

eWilliamsburg Phase II: Spatio-Temporal Modeling of the Colonial Past

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Abstract

eWilliamsburg is a multi-phase project designed as an access point for Colonial Williamsburg's research departments, interpreters, academic scholars, and the general public to gain information about the past. The second phase of this ongoing project is designed to produce a spatio-temporal visualization of the development of the city throughout the course of the eighteenth century. First, a synthesis of the archaeological, architectural, and historical evidence was put together, merging existing interpretations with new work. The resulting information formed a database containing both temporal and spatial information on extant structures and inhabitants in eighteenth-century Williamsburg. Ultimately, the aim is to provide Colonial Williamsburg employees, academic researchers, and members of the public with a unique spatio-temporal understanding of Williamsburg's changing structural landscape and its occupation throughout the eighteenth century.

Keywords: *spatial, temporal, GIS, interactive*

1 INTRODUCTION

The historic area of Williamsburg was restored to its eighteenth-century appearance in a process that began in the late 1920s and continues to this day. Over the years, archaeologists, architects, conservators, historians, and other Colonial Williamsburg Foundation staff members have worked in concert to research and build the city that we see today. At the same time, curators, interpreters, librarians, and educators have worked to teach visitors about the city, eighteenth-century life, and events before, during, and after the American Revolution.

The Colonial Williamsburg Foundation's Digital History Center was founded in 2002, with the goal of using innovative technologies to engage the public in a continuing conversation about the eighteenth century. Current projects include a comprehensive website on the American Revolution, a 3D modeling project entitled Virtual Williamsburg, a long-term project to digitize content from the Rockefeller Library's Special Collections, and eWilliamsburg phases I and II.

This article focuses on the second phase of eWilliamsburg, a project to map the city throughout the eighteenth century. The restored Williamsburg is chronologically static, circumscribed by the choices made in the first half of the twentieth century. Digital representations, on the other hand, give researchers the opportunity to envision the city as it was in any period, without resorting to the wrecking ball. eWilliamsburg is a two year grant-funded project, supported by the National Endowment for the Humanities.

1.1 EWILLIAMSBURG PHASE I

The first phase of this project focused on the creation of a map-based interface to access digitized research materials. The project was carried out between 2002 and 2005, with the support of a grant from the National Endowment for the Humanities. Our work resulted in two web-based GIS interfaces, allowing users to access nearly eighty years of Colonial Williamsburg Foundation research reports.

The first interface is available to the public on our main website, and provides a more streamlined experience through the use of Adobe Flash. The Flash-based tool is available at research.history.org/ewilliamsburg/, and a screen capture can be seen in figure 1. The second more specialized version of eWilliamsburg was built using ESRI ArcIMS; in addition to providing access to reports, it also includes spatial querying tools. This interface is only available to internal users on the Foundation intranet.

1.2 EWILLIAMSBURG PHASE II

The current phase of the project builds on the success of the first phase, while also expanding the project's scope considerably. Phase II creates a spatio-temporal timeline that records the development of the city throughout the course of the eighteenth century. Our goal is to capture the environment of Williamsburg as accurately as possible, including buildings, property lines, fences, and the landscape.

In addition to spatial coordinates, each feature is placed in time, enabling us to observe a snapshot of the city at any point throughout the eighteenth century. Because of

variations in evidence, each location and date receives a level of certainty to represent confidence in its accuracy. Figure 2 shows an overview of the project area, shortly before the completion of the project.



Figure 1. This screenshot of the Flash-based interface shows how information can be accessed on individual buildings.

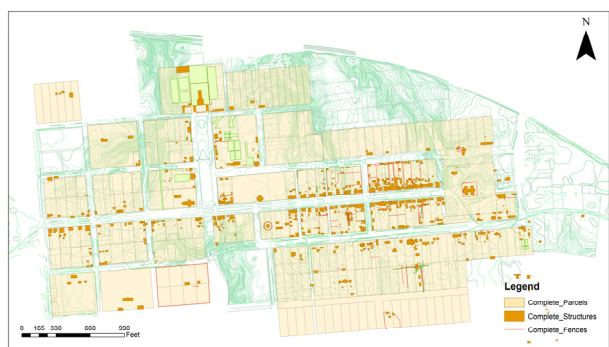


Figure 2. An overview of eWilliamsburg II as it nears completion.

1 RESEARCH

Williamsburg’s restoration to its eighteenth-century appearance is based on documentary research and field work undertaken by several generations of scholars. Even before beginning the overtly digital aspects of eWilliamsburg II, the project gave us the opportunity to break new ground; in this case, by creating the first real synthesis of the entire body of research throughout the city. Merging existing interpretations with new work, this overview improves our overall understanding of the city, and provides the information necessary to create our detailed geodatabase.

