seen today, is mostly a product of the 1814–1815 rebuilding efforts and the 1930s renovation. The georeferencing work employed the rough triangular shape of the fort itself to overlay the Williams Map on modern topography. This confirmed the previous observations that Government House stood somewhere within the central parade ground of the modern Fort York.

The historical-map review stage of the project not only had to identify the location of Government House itself, but also the locations of former structures that the ground penetrating radar or the excavation might encounter. As previously discussed, these structures are the Carpenter's Shop, the Sappers' and Miners' Barracks, the

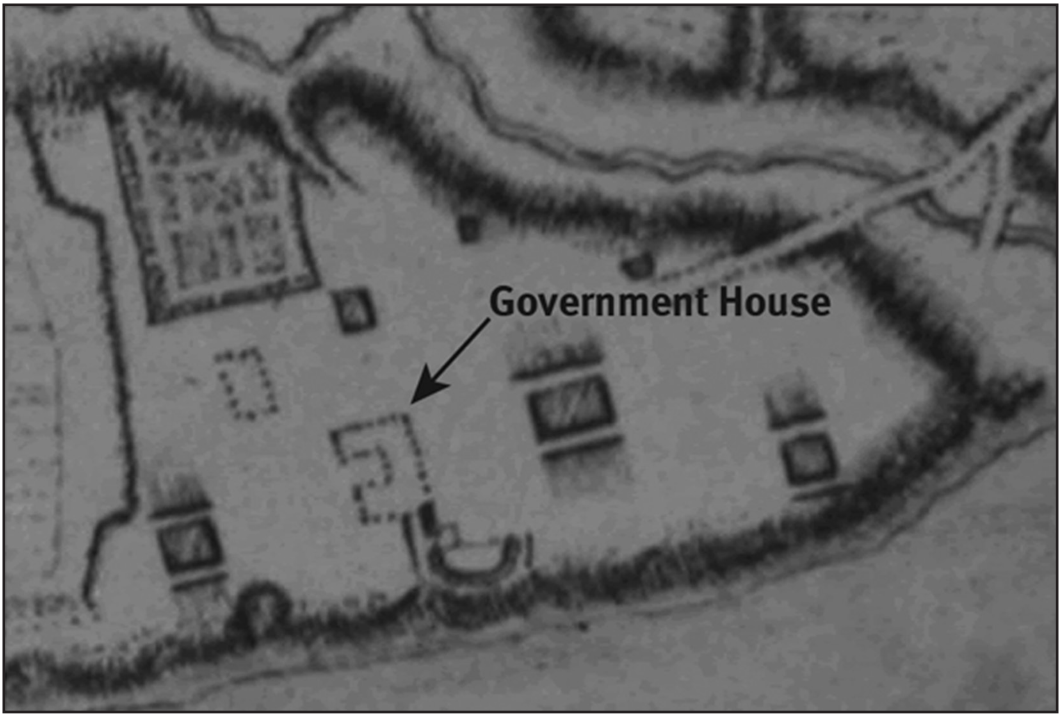


Figure 3. Detail of *Sketch of the ground in advance of and including York, Upper Canada, by Geo. Williams, R. M. S. D., Nov. 7, 1813*. (Williams 1814; courtesy of Library and Archives Canada.)

splinter-proof soldiers' barracks, and the Cook House, as well as the 1793 Simcoe Huts.

While the exact location of the Simcoe Huts is not known, the later historical maps of Fort York indicate the locations of other structures. These include Van Cortland's map of 1815, Gustavus Nicolls's 1816 map, and C. G. Gray's 1846 map of the fort. Three of these, the 1815, 1816, and 1846 maps, were geo-referenced on the modern orthoimagery of the fort (FIGS. 4, 5, and 6). This project employed two geo-referencing control points that have remained unchanged throughout Fort York's existence. These are the southeast corner of the 1814 Brick Magazine and the southwest corner of the Officers' Quarters, which were not impacted by the construction of an 1826 kitchen addition.

It is important to note that the geo-referencing process did not employ the southern ramparts as common anchor points. After their original construction in 1815–1816, they were rebuilt at least thrice—once in 1838, again in the 1860s, and, finally, in the 1930s. The 1837 Rebellion crisis prompted the first phase of renovation. During this time, the British military shored up the eroded fortification walls and expanded the circular battery to accommodate more cannons (Benn 1993: 102). Additional work consisted of the installation of palisades on all sides of the fort, the construction of a parapet and banquettes, filling in parts of the collapsed embankment, reforming the scarp of the ramparts, and sodding up the bank from the base to provide greater stability (Baddeley 1838: 226; Foster 1838: 84–86).

The increased tensions between Britain and America as a result of the 1861–1862 Trent Affair spurred the second phase of renovation. The British regarrisoned the fort after over a decade of neglect and undertook several upgrades, including the erection of new palisades, the building of parapets, and the cutting of embrasures for a seven-gun battery along the southern rampart wall (Benn 1993: 116, 121, 126; Webb 1994: 7).

