WHAT LIES BENEATH AT THE PINE STREET BARGE CANAL BREAKWATER SHIP GRAVEYARD: SITE FORMATION PROCESSES AS A DOCUMENT OF CHANGE IN BURLINGTON, VERMONT (C. 1830-1960)

by

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The Pine Street Barge Canal Breakwater Ship Graveyard in the waterfront of Burlington, Vermont contains a small assemblage of abandoned vessels along the shores of Lake Champlain. Representing a span of time dating from the early half of the 19th century into the middle of the 20th century, the ships within it are associated with the changing social, economic, and technological trends of the Burlington Waterfront. This thesis will examine the graveyard through the lens of behavioral archaeology using signs of human modification to provide evidence of structural and component removal along with other discernible patterns of salvage. Additionally, site formation processes of cultural and non-cultural transformation signatures will be used to explain the creation of the ship graveyard.

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by

Paul Willard Gates

December 2019

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CHAPTER 1: INTRODUCTION

Introduction

The city of Burlington is in the Northeastern section of the United States between the state of New York and the state of New Hampshire. Figure 1.1 shows the geographic location of the city of Burlington in relation to the Pine Street Barge Canal, the towns of Plattsburgh and Whitehall, New York, and Rouses Point Port of Entry at the border of Quebec, Canada. Whitehall, New York connects the Hudson River to the Southern part of Lake Champlain and is 71 miles Southwest of Burlington. Plattsburgh, New York is 31 miles Northwest of Burlington. The border of Quebec, Canada at the Rouses Point Port of Entry is 54 miles North of Burlington (Google Earth 2019). Burlington occupies the eastern shore of Lake Champlain where the Pine Street Barge Canal is just South of the main ferry landing for the Champlain Transportation Company.

Lake Champlain is the repository of well over 300 shipwrecks and submerged cultural resources, representing over twelve thousand years of known human occupation within the Champlain Valley. These precious and irreplaceable archaeological resources are important to the interpretation of people and history in the region. Archaeological and historic sites can be found throughout the entire region, with a collection of resources relating to maritime commercial activities located all along the harbor of Burlington. As a major industrial center starting in the late 18th century and gradually developing over well into the 20th century, the area became a hub for trade and connected to the rest of the United States through the Champlain Canal and Canada through the Chambly Canal. Steam and canal boat docks, railways, lumber yards, mills, and other manufacturing sites lined the shores of Lake Champlain south from Pine Street all the way north past Battery Park (Cohn 2003).

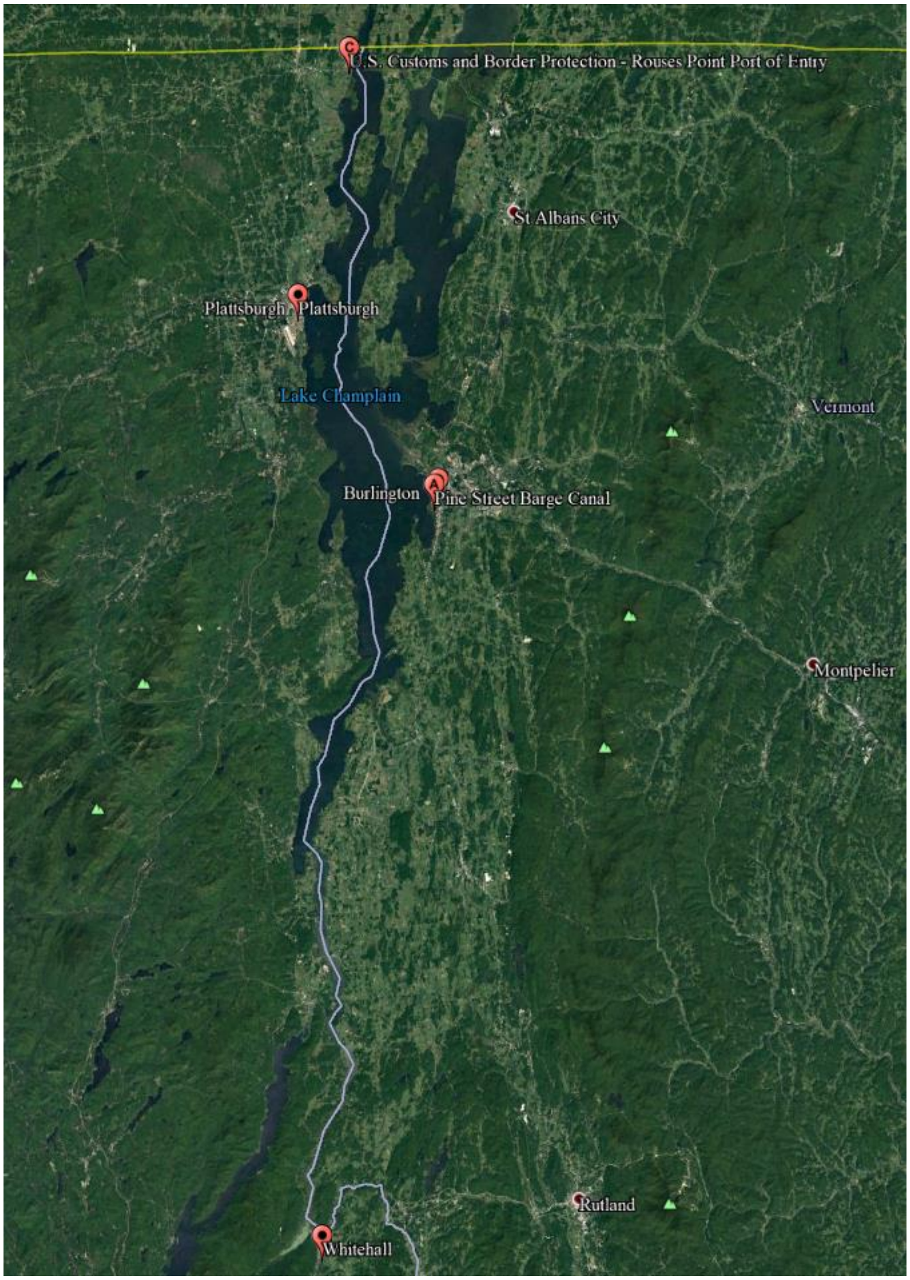


FIGURE 1.1. Burlington, Vermont in relation to the Pine Street Barge Canal, Whitehall New York, Plattsburgh, New York, and the U.S. Customs and Border Protection -Rouses Point Port of Entry (Image courtesy of Google Earth).

The Pine Street Barge Canal and Breakwater is an example of a historic industrial area along the waterfront of Burlington, Vermont. As an inland canal used for offloading lumber and other raw material, the canal and basin within the breakwater were heavily used in the 19th and early 20th century (Cohn 2003). Over the years, it has generated a significant amount of archaeological data based on cultural and historical contexts. Additionally, a cluster of abandoned ships (comprised of *Excelsior* [VT-CH-796], *Hildegarde* [VT-CH-794], Construction Barge 1 [VT-CH-795], Construction Barge 2 [VT-CH-793], and Construction Barge 3 [VT-CH-797]) resides beneath the water in the basin of the breakwater and the Pine Street Barge Canal (see Figure 1.2). While much research has already been conducted on these vessels, they have yet to be examined through the lens of behavioral archaeology. Neither has the abandoned vessels been placed in their historical and local contexts.