We began with the over 80 years of archaeological, architectural, and historical research reports, which number close to 1100 volumes. Sometimes ambiguous or even contradictory, these reports show the significant changes in scholarship and techniques that have occurred throughout the last century, and necessitate the careful weighing of all available evidence.

2.1 MAPPING

Mapping, too, is a synthetic process: we began with a georeferenced version of the James L. Knight “Key Map.” This “Archaeological & Research Key Map” was first drawn in 1932, and then revised the following year. It was intended to bring together all of the relevant features of the city, including contemporary street lines, buildings both original and restored, excavated foundations, and colonial lot lines. The original copy of the map covers an entire wall; it depicts the whole of the city, and shows the overall block structure that is still used to organize research within the city.

Within eWilliamsburg II, the key map (shown in figure 3) was used as a base layer, to help register more detailed archaeological and architectural drawings of sites and building foundations. Depending on their era, these drawings were recorded on paper, film, or as AutoCAD files. These drawings allowed us to create accurate sizes and locations for building footprints, while the key map helped to maintain an accurate relationship throughout the entire city.

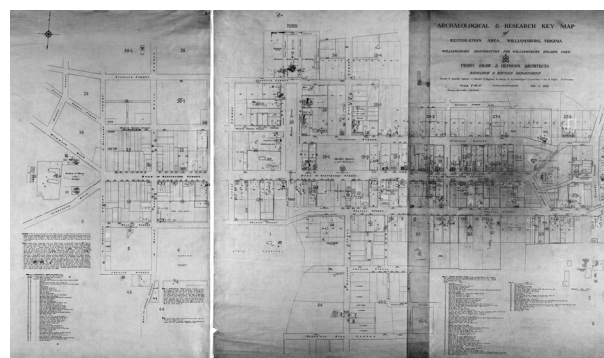


Figure 3. The Jimmy Knight “Key Map,” from 1932.

A variety of historical maps were also used, including the Frenchman’s Map dating to ca. 1782 (figure 4), and the Bucktrout plat from ca. 1800. These period maps helped us acquire additional information on buildings and lots, once we grew comfortable with their possibilities and limitations. Later maps, such as Sanborn insurance maps from the early twentieth century, also helped to provide information about structures that survived to that time.

Finally, we used a Leica GPS1200 as the final arbiter of location, in cases where original buildings remain or where reconstructed structures were built on historic foundations. The GPS can provide spatial accuracy to within millimeters. Ultimately, we used these layers of spatial information as guides to place vectors within ArcGIS, which will represent building footprints, parcel boundaries, and other features.

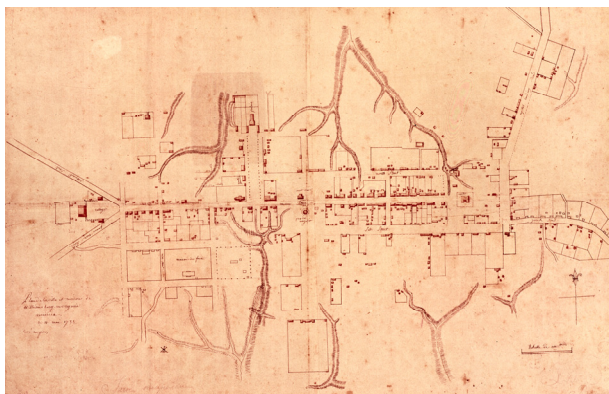


Figure 4. The “Frenchman’s Map” from 1782.

2.2 TOPOGRAPHY

In addition to the built environment, we also sought to recreate the city’s historic topography. Unfortunately, such information from the eighteenth century is generally vague, and inadequate for our needs. However, there is a series of topographical maps from the Waddill Survey in 1929, which cover the majority of Williamsburg’s historic area. These maps, created before the city’s restoration began, allowed us to at least move closer to the eighteenth-century topography, showing the environment before many of the modern changes occurred.

Staff members imaged these maps, and then traced the relief lines within ArcGIS to give us a topographic underlay for the city as a whole (a sample can be seen in figure 5). As time goes on, we hope to use archaeological information to improve our topographic data even further.

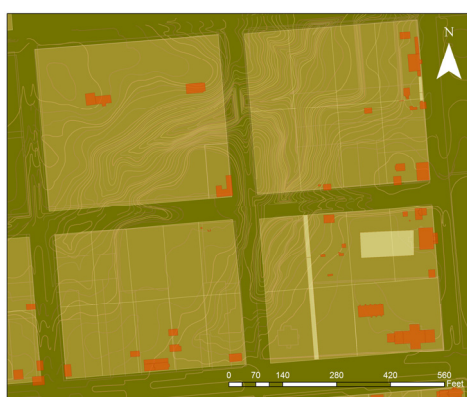


Figure 5. A view of blocks 21, 22, 30-1, and 30-2, showing a close-up of the topographic relief.