The modern walls are a relic of the 1932 restoration of the rampart wall. The renovation work significantly altered the fort's ramparts through the addition of fill along the eroded

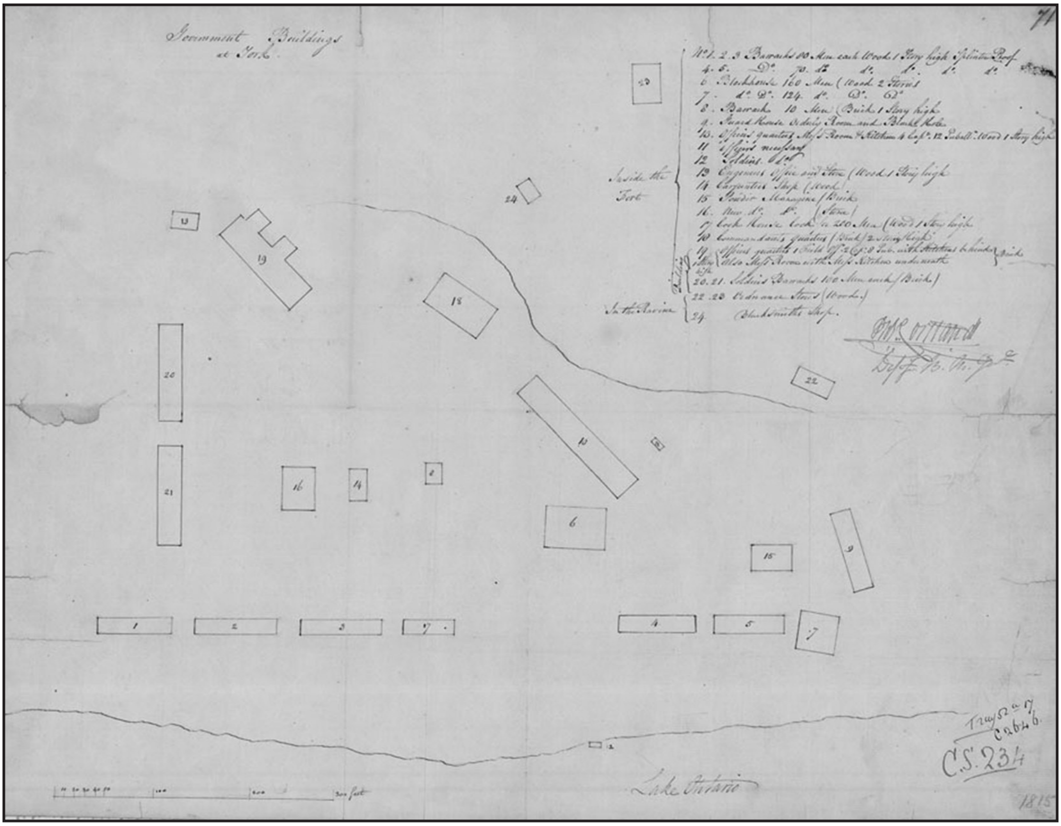


Figure 4. *Government Buildings at York*. (Van Cortland 1815; courtesy of Library and Archives Canada.)

rampart walls, the lining of the inside of the fort with stone (rather than the historically accurate wood), and raising the rampart higher than it would ever have been in its entire history (Benn 1993: 155–156). The work shifted the location of the ramparts as well. The 2011 archaeological investigation of the Fort York southern ramparts determined that the walls were raised as much as 1.6 m from the original, 1860s grade, and that the southern rampart wall moved 5 m north (ASI 2012a: 25).

The fluctuating location of the rampart wall is seen from the georeferenced historical maps, where the location of the wall and its adjoining barracks is never in a single place and never conforms to modern topography. Only on the 1846 map are the barracks along the south wall of the ramparts actually in the survey area. The other structures, the 1814–1815 Carpenter's Shop and the 1813–1822 Sappers' and Miners' Barracks, are on the far northern edge of the survey area. These results revealed that the main survey area on the central parade ground remained free of structures after the destruction of Government House in 1813.

## LiDAR Survey

The Fort York project had high-definition LiDAR imagery available to supplement the other data sources. LiDAR, or Light Detection and Ranging, is a remote-sensing technology that uses pulses of light, often in the form of a laser beam, to measure distance, as well as to identify other properties of a target. LiDAR uses ultraviolet, near-infrared or visible light to image objects or areas, and it can be fitted to satellites, aircraft, vehicles, or tripods (English Heritage 2010: 3–4). LiDAR's two biggest benefits for archaeologists are its ability to create high-resolution digital elevation models (DEMs) to reveal microtopographic features that would otherwise be indistinguishable on the ground, and its ability to map features beneath forest canopies (English Heritage 2010: 5–8). It has