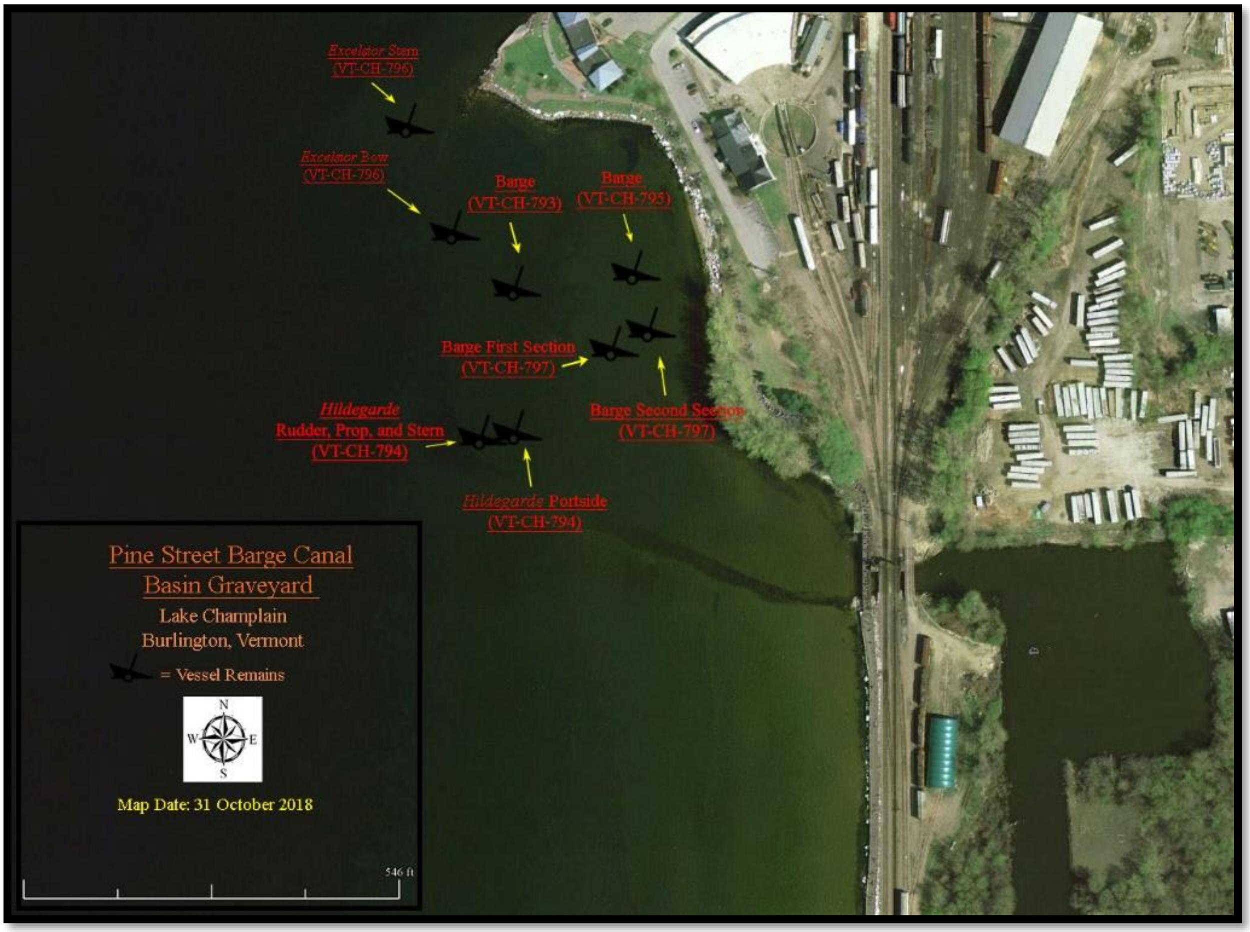


FIGURE 1.2. Field map of the Pine Street Barge Canal Basin Graveyard (Image by author and Google© Maps).

Research Questions

Studying the remains of the vessels in the Pine Street Barge Canal Basin Ship Graveyard presents an opportunity to explore site formation processes and behavioral patterns of ship abandonment. It also provides a means to interpret signatures from these processes and their reflection in the vessel's designated uses and purposes. The primary research question of this thesis is: what does the abandonment of the five vessels in the Pine Street Barge Canal Ship Graveyard tell us about changes to the nature of shipping and transportation in the Burlington, Vermont area? Secondary research questions focus on the industrial, economic and technological related changes in the history of Burlington's Waterfront, including:

- Why were these vessels abandoned and what can they tell us about the use-life of each vessel?
- Why were they abandoned within the confines of the inner breakwater adjacent to the Pine Street Barge Canal and the Northern sections of the Waterfront District?
- Did the presence of the schooner *Excelsior* (VT-CH-796), Construction Barge 1 (VT-CH-795), Construction Barge 2 (VT-CH-793), Construction Barge 3 (VT-CH-797) and *Hildegarde* (VT-CH-794) present navigational hazards for maritime shipping and transportation?

Research Design

This thesis is divided into six chapters. Chapter 2 provides a review of the history of Burlington, Vermont along with research into the commercial development of the waterfront. After the end of the American Revolutionary War in 1783 (American Battlefield Trust 2019), the city of Burlington grew markedly from the late 18th century to the 19th century. While traditional regional sailing vessels like *Excelsior* were used in lakeside trade during this time, technological developments in canal boats, steam engines, and railroads made sailing craft obsolete by the late 19th century. Steam tugs like *Hildegarde* would have been a common vessel type seen along the waterfront hauling barges with raw or finished goods. However, steam vessels were replaced by modern petroleum-based engines used in both marine vessels and automobiles in the 20th century. By then, much of the industry on the waterfront fell into decay and the once-bustling maritime port halted much of waterborne commercial activity. It is important to understand the historical progression and development of the Burlington Waterfront as it provides insight on the maritime industries in the region (Hemenway 1867; Rann 1886; Crockett 1931; Wilgus 1945; Cohn 2003).

The theoretical foundation discussed in Chapter 3 outlines an understanding of site formation processes. With a review of Schiffer's (1987) work in site formation processes from both a systemic context and an archaeological context, the theoretical principles will be discussed on how they apply to the ships of the Pine Street Barge Canal Basin Graveyard. Such principles include cultural formation processes and non-cultural formation processes, which explain how human behavior and environmental factors alter artifacts (in the case of this study being the abandoned watercraft). From the systemic context, formation processes such as lateral cycling and primary salvage will be discussed in relation to how they affect the artifact in a pre-depositional context. Within the archaeological, or post-depositional context, the processes of discard, secondary salvage, and abandonment will be reviewed to show how sites continue to change. Discussions of other archaeological paradigms using modified site formation processes will also be reviewed.

Chapter 4 reviews the methodologies used to acquire and analyze research for the thesis. The research methodology used for this study included historical research on primary and secondary resources gathered from the Howe Library of the University of Vermont, research from the Lake Champlain Maritime Museum, searches through records of Burlington City Hall, reviews of books, and internet searches. Resources from Joyner Library at East Carolina University was also used including records from the *Merchant Vessels of the United States*, *The American Yacht List*, Lloyds Register of American Yachts, and *Annual Reports of the Army Corps of Engineers*.

The archaeological research was conducted through a review of previous archaeological data recorded from the Historic Preservation Program of the University of Vermont, the Champlain Maritime Society, and the Lake Champlain Maritime Museum. Fieldwork for data collection consists of *in situ* documentation using videography and a proforma sheet to record signatures of abandonment and other pertinent information. Collected data from the research was analyzed and incorporated into Chapter 5 and 6, which consists of information on the systemic context and the archaeological context of all the ships.

Chapter 5 looks at the histories and use-lives of *Excelsior*, *Hildegarde*, and the Turner & Breivogel barges in their systemic context. The *Merchant Vessels of the United States* provides research on vessel histories with their registration numbers, vessel types, names, owners, measurements, ports of origin, and home ports. Historical information collected from newspapers and secondary sources conveys more of the vessel's histories. A discussion of the site formation processes of each vessel in its *pre-depositional* context will provide inferences on their use-lives before abandonment. Aiding the dialogue are representative diagrams show how each vessel was affected by transformation processes. A discussion on the signatures conveyed by site formation processes and behavioral patterns related to the use, modification, and discard of the vessels in the graveyard concludes the chapter.

Chapter 6 focuses on the archaeology of the abandoned vessels in the Pine Street Barge Canal Ship graveyard in their post-depositional context. Models of each vessel will demonstrate salvage patterns on the ships before they enter the archaeological context. Collated data is arranged on a site-by-site basis where each vessel has a description of the archaeological context. Each site has a catalog of observed and documented cultural and non-cultural site formation processes with their respective locations marked on archaeological site maps and referenced in tables. Annotated digital photographs of the observed site formation signatures on each site are included to highlight the processes. A final section includes an analysis of the potential correlation between ship abandonment and Burlington's maritime commerce, with separate sections considering likely relationships between abandonment and salvage actions and corresponding economic, population, technological and use trends.

Chapter 7 summarizes the thesis by reviewing all aspects of changes in industry, economics, and technology along the Burlington waterfront and how it is represented in the archaeological remains of the vessels. It will also review the thesis questions and answer them based on the evidence found through historical and archaeological research. Future research directions will be discussed as potential avenues for academic work on other abandoned watercraft sites along the shoreline of Burlington. Further possible research on the entire collection of ships in Lake Champlain can provide in-depth insight on site formation processes for freshwater archaeological sites. References and appendices are included at the end.