3 DATABASE

Besides topography, the data within eWilliamsburg II falls within two semi-independent categories: the first, *structural*, includes buildings of all sizes, fences, and

significant landscape features; the second, *property ownership*, is less tangible, and includes information on both owners and renters.

In neither case are these entities static when considered over time. Property parcels are often divided and consolidated over the years, whether through inheritance or spatial needs. Structures are just as likely to change in footprint, as structural additions are added or removed, and in a few cases buildings are entirely relocated. Figure 6 shows the sort of property changes that can occur in a series of lots, even over a relatively short period of time.

After individual vectors were created within ArcGIS, they were affiliated with tables in the eWilliamsburg II database. This additional data includes information such as dates, levels of spatial and temporal certainty, building names, usage, and parcel ownership. Though data is originally entered in Microsoft Access, it will ultimately be housed within SQL Server, in concert with ESRI’s ArcSDE.

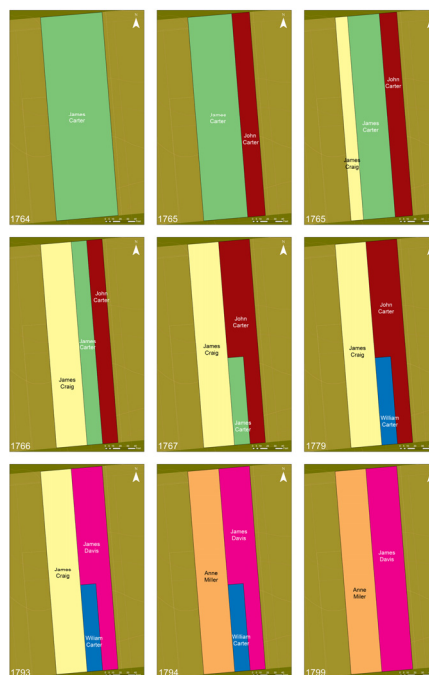


Figure 6. The complex changes in land ownership seen in Block 17 Lot 53, from 1764–1799 (each shade represents a different owner).

The structural data is organized into the following hierarchy of tables (an example series of entries can be seen below in tables 1, 2, and 3):

- *Structure table*—One entry per building.
- *Structural unit table*—Each entry is linked to a single geospatial vector, representing a contiguous portion of a structure built at one time. In some cases, a structure may have only one unit,

while others might have numerous additions or subtractions.

- *Structural date table*—In addition to the calendar date, each date entry has a type (construction or demolition) and reliability (unknown to definite), and may also have a date qualifier (circa, by, or after). A structural unit could have any number of affiliated dates.

Struc_ID	EW0044
Modern Name	Roscoe Cole House
Block and Building Number	CWF19.13
Original Building	Yes
Probable Primary Use	Dwelling

Table 1. Each building has a single entry in the top-level structure table.

SU_ID	EW0044.1
Location Reliability	Definite
Size Reliability	Probable
Moved From	
Moved To	

Table 2. A building’s individual structural units, representing additions or subtractions, are recorded in the unit table.

SU_Date	SD0201
Month	
Day	
Year	1716
Date_Type	Definite
Date_Qualifier	After

Table 3. Each structural unit can have many affiliated dates, with varying levels of certainty.

The property ownership tables are organized in a slightly different fashion:

- *Property table*—One entry per individual
- *Property association table*—In this context, an association refers to a relationship between an individual (owner or renter) and a single geospatial vector, which represents one lot or contiguous series of lots. If the lot or series of lots should change (with a spatial addition or subtraction), then a new parcel association is created.
- *Property transaction table*—Each parcel association has two affiliated parcel transactions, a beginning and an end. If the transaction represents an inheritance, reversion to the Williamsburg Trustees, or change in lot size, that is also recorded.
- *Parcel transaction date table*—Just as in the Structural Date table, a given Parcel Transaction could be affiliated with a number of dates of varying levels of certainty.

4 PROJECT CHALLENGES

4.1 UNCERTAINTY

In a perfect world, we would not have to make any sort of allowances for uncertainty; all maps would be perfectly accurate, all ground-based evidence would be unambiguous, and all interpretations would be in total agreement. In the real world, however, we are deeply impacted by the limited information that we work with. If we simply chose to discard all data that we have anything short of complete confidence in, our map would look very sparse indeed; alternately, if we showed every fence suggested by a single possible posthole, or every building vaguely depicted on a two hundred year old map, the view of the city would be just as misleading.