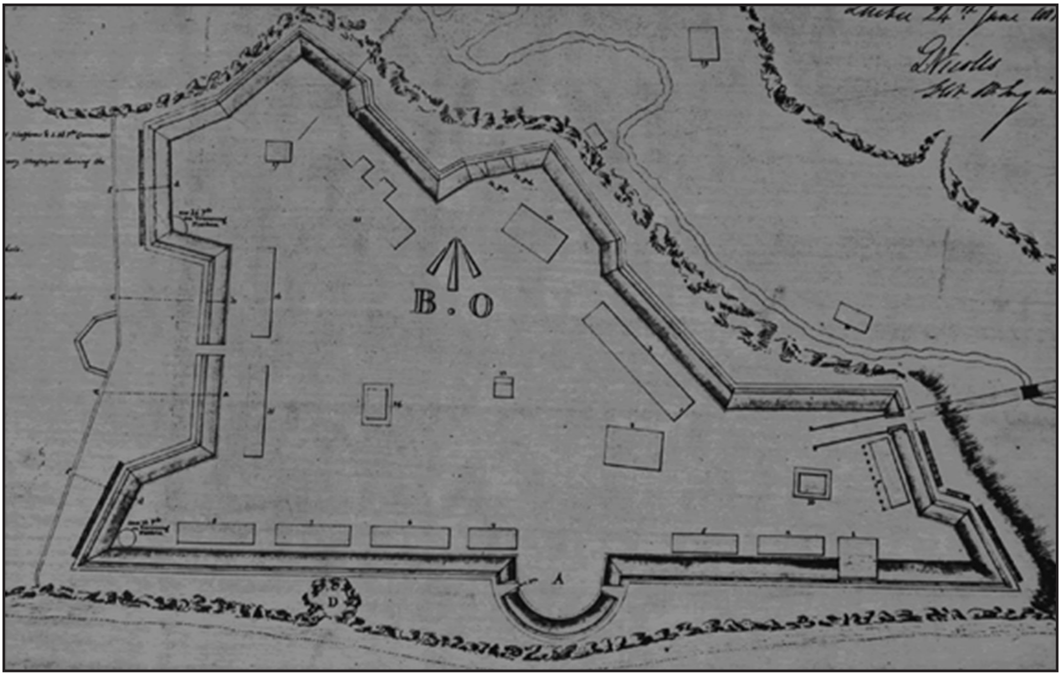


Figure 5. Detail of *Plan of Fort York, Upper Canada, Showing its State in March 1816*. (Nicolls 1816; courtesy of Library and Archives Canada.)

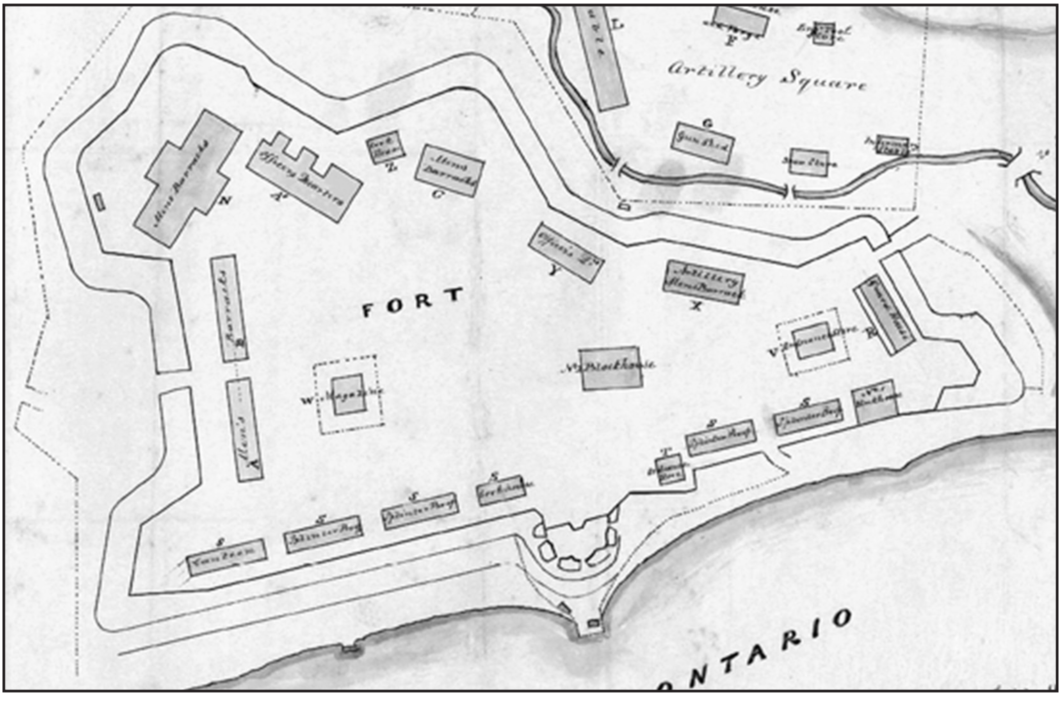


Figure 6. Detail of *Toronto, C. W. Sketch Showing the Harbour, and Ordnance Property with the Encroachments on the Latter Coloured Yellow*. (Gray 1846; courtesy of Library and Archives Canada.)

been used successfully in Canada to survey other poorly defined archaeological features on military sites (Millard, Burke, and Redden 2009).

Optech conducted this survey gratis for the Friends of Fort York Foundation as a trial run of one of its new downward-looking, aircraft-based LiDAR systems and provided a processed hill-shaded DEM for the foundation's purposes. Archaeological Services, Inc., retrieved this data for its project. Given the original undulating topography of the Lake Ontario tablelands and the long settlement history of Fort York, the foundation believed that evidence of relict cultural features would still be visible within the fort (Vaccarelli 1997: 90–91). While LiDAR has proven its tremendous utility for archaeology around the world, this source of data did not provide any details of the locations of historical buildings inside the fort. Instead, the LiDAR mapping shows a remarkably featureless, flat landscape within the walls of Fort York (FIG. 7).