CHAPTER 2: THE HISTORY OF BURLINGTON, VERMONT

Introduction

This chapter reviews the history of Burlington, Vermont as it changed over the course of the late 18th century into the 20th century. As an ideal location for a maritime port along the lake, Burlington developed into a commercial center. The development of the city was heavily propelled by the increase in trade and commerce created by the canals and railroads in the 19th century. Traditional lake sloops and schooners used before the creation of the Champlain and Chambly Canal were still used for heavier bulk cargoes such as coal and stone, but slowly faded out of use and were ultimately abandoned over time. As they and other boats were eventually discarded in local derelict ports, ship graveyards began to appear (Hemenway 1867; Rann 1886; Cohn 2003).

When canals and railroads took over in the 19th century, they represented a change in technology from the use of traditional sailing craft to the adoption of more reliable and efficient means of transportation. Shipping with fleets of modified sailing canal boats, merchants could access markets and good outside of the Champlain region. As rail use and networks grew outside of the state of Vermont, shipping and transportation became even more dependable. Steamboats and the consortiums that operated them also aided in changing the nature of shipping and transportation in Lake Champlain. Well into the early part of the 20th century, Burlington experienced unprecedented growth as a port city (Hemenway 1867:518-519; Auld 1893; Crockett 1931:189-190).

However, the use of sailing canal boats, steamships, and even trains steadily declined over the course of the 20th century. Much of the once-thriving, industrial waterfront began to wane. The use of automobiles running on gasoline and diesel engines along with the development of roads and highways became the norm. Though lake traffic consisting of a few remaining canal boats and steam vessels lingered into the early part of the century, maritime use decreased.

This chapter will also include a summary of the history of the Pine Street Barge Canal and the associated ship graveyard. As a naturally protected area of the Burlington Waterfront, it was used in the late 18th and early 19th centuries as one of the first ports. By the middle of the 19th century, the area was developed primarily for use by the Rutland and Burlington Railroad. A canal was also made for canal boats to dock inland to the surrounding lumber mills. Gradually, the Pine Street Barge Canal and Basin fell into disuse and became a dumping ground for old, derelict vessels. The known vessels abandoned in the area include a mid-nineteenth century lake schooner *Excelsior* (VT-CH-796), the steam converted schooner yacht *Hildegarde* (VT-CH-794) and three mid-twentieth century work barges (VT-CH-793, VT-CH-795, and VT-CH-797). A brief history of the vessels will be reviewed as the complete histories of the ships is covered in Chapter 5.

The Development of the Burlington Waterfront

Burlington was the most important commercial center on Lake Champlain and saw a dramatic change from its initial settlement prior to the Revolutionary War all the way up to the present day. As people established permanent settlements in the late 18th century, the town progressively developed and experienced significant industrial and economic growth throughout the 19th century. The Champlain and Chambly Canal systems aided in part as newer sailing canal vessels replaced traditional sloops and schooners for bulk cargo distribution. Steamships and railroads were vital passenger transportation services that advanced alongside and complimented canal boat use. The waterfront of Burlington systematically established wharves, harbors, breakwaters, lighthouses, storage yards, lumber mills, factories, rail to water services, and a myriad of other associated maritime infrastructure throughout the 19th century. (Zadock 1842; Hemenway 1867:518; The Burlington Board of Trade 1889:37-67; Auld 1893:40-43; Allen 1905:125-130).

Figure 2.1 depicts the shoreline of the Burlington waterfront today with an approximation of the original historic shoreline. Into the 20th century, most of the heavy industry was in decline as city officials reclaimed the waterfront for public use. Today, archaeological and historic remains of this segment in time are present with the Pine Street Barge Canal Graveyard and serve as a perfect example of the industrial use and adaptation of the Burlington Waterfront (Kane et al. 2008:70-100).

In the late 18th century, the city of Burlington began expanding after its survey and settlement by the Allen brothers (Hemenway 1867:668; Auld 1893:37-40; Cohn 1984:10). Following the periods of intense warfare of the American Revolution and The War of 1812, people began to settle throughout the Champlain Valley as colonial governors from both New York and New Hampshire issued out large land grants (Lake Champlain Maritime Museum 2018). Land speculators from the colonies of Massachusetts and Connecticut also began to expand into the region, with the brothers Ethan and Ira Allen as some of the most well-known investors, who had bought thousands of acres of land. Ira Allen was the first to survey and map Burlington in 1773 when he started the initial planning for the design of the city (Auld 1893:37-40; Cohn 2003). The Allen brothers settled in Winooski and formed the Onion River Land Company to manage their landholdings.

Most settlements in the late 18th century was small, widely spread out, and focused along waterways close to Lake Champlain. As an agrarian culture using the landscape for its vast natural resources, settlers of the region began developing the region. Industry was relatively small as much of the commercial activity relied on produce and goods carted inland to the shores of Lake Champlain. “Admiral” Gideon King was one of the first successful entrepreneurs of maritime trade along the waterfront in the late 18th century and built a fleet of sloops and schooners to support shipping goods along the lake (Hemenway 1867:669-670).

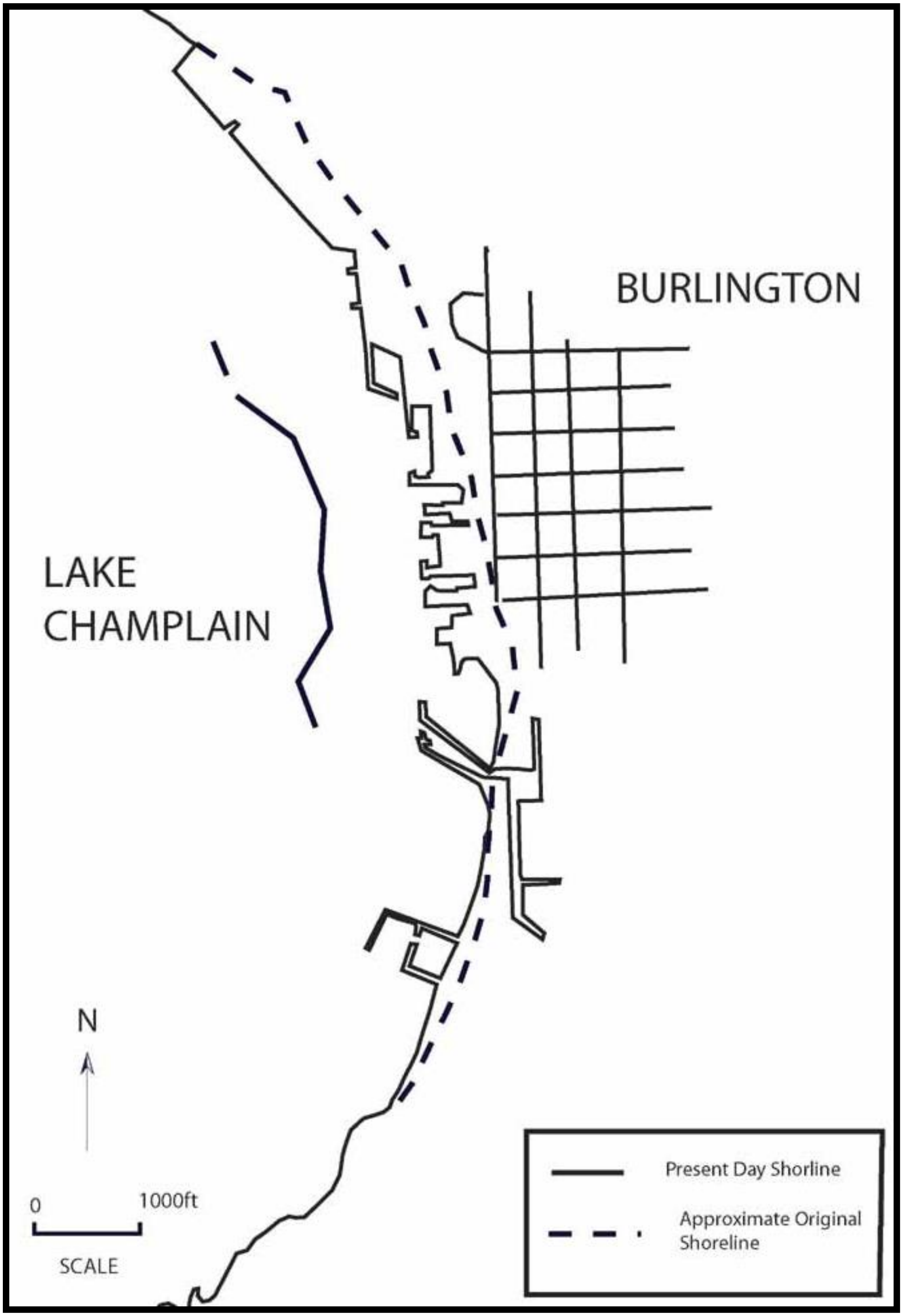


FIGURE 2.1. Map of Burlington Waterfront with current shoreline and approximated original shoreline (Image courtesy of the Lake Champlain Maritime Museum).