Within eWilliamsburg II, we have utilized certainty ratings to show our level of confidence in a given date or location. For both, we have created a graduated system from definite to unknown. In the case of an unknown spatial rating, we might know from historical documents that a building was present on a lot, but still have no geographic clues or archaeological evidence. Conversely, a definite temporal rating implies that a construction event has multiple forms of concurring evidence. For the end user, uncertainty is represented visually with degrees of transparency as well as textually; alternately, the user can set the interface to ignore information below a given threshold.

4.2 MULTIPLE DATES

It is worth pointing out that, due to the vagaries of evidence, a feature may have a number of affiliated dates, each with a different level of temporal uncertainty. As a hypothetical example, imagine that we are concerned with a stable built in close proximity to a house. The landowner purchases the land in 1772, so it is possible that the stable was built in that year. However, evidence shows that the landowner’s house was not built until 1773—so it is probable that the stable was built after that date. Finally, the stable appears on the Frenchman’s Map of 1782, so it was definitely constructed by that date.

4.3 LEVELS OF TEMPORAL UNCERTAINTY

1) *Unknown*—Known building with no chronological phasing. Example: We know there was a building on a specific lot, through historical or archaeological evidence, but we have no dating information.

2) *Possible*—Known building with partial or circumstantial evidence of its presence. Example: A person is deeded a lot from the Trustees and it does not revert after the initial two year period, so a building must have been constructed.

3) *Probable*—Based on indirect evidence or the Frenchman’s Map. Example: Partial foundations with indirect dating evidence, or a building that matches a shape and location on the Frenchman’s Map.

4) *Definite by a set date*—Based on datable archaeological evidence or the Frenchman’s Map along with other corroborating evidence. Example: There is a foundation with indirect dating evidence as well as evidence from the Frenchman’s map.

5) *Definite date of construction*—A firm date for a building phase based on documentary evidence. Example: Standing buildings that have clear dating evidence from multiple sources, including TPQ (terminus post quem, or “date after which” a structure must have been constructed), dendrochronology, historical sources, etc.

4.4 LEVELS OF SPATIAL UNCERTAINTY

1) *Unknown*—Known building with no location. Example: Historical documentation shows there is a building, but the lack of physical evidence makes the location indeterminable.

2) *Questionable*—Known building with tenuous location. Example: Historical evidence shows that there is a building, but it can only vaguely be tied to archaeological or architectural evidence, such as non-contiguous bricks.

3) *Possible*—Location based on documentary evidence. Example: There is historical evidence of a building and some slight archaeological evidence (i.e. a few bricks or postholes).

4) *Probable*—Location based on documentary evidence or the Frenchman’s Map, with some archaeological evidence. Example: There is historical evidence of a building that matches with the Frenchman’s Map, in addition to some archaeological evidence (i.e. corner brickwork or features consistent with the type of building).

5) *Definite*—Archaeological foundation that can be associated with a specific structure.

5 FINAL RESULT

eWilliamsburg II has utility for a broad audience, including staff members across the Foundation, researchers both internal and external, and members of the general public. From the beginnings of this project, the prospect emerges of discerning a complex set of relationships that have hitherto been unconnected. The opportunity for socio-temporal and spatial research within this environment is immense; allowing researchers to gauge correlations—between patterns of ownership, tenant relationships, social interaction and building usage—across all levels of time, space and structural type. It is likely that it will allow further conclusions to be applied across the city that are exceptional for a city of this date. eWilliamsburg II will be released to the public early in 2010, and will be available at research.history.org. In its completed form, eWilliamsburg II allows users the opportunity to interact with the city in a variety of ways. They can

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observe the city in a given year, through a range of years, or though the entire eighteenth century (figures 7 and 8). Users are able to focus on specific layers, or see the vectors placed upon a variety of background layers, from historical maps to aerial photos. They can also search for a structure spatially or by name, and from there see additional information, as well as links to appropriate digitized research reports. In addition, users can search through ownership parcels by lot, name, or date. As an example, figure 9 shows what a user would find if they had searched for lots affiliated with the last name “Blair.”

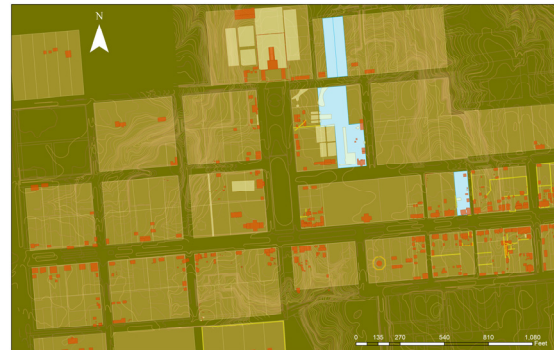


Figure 7. This image depicts Williamsburg in 1710 (structures in red).



Figure 8. This image shows Williamsburg as it existed in 1776 (structures in red).



Figure 9. This image shows lots owned by anyone with the last name “Blair” in 1720 (in blue).