As Vito Vaccarelli (1997) had noted, the Fort York cultural landscape has been subjected to multiple landscape-fill events that have removed all traces of the original topography. The scope of soil alteration is so great that even a high-precision remote-sensing technique like LiDAR could not pick up most traces of the original topography and former standing structures. Despite its lack of applicability for detecting buried subsurface deposits for this project, one should not overlook the fact that the creation of a digital, permanent record of all the buildings at Fort York, in full detail, represents the greatest contribution of this survey.

## Ground Penetrating Radar Survey

Due to this lack of structural remains visible on the surface, Archaeological Services, Inc., commissioned a geophysical survey to cover the documented area of Government House. The work employed ground penetrating radar (GPR) for this specific survey, given the conditions within and around the fort. In the modern urban environment of downtown Toronto other geophysical survey techniques such as magnetometry, which measures magnetic variation in the soil and surrounding environs, could potentially have been employed. Alternatively, other geophysical survey techniques, such as electrical resistivity, which Claus Breede carried out within the fort

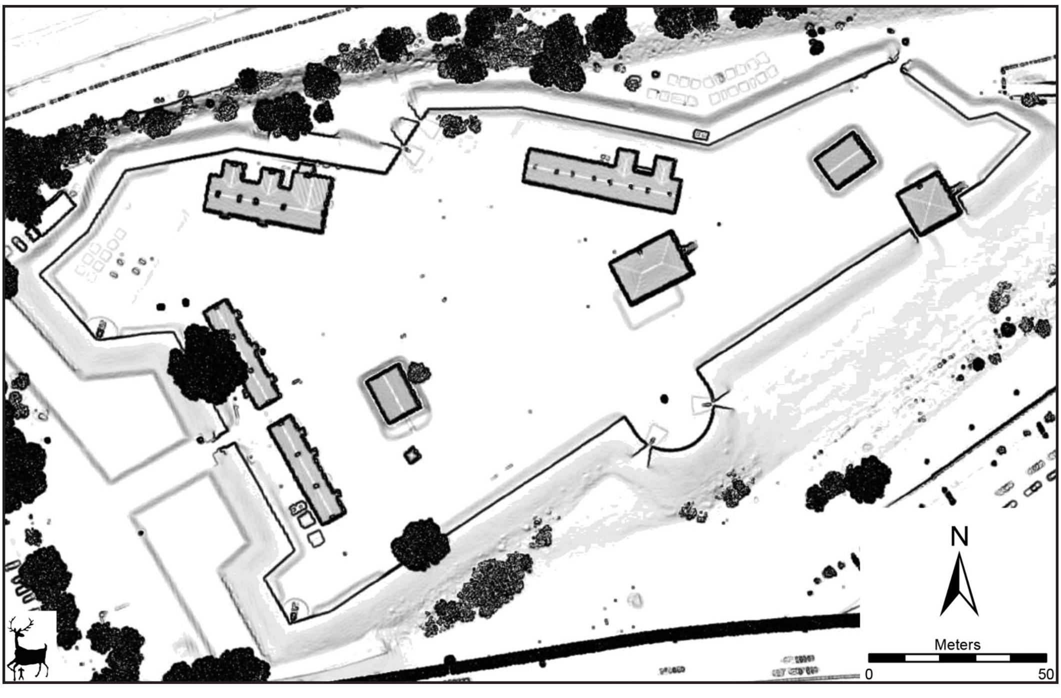


Figure 7: LiDAR survey results from the Fort York National Historic site (AjGu-26). (Map by Blake Williams and Anatolijs Venovcevs, 2015; courtesy of Archaeological Services, Inc.)

in the 1970s, could have been employed. However, Breede's work predated the widespread application of GPR, which is faster and has greater depth penetration than other geophysical survey methods (Conyers 2006). Additionally, GPR was better suited to detect the features identified in previous excavations, as well as any other subsurface deposits within the survey area.

GPR works best for surveys at locations with well-drained soils and with a depth range of from 20 cm to 2 m (Conyers 2006). This was useful in the search for Government House, given the complex stratigraphy previously noted within the fort.

Another consideration for using GPR in this instance was the physical nature of any remains of Government House. GPR wave reflection is stronger in cases of greater variability among subsurface materials. Therefore, detection of the brick and stone remains of Government House would be detected most effectively using GPR. Similarly, reflection from some more ephemeral structures, such as the 1793 Simcoe Huts, which were built from green logs with few significant structural elements, or the short-lived Carpenter's Shop, would be less pronounced with this method of geophysical survey and, thus, would have less chance of interfering with the results of this survey.

GPR systems feature a transmitter and receiver antenna array that is typically mounted to a rig so that it is properly aligned and oriented. The transmitting antenna emits radio waves that travel through the subsurface. When a radio wave encounters an area of contrasting electrical and magnetic properties, such as interfaces of buried stratigraphic layers, objects, or features, the radio wave is reflected back to the surface and is recorded as an anomaly (Clark 1990). When conducting a survey over a pre-set grid, the recorded GPR data can either be viewed in individual line profiles or as interpolated plan maps sliced at designated depths. Viewing the data in the latter way allows for anomalous areas to be displayed in their horizontal and vertical spatial context (Conyers 2006).