By this time, not much of the Burlington Waterfront was developed for commercial or industrial purposes and any real wharves were nonexistent as seen in Figure 2.2 of a survey of the village from 1798 (Coit and Johnson).

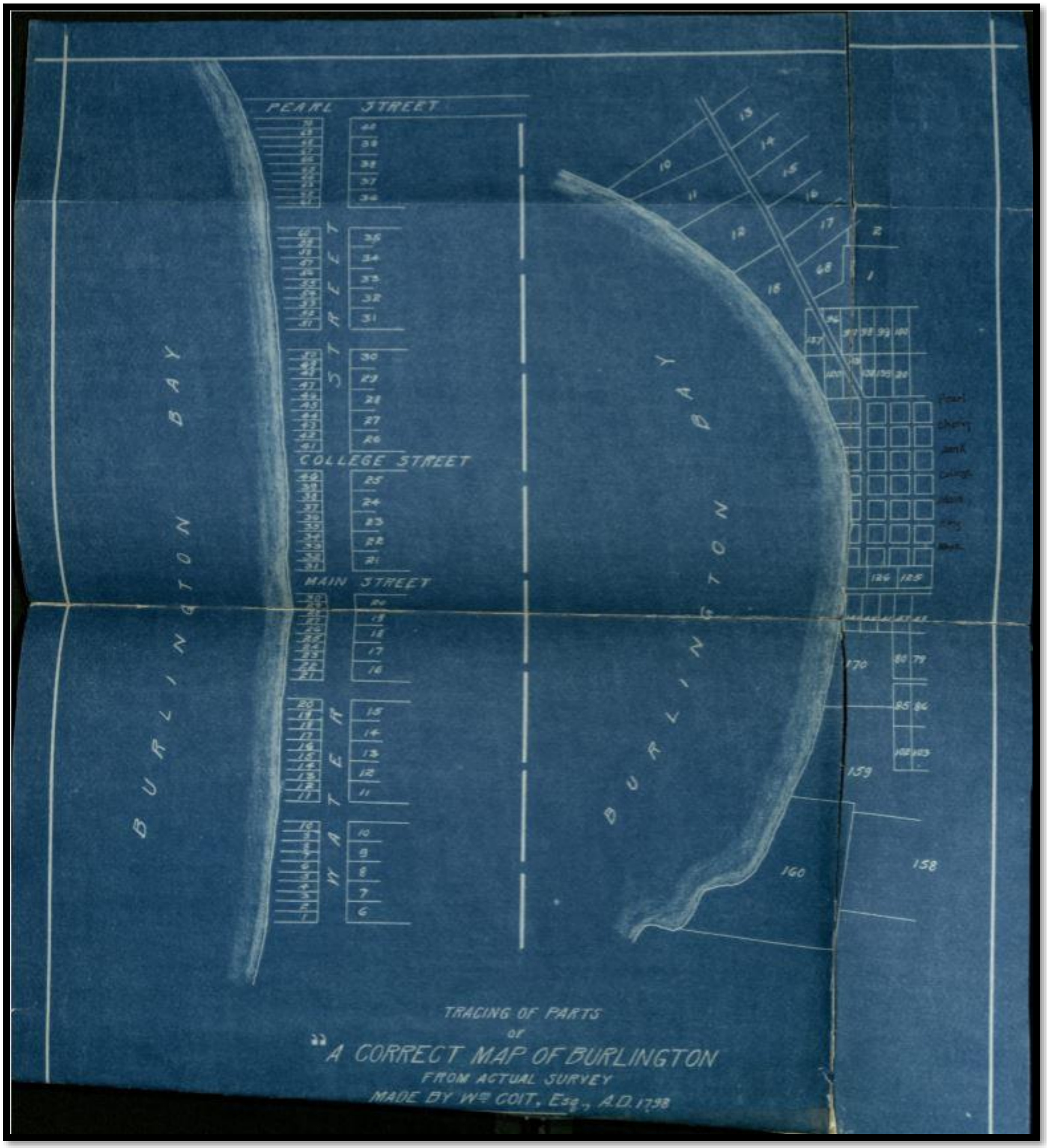


FIGURE 2.2. A Correct Map of Burlington From Actual Survey 1798 (Image courtesy of the City of Burlington Land Record Office).

In 1783, settlers driven out of the region by war began to return to the state and local towns such as Burlington, Guilford, Windsor, and Middlebury thrived with increased growth in population (Hemenway 1867:666-667; Cohn and Crisman 2003:31; Cohn 2003:14;). Trade flourished in the area, with the lake serving as an essential maritime transportation hub for the various goods and commodities moving in and out of the area. Timber was a vital resource and was not only transported in bulk as seen in Figure 2.3, but also used to make potash, pearlash, charcoal, tar, pitch, and mineral spirits (Hemenway 1867:517-518; Allen 1905:126; Kane et al. 2003:26). Trade with Canada also increased as this raw material and other diversified goods were exchanged in Canadian markets for liquors, tea, coffee, salt, and other merchandise.

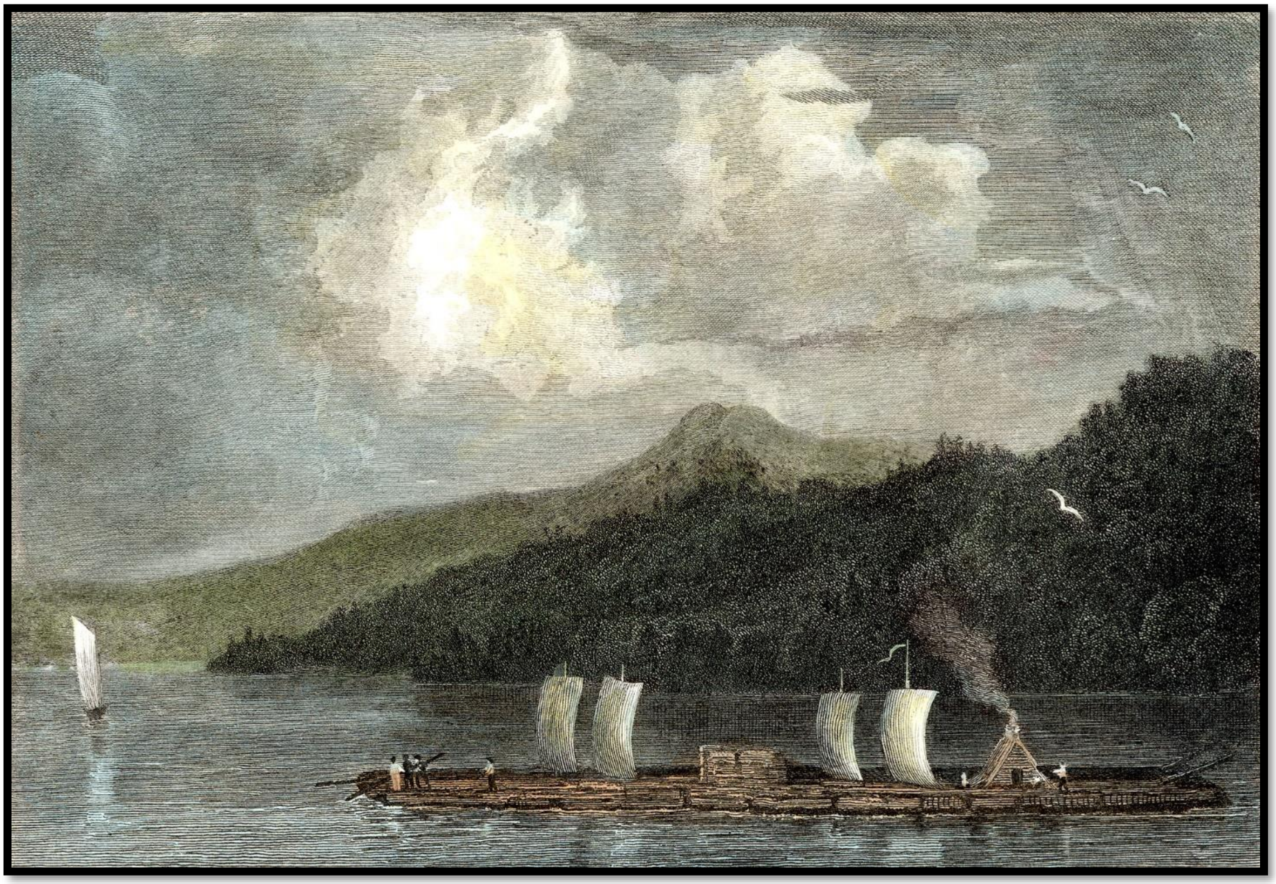


FIGURE 2.3. Log rafting on Lake Champlain (Image courtesy of the Lake Champlain Maritime Museum).