The GPR survey was conducted in a 60 × 45m area at 0.5 m transect intervals. The instrument had a 250 MHz antenna that transmitted waves every 2.5 cm, achieving an optimal range of 25–125 cm. The GPS data was plotted on the orthoimagery that comes with ESRI's ArcGIS package.

The GPR survey recorded multiple anomalies, both weak and strong, throughout the parade ground. The anomalies are described as either weak or strong based on the reflection of the returning radio wave off the recorded deposit. Stronger, sharply defined changes in subsurface composition will create stronger anomalies, while other types of subsurface deposits, such as pre-existing excavation trenches or hollow, large utilities, such as sewers, will be recorded as weak anomalies. The area is dominated by modern utilities, which are indicated by weak, linear anomalies, such as the sewer line extending east–west across the southern end of the parade ground (FIG. 8). Other, shorter utility trenches or excavation trenches dotted the parade ground as similar, weak, linear anomalies. Strong anomalies were present within the general area of Government House from 45 to 80 cm below surface, although these anomalies were not readily identifiable as relating to any of the historical features noted on any of the mapping. The GPR survey did not record any anomalies along the southern portion of the house because utility trenching caused heavy disturbance in that area of the site (FIG. 8). The nature of the anomalies within the location of Government House indicated that discrete deposits lay within its location, providing a strong indicator that these anomalies were, in fact, related to Government House. However, previous excavations, small utility trenching, and the general usage of this portion of the fort impacted the integrity of the Government House deposits. The destruction of the structure itself makes the exact identification of its former location impossible without ground-truthing excavation.

Finally, it should also be noted that the GPR survey detected strong anomalies that correlate to the Carpenter's Shop and the location of the barracks and Cookhouse depicted along the southern rampart wall in the early historical plans (Venovcevs et al. 2014). Claus Breede's previous electrical resistivity survey in the mid-1970s also detected these buildings (Breede 1977); however, these deposits were not the focus of this study; see Venovcevs et al. (2014) for a brief discussion of these features.

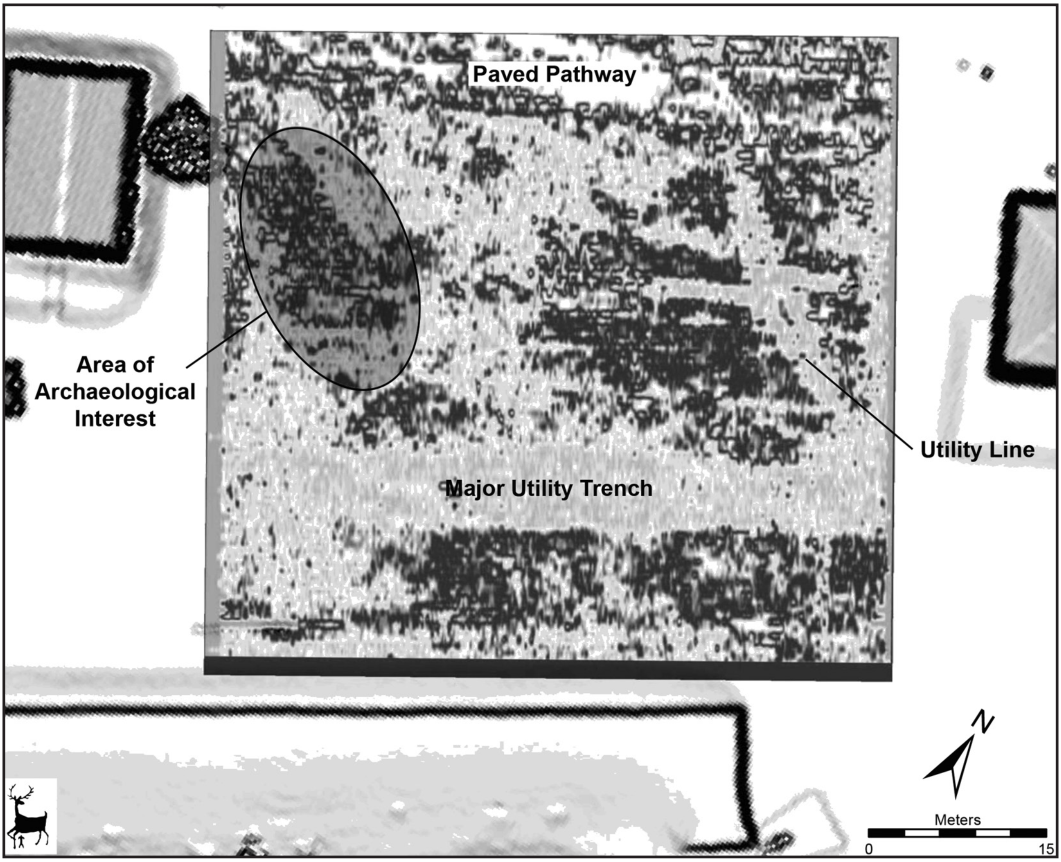


Figure 8: GPR survey results at a depth of 60–65 cm. (Figure by Blake Williams, Dan Kellogg, and Anatolijs Venovcevs, 2015; courtesy of Archaeological Services, Inc.)

## Archaeological Excavations

The final components of the GIS database are the previous excavations at the central parade ground. Prior to 2011, archaeologists had excavated seven trenches in this area. Their relationship in space and the results they produced are important for understanding the complex culture history of Fort York's central parade ground for the purpose of relocating Government House.

Of note for this study are Claus Breede's 1976 excavation units TT1 and TT4, the 1987 unit 1FY4, and the 1989 units 1FY21, 1FY22, and 1FY25. TT1 and TT4 identified one of the walls of the Cookhouse. Contrary to Breede's conclusions, however, contemporary GIS work suggests he found the north and not the south wall of the building (Breede 1977; Venovcevs et al. 2014). Of more interest for the location of Government House itself, 1FY4 and 1FY22 contained burned areas that Catherine Webb attributed to the destruction of the vice-regal building, while 1FY25 contained a possible stone foundation wall, though the later unit's small size makes interpretation difficult (FIG. 9) (Webb 1991).

Most pertinent to this study was the 1989 excavation unit 1FY21. In this 10 m trench, the two northernmost sub-units identified significant architectural remains consisting of charred wood debris, including four possible beam segments and several floor boards that overlay a single course of flat, dry-laid stones representing a foundation wall (Webb 1991: 73–74). The creamware and pearlware ceramics, along with a New Brunswick Regiment button, suggested that this material represented the remains of Government House (Webb 1991: 77–78). When the locations of all these trenches are mapped on the GPR survey results, the unit 1FY21 is located within the most distinct anomaly in the center of the parade ground.

Thus, the mapping exercise established that the 1989 excavation unit 1FY21 identified architectural remains within an area of strong anomalous readings picked up by GPR survey in an area that contained no other known structures, aside from Government House. This information allowed ASI to plot an 8 × 2m trench in an area that had high potential for identifying the buried remains of Government House (FIG. 9).

The 2011 trench was divided into four 2 × 2m sub-units, labeled A, B, C, and D alphabetically from north to south. Archaeologists used trowels to excavate the trench by strata and screened all of the soil through ¼ in. (6 mm) mesh. Each unique stratigraphic layer or feature received its own unique designation as a "lot," following the Parks Canada convention (Cary and Last 2007), and, where possible, the archaeologists correlated the lots in the 2011 trench with the events from the nearby 1989 unit, 1FY21 (Webb 1991). In total, they identified 27 unique stratigraphic lots.

Unfortunately, the nine-day excavation's budget did not allow Archaeological Services,