The advent of steam also affected the Lake Champlain region as steamboats like *Vermont* were used to ferry people and material around the entire region.

Commercial interests with merchants in the area expanded to businesses in the Hudson Valley and radically increased over the course of the 19th century. However, there was no natural navigable waterway connecting Lake Champlain to the Hudson River. Most goods at the time had to be transported overland in stagecoaches and wagon trains, leaving most of the heavier bulk materials such as iron ore and timber without any real cost-effective means of transference. The initial planning and effort to connect the Hudson River to Lake Champlain with canals began on March 30, 1792, when legislative action proposed the creation of a state-wide lock system (Cook 1887:316; MacGill 1917:172; Crockett 1921:187). In the late 18th century, the Northern and Western Inland Lock Navigation Companies undertook efforts to survey and gather a workforce and materials to begin construction of a canal system with improved natural waterways (New York State Historical Literature 2018). Though some initial work was done to dredge and create a small canal along the Mohawk River and Wood Creek, work was sporadic, and funding limited, effectively halting any further development until the 19th century (MacGill 1917:172-174).

In the early 19th century, commissioners for the State of New York began planning for the creation of a navigable waterway from the Hudson River to the Great Lakes and Lake Champlain. DeWitt Clinton, president of the Canal Commissioners Board, advocated strongly for the creation of a canal system. Realizing the importance of using existing natural waterways for transportation, the commissioners began discussing plans and routes for augmenting existing natural waterways with constructed artificial ones. He submitted his draft plan for the Erie and Champlain canals, along with the financial pledges of interested New York citizens, estimated costs, and surveyed routes on February 16, 1816 (Clinton 1816b:211-233). It was approved by the state, making it the first publicly funded canal project in the United States. Two months later, on April 16th, 1816, legislation was passed by the state legislature to provide for the improvement of the internal navigation of the state of New York (Clinton 1816b:211). Clinton and the commissioners then applied for "cessions, grants or donations of land, or money, for the purpose of aiding in opening communication, by means of canals, between the navigable waters of Hudson's river...and Lake Champlain" (Clinton 1816a:3; MacGill 1917:179-187).

When the Champlain Canal opened in 1823, it provided a connection from Lake Champlain to the Hudson River, which had an enormous effect on the economic prosperity of the Champlain Valley (Hemenway 1867:681; Crockett 1921:187-190; Wilgus 1945:53-56; Cohn 2003:29). Later canal developments also opened waterborne commerce with Canada, such as the opening of the Chambly Canal in 1843, which created a direct route into the Saint Lawrence Valley (Kane et al. 2003:33). Bulky raw materials, which were previously too costly to ship overland, could now be transported cheaply to marketplaces along the Hudson River and well beyond into other geographic regions. Lake Champlain's importance as a commercial transportation waterway spurred exponential economic growth in port towns along its shores, especially in Burlington, Vermont.

The Champlain Canal was expanded three times during the nineteenth and early twentieth century, with each new expansion corresponding to the development of a new larger class of canal boats (Crisman 1990:6; Cohn 2003; Lake Champlain Maritime Museum 2017). The dimensions of the canal prism were 40 feet for the top width, 26 feet for the bottom width, and 4 feet for the depth. The dimensions for the locks were set at 90 feet in length, with a width of 15 feet, and a depth of 5 feet (American Canal Society 2018; Cohn 2003:38). In 1835, construction teams re-dredged the canal, ending with the lock's completion in 1858 and the completion of the prism expansion in 1862. Size standards for the prism were now set at 50 feet for the top width, 35 feet for the bottom width, and 5 feet for the depth with lock dimensions set at 100 feet for the length, 15 feet width, and 5 feet depth. The third and final expansion was authorized in 1864 and the construction was completed in 1877, with the lock dimensions set at 110 feet in length with a width of 18 feet. The measurements for the prism top width were 65 feet, the width at the bottom was 44 feet, and the depth was set at 6 feet (Cohn 2003:40-41).

The use of canal boats to haul freight extended well into the twentieth century, as the construction and development of sailing canal vessels by builders in the Lake Champlain region was critical to the economic success of canal freight and transportation. Sailing canal boats are a modified version of a standard canal vessel outfitted with a centerboard, masts set into stepped boxes called tabernacles, and gaff-rigged sails (Hemenway 1867:683-684; Cohn and Crisman 2018). This gave canal boats an advantage in utilizing wind power for open water travel without having to rely on steamships for tug assists. Upon arriving at locks, the masts and rigging could be removed and stowed on the deck to clear locks and bridges while they were towed inland. With each progressive expansion of the Champlain Canal, ship rights and merchant firms constructed canal vessels to accommodate the new canal dimensions. Figure 2.4 depicts an 1862 class sailing canal vessel underway on Lake Champlain.

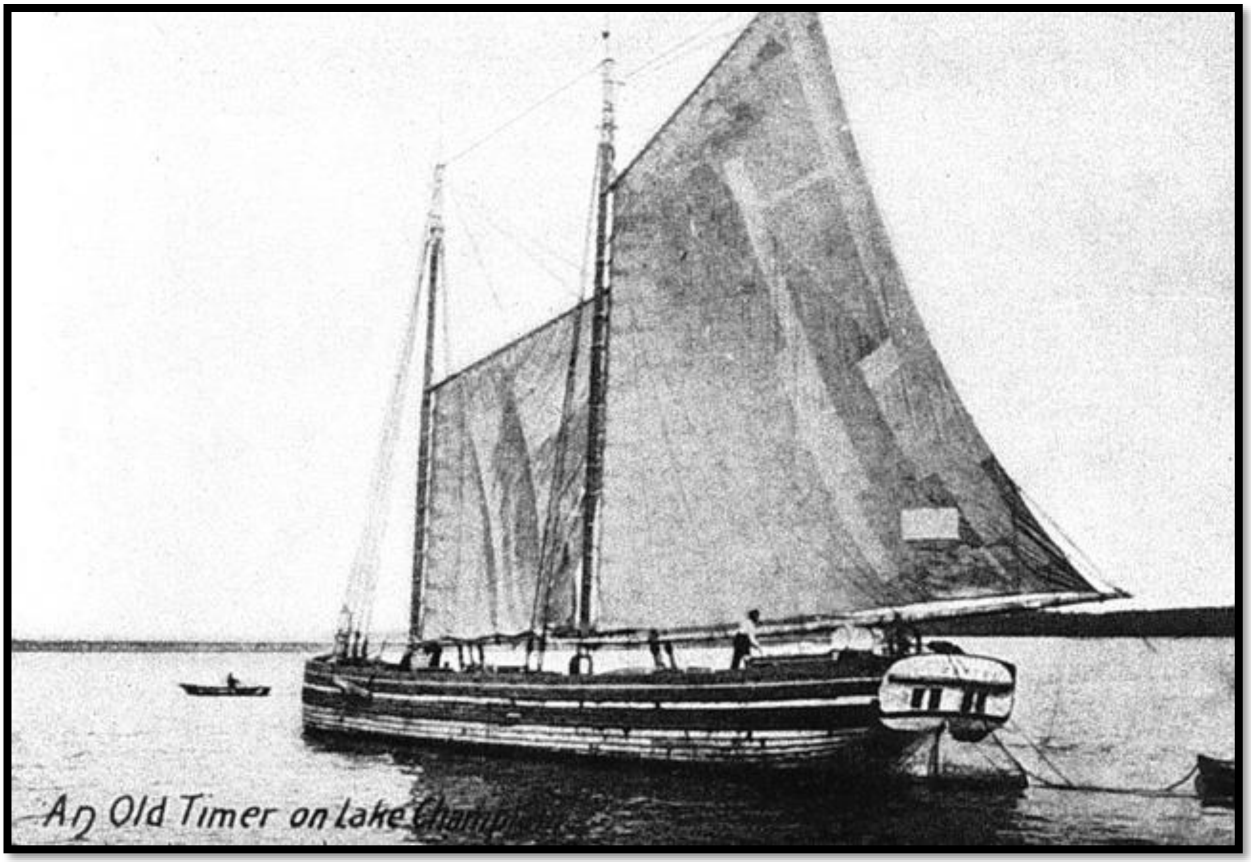


FIGURE 2.4. Historic photograph of a sailing canal boat titled, “An Old Timer on Lake Champlain” (Image courtesy of the Lake Champlain Maritime Museum and Texas A&M University).

With the change in the maritime technology of sailing canal boats, it dramatically changed the Lake Champlain region into a thriving hub for commerce. Burlington grew as a major maritime city, along with most of the Chittenden County area. The *Vermont Gazette*, Hemenway (1867:459) comments on the economic prosperity of the region saying:

> The county of Chittenden has better advantages, meanwhile, over the commerce and navigation of the lake, than any other portion of the state. This is owing to its proximity to the broadest part of the lake which affords the most accessible points of shipment on its eastern shore. The harbor of Burlington is the natural stopping place of the steamers and other craft, that pass along the lake, in either direction –

> it is protected by a breakwater, constructed at the expense of the general government; and the lines of rail road concentrate on the wharves here, where they have their principal depots. This has already become an important point of inland trade, from which large amounts of produce is shipped, and merchandise land in return, for the use and consumption of this section of the country; and it has also become the depot of an immense lumber trade, with the province of Canada.

Hemenway's remarks on the Burlington waterfront are reflected in historic maps, which show a gradual progression of industry beginning to take shape. The Presdee & Edwards Map of Burlington, Vermont, 1853 in Figure 2.5 shows the vast expanse of the city of Burlington and the harbor. Drastically different from the W. M. Coit map made in 1798, Presdee & Edwards include the heavy industry of sawmills, planing mills, wharves, docks, and warehouses. Occupying much of the waterfront is a network of tracks owned by the Rutland and Burlington Railroad along with other infrastructure such as depots, an engine repair roundhouse, and administrative buildings.

FIGURE 2.5. Presdee & Edwards Map of Burlington, Vermont, 1853 (Image courtesy of Bailey Howe Library Digital Collections, University of Vermont).

However, canal boats encountered economic competition from steamships, railroads, and later automobile transportation. With the development of rail lines in the middle of the 19th century, it provided more reliable transportation throughout the region and into neighboring states. Rail service had the advantage of not only allowing for year-round service as the canals typically froze over in the winter but allowed for a greater increase in bulk cargo shipping. Steamboats like the advertisement of the steamer *Burlington* as seen in Figure 2.6 also operated on the lake as early as the beginning of the 19th century, with various companies operating and providing passenger service in the region. The Champlain Transportation Company was the most profitable steamship businesses and eventually bought out most of the other companies, creating a monopoly in 1835 (*The Daily Free Press* 1848:2; MacGill 1917:340-342; Crockett 1921:348-352; The Champlain Transportation Company 1930; Wilgus 1945: 63-70; Crisman 1990; Bellico 1992; Cohn and Crisman 2003).

As suggested by Rann, the opening of the railroads in Vermont and Burlington, was an event that "seemed ominous for the future of the town" (Rann 1886:425). It is also noted that the railroads discriminated against the interests of the city in favor of wholesale merchant businesses in Massachusetts, New York, and Canada. Though there was some depreciation of property values in the middle of the 19th century, railroads only seemed to bolster the industry of the Burlington waterfront. This was relatively short-lived as expanding rail systems on both the western side of the lake and the eastern side took over most of the bulk commercial trade.

Figure 2.6. Steamer Burlington, R.W. Sherman Commander, Lake Champlain 1837 (Image courtesy of the Champlain Transportation Company).

The use of steamboat passenger service also began to decline, as rail service and eventually roads made for automobiles in the early 20th century created a more complex transportation network. In 1916, New York State undertook a final enlargement of the Champlain Canal that could accommodate self-propelled barges carrying fuel oil, kerosene, and gasoline into Lake Champlain. This attempt was meant to stimulate commercial activity based on the notion that larger transport ships would reduce costs of lake shipping, but the older wooden-hulled canal boats were too small for the new lock dimensions. This led to the stagnation and eventual decline of the canal and commercial sailing craft era from about 1870s the 1945 (Wilgus 1945:79-91; McFee 1998:35, 53-54; Kane et al. 2003:36).

Well into the 20th century, most commercial activity on Lake Champlain ended apart from car ferries, work diesel tugs, and steel barges bringing in various grades of oil along with other petroleum products into the region (Wilgus 1945:89; McFee 1998:181-184). Lake Champlain became a popular tourist attraction for many travelers coming into the area to enjoy recreational activities. The city of Burlington also underwent significant change as public concern for the condition and quality of the waterfront, which had fallen into a severe state of neglect as seen in Figure 2.7. Though many oil tank farms such as Mobil Oil Corporation, Exxon, and Green Mountain Petroleum corporation occupied the industrial spaces of the waterfront, much of the infrastructure from the 19th century was no longer present. Furthermore, the latter half of the 20th century saw an increased effort by environmental groups to protect the lake and waterfront (*The Burlington Free* Press 1970a:9). The city of Burlington passed a zoning ordinance in 1970 stating that all non-conforming industry had a period of twenty years to fully remove or relocate infrastructure from the waterfront (*The Burlington Free* Press 1970b:9; City of Burlington, Vermont 1970). Additionally, the city used the state-mandated Public Trust Doctrine in the 1980s which determined that the waterfront was land to be used for the public benefit (*The Burlington Free* Press 1984a:1a, 1984b:9a; 1987:1a; City of Burlington, Vermont 2018).

Figure 2.8 shows a map made in 2019 from the National Oceanic and Atmospheric Administration for Burlington. The radical expansion of the city along with the development of the waterfront shows a much larger city and associated maritime infrastructure. As the waterfront once followed a graceful concave curve from the north to the south in the late 18th century, it is now filled in and occupied by piers, wharves, breakwaters, and other built-up features. The stunning transformation of the Burlington Waterfront occurred mostly in the 19th century, as the opening of the Champlain and Chambly Canal, railroads, and steam service required significant development of maritime infrastructure.

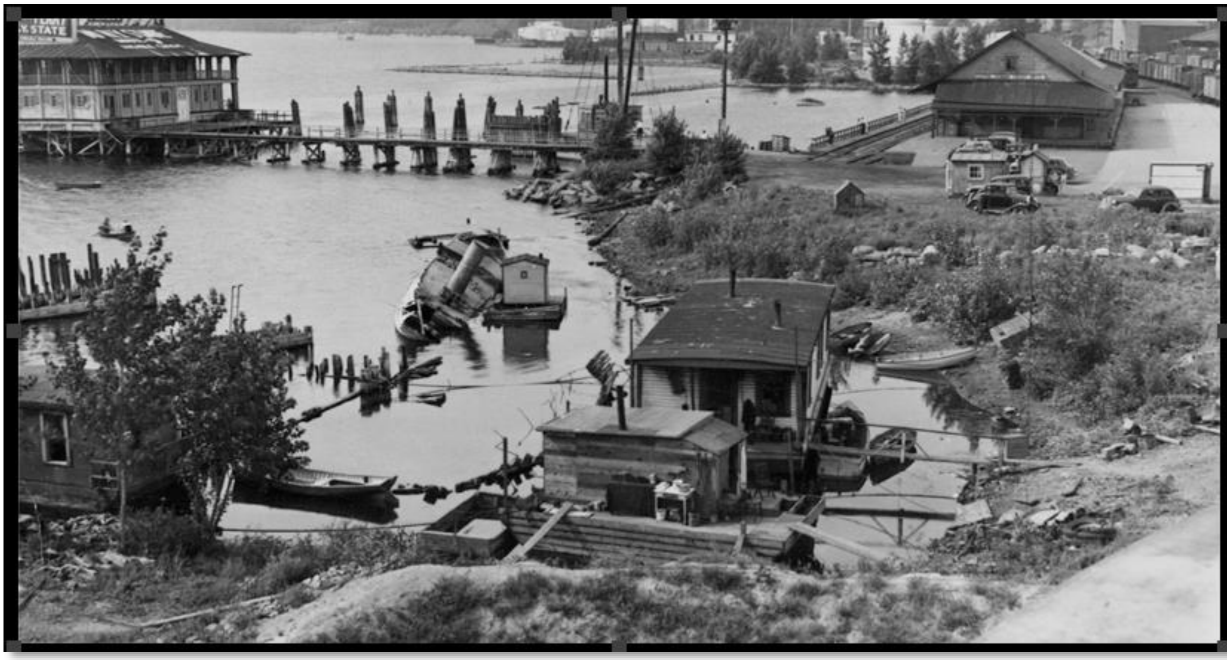


Figure 2.7. Burlington’s waterfront circa 1935 (Image courtesy of the University of Vermont, Bailey Howe Library, Wilbur Special Collections).