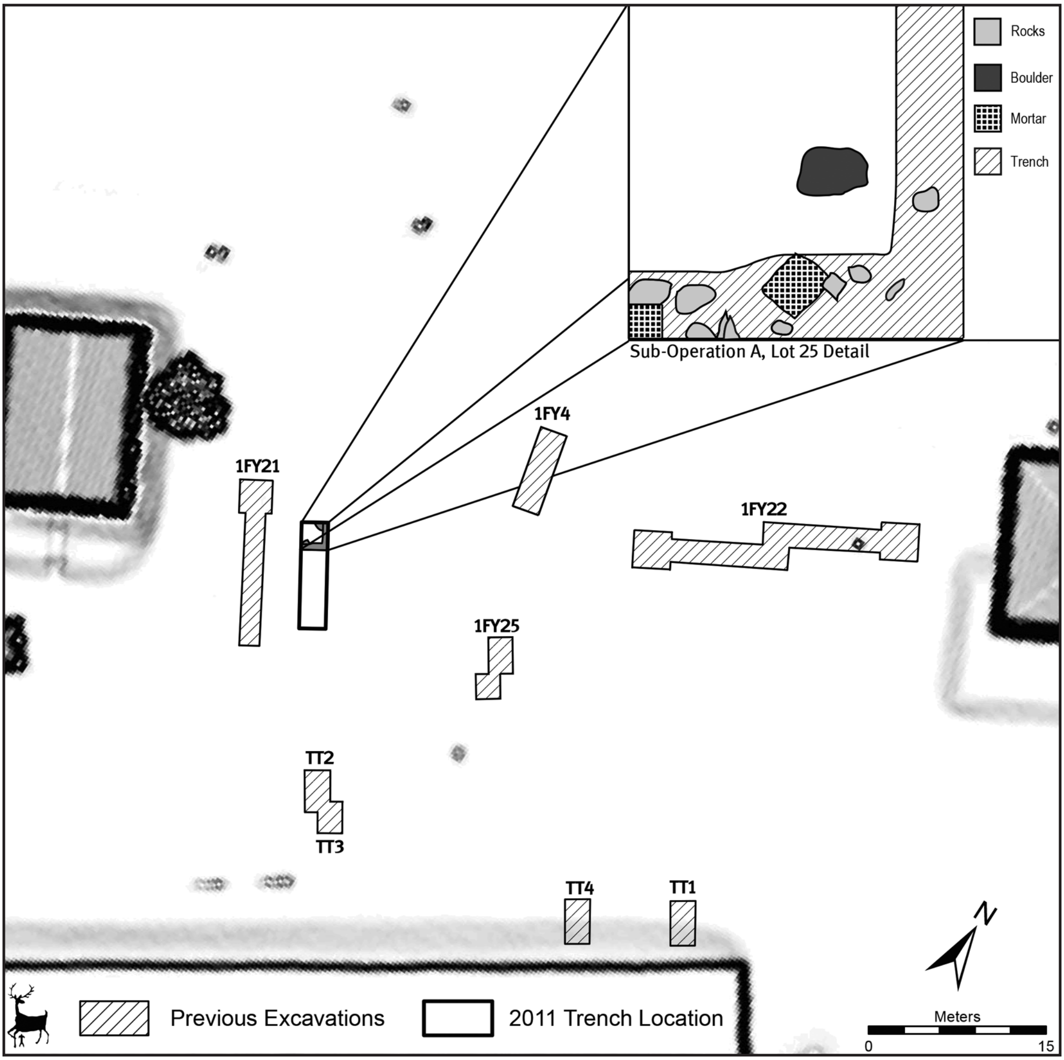


Figure 9: Locations of excavation trenches at the Fort York central parade ground 1976–2011. (Figure by Blake Williams and Anatolijs Venovcevs, 2015; courtesy of Archaeological Services, Inc.)

Inc., to fully investigate the entire trench. To save time, the excavations of sub-units B and D ceased at 40 cm below the modern ground surface, while the excavation of sub-units A and C continued to depths of 52 cm and 58 cm, respectively (ASI 2012b). On the last day of the excavation, the field crew identified a feature that it interpreted as a robbed foundation trench in sub-unit A, the northernmost 2 × 2 m segment of the excavation unit.

The unit was recorded as a reverse L-shaped deposit hugging the south and east walls of the sub-unit, containing organic soil, red bricks, and small, flat, shale fragments (FIG. 9) (ASI 2012b: 8). While time limitations did not permit archaeological excavation of the foundation trench and, thus, no artifacts from this context were recovered, the deposit lay at the same depth as Government House deposits identified in the 1989 1FY21 trench, and close to the 60 cm mark predicted by the anomaly in the GPR survey results (Webb 1991: 74) (FIG. 8). Additionally, the material culture recovered from the upper strata of the sub-unit indicates that the context predates the 1820s. This evidence includes early 19th-century creamware, broken and thermally altered pre-1813 bricks, probably representing the debris from Government House, and a two-piece domed button from the 76th (Hindoostan) Regiment of Foot, which was stationed at Fort York from 1822 to 1826 (Spittal 2000; ASI 2012b: 37–38).

Since this deposit could not be explored further, GIS helps with the interpretation of the archaeological remains. Comparing this robbed foundation trench to the architectural material identified in 1FY21, one can see that the robbed foundation trench feature discovered by ASI in 2011 lines up with the dry-laid stone foundation identified in 1989 (FIG. 10). What ASI uncovered in 2011 represents a continuation of that foundation, which must relate to the southern wall of the north wing on the building. The northward-running component of the robbed foundation wall, therefore, would represent the support for one of the interior walls. While one must allow for some discrepancy, given the difficulty in overlaying historical maps, especially a sketch like the one from George Williams, it is important to reiterate that such a conclusion is difficult to make without the application of GIS. The use of a GIS framework facilitated the effective communication of geographic data that allowed for the successful comparison of two different deposits identified by two different archaeological teams 22 years apart.

## Discussion

The opportunity to undertake an archaeological investigation featuring multiple sources of evidence is a unique gift offered by Fort York. Seldom does the archaeological record provide the right mix of intact deposits, archival research, and the access and opportunity to undertake geophysical surveys. Yet, the comparison and evaluation of these multiple sets of data in an efficient fashion were feasible through the application of GIS software. GIS allowed for informative mapping of spatial data, enabling the researchers to compare efficiently, in a single framework, all four data sources from this investigation. The results of this exercise have added to Vito Vaccarelli's (1997) work on the reconstruction of the original landscapes within the historical fort by presenting a different approach by which Fort York researchers can continue to reconstruct the historical landscape. The application of GIS to plot the locations of non-extant historical buildings expands on his work, which was limited to standing structures. The incorporation of geophysical survey provides a clearer picture of the buried landscape of Fort York that Vaccarelli could only explore through archaeological investigation.