The Pine Street Barge Canal and Associated Ship Graveyard

The Pine Street Canal Breakwater site lies just offshore of Burlington, Vermont adjacent to the Pine Street Barge Canal. The site is southwest of the sewage treatment plant and due west of the Vermont Railway Company offices as seen in Figure 2.9. Historically, the area is referenced to as “the cove,” where the location from Peterson's Brewery to the shore was lined with trees and the water came up to them so that vessels could enter the cove and tie up to them (Hemenway 1867:669). Hemenway remarks that stores belonging to the Master Builder Richard Fittock were kept near where the Rutland and Burlington railway depot is and that the beach formed a natural breakwater near the tree line. Fittock also ran lighter services to larger sloops and schooners out in deeper waters to collect cargo.

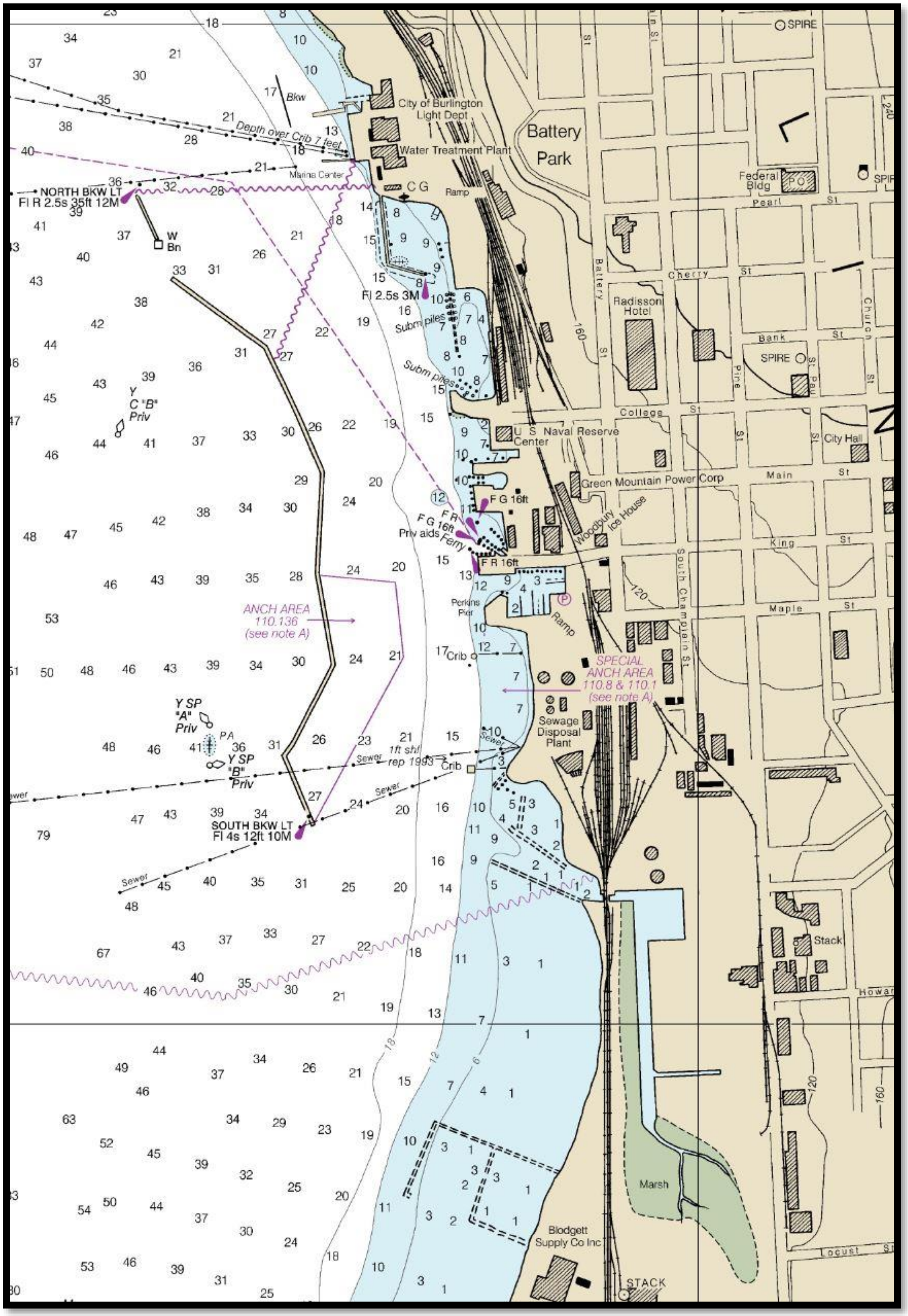


FIGURE 2.8. National Oceanic and Atmospheric Administration, National Ocean Survey, U.S. Dept. of Commerce, United States – Great Lakes, Lake Champlain Vermont, Burlington Harbor, 18th Edition, January 2019, Chart No. 14785 (Image courtesy of the National Oceanic and Atmospheric Administration).

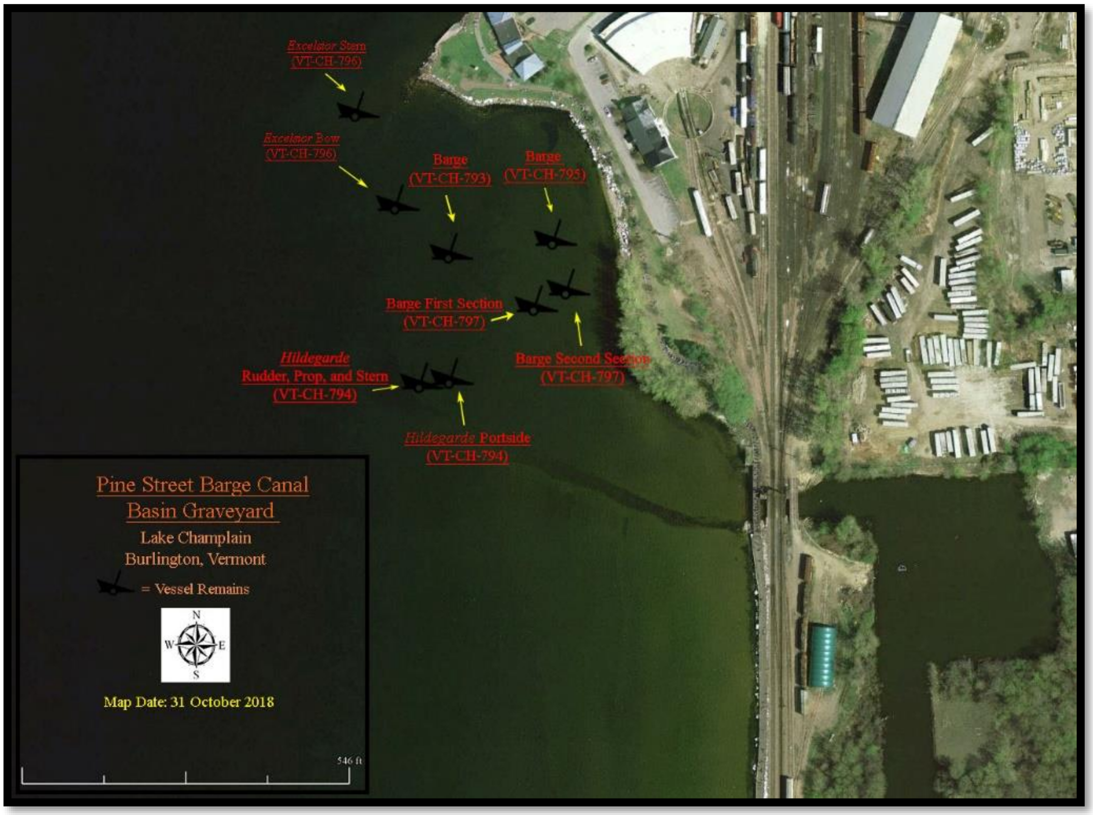


FIGURE 2.9. Field map of the Pine Street Barge Canal Basin Graveyard (Image by author and Google© Maps).