This study not only illustrates the importance of using all sources of data available, but also ensuring that the data are being evaluated within a proper context. The successful application of GIS software to many archaeological investigations has shown that it has the potential to act well beyond a simple mapping program, as it can correctly locate archaeological deposits and all other related evidence geographically (Cowley 2011). Using GIS as a method for synthesizing multiple lines of evidence is an accepted and ongoing strategy, especially in the cultural resource management industry, and is employed on differing scales (Delle 2003; Kvamme and Ahler 2007; Parkyn 2010; Cowley 2011). Jurisdictions wherein practitioners of remote sensing survey methodologies have for some time used these strategies to better manage the archaeological resources for specific infrastructure and heritage projects are all

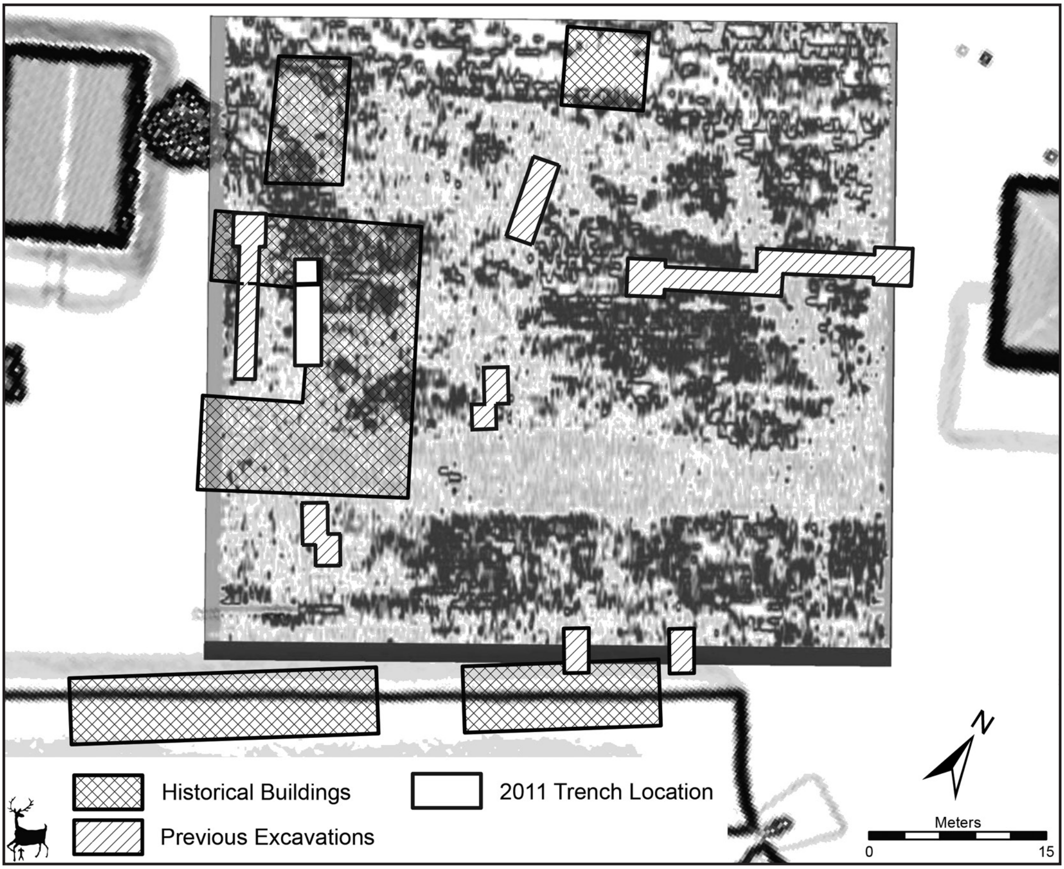


Figure 10: The results of the Fort York Government House GIS project revealing the correlation between three sets of archaeological data. (Figure by Blake Williams, Dan Kellogg, and Anatolijs Venovcevs, 2015; courtesy of Archaeological Services, Inc.)

utilizing GIS as a method of interpreting and correcting the various sources of evidence (Campana 2011; Horne 2011; Powlesland 2011). With this approach, standard archaeological excavation becomes one method among many for obtaining archaeological information and is placed accurately within a wider archaeological context. The result is that a greater portion of the fort, a national historic site, is preserved, along with other in situ deposits. While researchers could have come to similar conclusions without the application of GIS, the organization of various bits of geospatial data into a single package allows for demonstrable conclusions.

These results provide a greater understanding of the archaeological record within Fort York whilst minimizing the amount of destructive excavation, which formerly would have been the sole method of obtaining any information regarding the location and nature of the remains of Government House. This work was the first step toward creating a GIS master plan for the Fort York National Historic Site that will incorporate historical mapping, geophysical survey data, and excavation results into a single database that will help researchers explore the site further, while providing park staff a useful heritage-management tool. More recently, the researchers expanded on this work by incorporating archival remote sensing data into their understanding of the central parade ground and expanding the scope beyond the walled enclosure of Fort York and into an area in which ASI conducted a GPR survey and excavation. There the construction of a new visitors' center would impact late 19th- and early 20th-century deposits (Venovcevs et al. 2014).

This project successfully employed GIS software to amalgamate four vastly different sources of data. It brought together archival mapping, LiDAR imagery, GPR data, and the results of numerous excavations conducted within a 35-year period into one cohesive database that allowed for an effective and methodologically sound interpretation of one the most important archaeological sites in Ontario. This process established that the archaeological remains uncovered within the 2011 trench dug at the central parade ground of the Fort York National Historic Site (AjGu-26) relate directly to the vice-regal building, dating to 1800, that served as home to some of the most notable people in the early history of the province. By continuing to use this method, archaeologists can answer broader questions about changes in the landscape, seek more specific answers about individual structures within complex built environments, and respond better to the quickly changing demands of today's cultural heritage management.

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