Over time, the area was developed by the Rutland and Burlington Railroad Company along with a small canal built to facilitate the loading and unloading of lumber to the mills in the area (Lake Champlain Maritime Museum 2017a). Displayed in Figure 2.10, this small canal was excavated in the 1860s to facilitate loading and unloading of canal boats along Burlington's waterfront. Burlington was one of the largest lumber ports in the nation at the time. The southern leg of the Barge Canal Breakwater was built in 1868, while the northern leg was finished two years later in 1870. The northern breakwater and another smaller breakwater extending from Roundhouse Point to the north made a small basin in the area north of the Pine Street Canal breakwaters. A gap between the breakwater allowed lake vessels access to this basin, however, in 1893, the opening was enclosed with another breakwater (Kane et al. 2004).

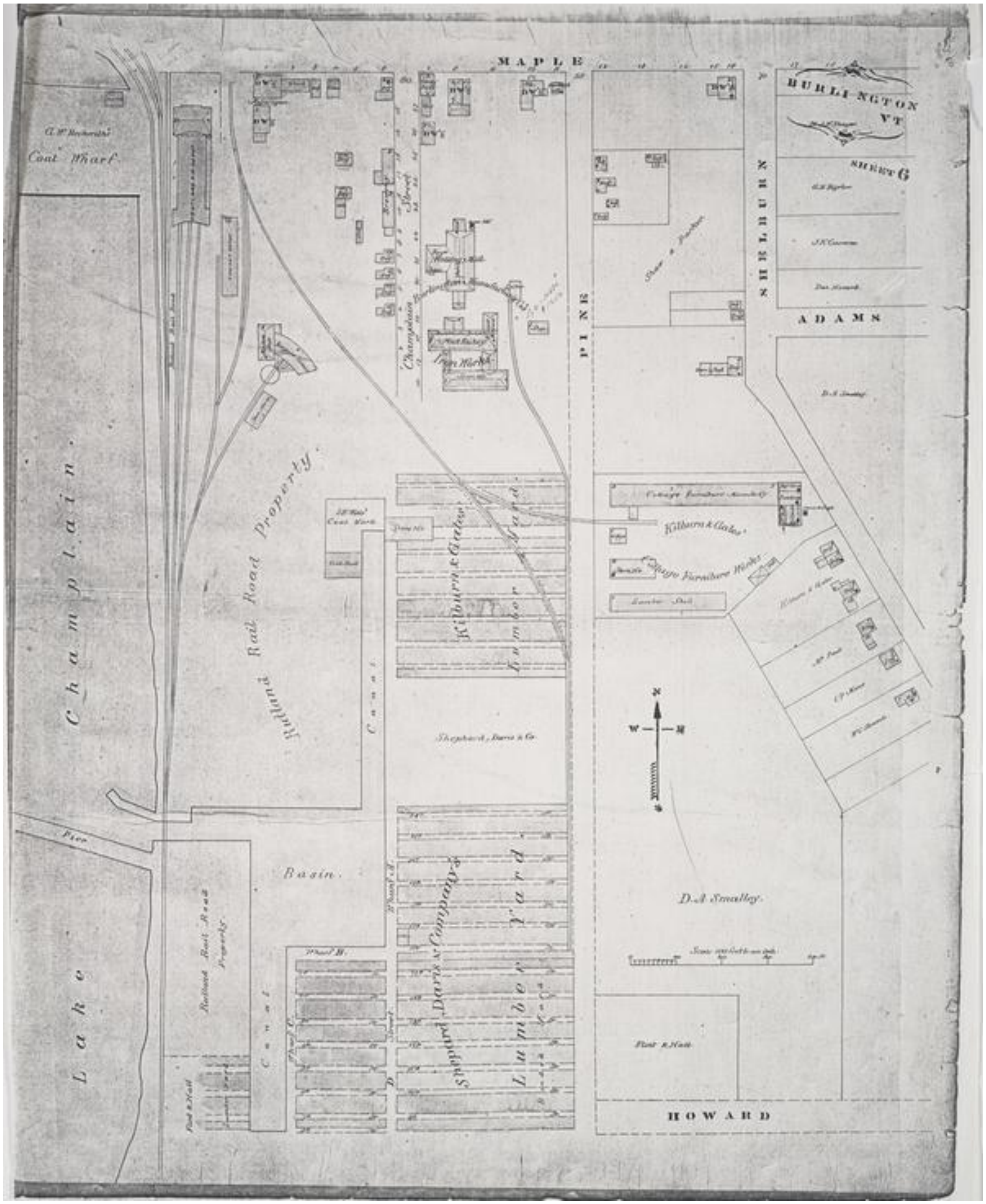


FIGURE 2.10 Sanborn Fire Insurance Map of Burlington, Vermont 1869, Sheet 6 (Image courtesy of Howe Library Digital Collections, University of Vermont).

In 1895, a coal gasification plant, which created gas from oil and coal, was made next to the canal. Wood chips from the local mills were used as a filter for the gasification process, creating hazardous waste by-products like tar, cyanide, and fuel oil. Much of the waste was thrown in the wetlands surrounding the canal. In 1983, the Environmental Protection Agency placed the Pine Street Barge Canal site on the Superfund National Priorities List and was eventually cleaned up and environmentally sealed (ARCADIS 2010). During the environmental remediation, the remains of several heavily deteriorated canal boats were discovered, and a historic study determined that they were abandoned sometime in the 1920s or the 1930s.

The basin remained closed from lake traffic until 1960 or 1961, when the U.S. Army Corps of Engineers removed a portion of the breakwater to allow work barges to moor inside the basin and by Perkins Pier to the North of the basin. The mooring area was needed because of repair work associated with the 1958 collapse of a portion of the concrete superstructure of the main Burlington Harbor breakwater. The U.S. Army Corps of Engineers completed repairs on the breakwater in 1961 for which several barges contracted through Turner and Breivogel, Inc. from Falmouth, Massachusetts was used. According to Captain Merritt Carpenter, these barges were brought to the lake from the Hudson River and were moored inside the recently opened basin. *The Burlington Free Press* also has extensive documentation on the Breakwater Rehabilitation project, which mentions Turner and Breivogel are mentioned as the contractors for the project (1962a, 1962b, 1962c, 1962d, 1962e, 1963a, 1963b, 1963c, 1963d, 1964a, 1964b, 1964c, 1964d, 1964e, 1964f). After completion of the repair, they were abandoned in this same location. The modern setting of the Pine Street Barge Canal Basin is represented in Figure 2.11.

Figure 2.11. Panoramic view of the Pine Street Barge Canal Basin, Burlington Waterfront, Vermont, USA. Image courtesy of Paul Willard Gates.

The Pine Street Barge Canal Basin contains the remains of five vessels with their associated archaeological site designation number issued by the state of Vermont: the mid-19th century lake schooner *Excelsior* (VT-CH-796), the late 19th century steam converted schooner yacht *Hildegarde* (VT-CH-794) and three mid-20th century work barges (VT-CH-793, VT-CH-795, and VT-CH-797). The sites were initially located during a 1991 Phase I archaeological survey for a proposed AT&T fiber optic cable line from Burlington, Vermont to Port Douglas, New York (Kane et al. 2004). Further archaeological documentation of this site and the Pine Street Barge Canal was done in 2004 by the Lake Champlain Maritime Museum.

One of the vessels in the Pine Street Canal Breakwater site has been identified through the historical record and archaeological documentation of the extant remains as the 1850 schooner *Excelsior* (VT-CH-796). *Excelsior*'s enrollment papers provide the following information on the vessel. The permanent enrollment number 4 was issued at Burlington on May 20, 1884, and lists Mary A. Kiernan of Burlington as owner with Henry Dupee as master. The vessel Official Number is 8092 and it was built at Willsboro in 1850. The enrollment describes the ship as having one deck and two masts and being a schooner-rigged vessel with a mounded bow, plain head, and a transom molded stern. Measurements included a length 87ft (26.5m), breadth 25ft (7.6m) and depth 7ft (2.1m). Gross tonnage was listed as 99.08 and a net tonnage of 94.13 (United States Bureau of Marine Inspection and Navigation 1884). Other records of enrollment also list the vessel in 1870, 1872, 1879, and 1884 (Lake Champlain Maritime Museum Archives). *Excelsior* is also mentioned in the *Merchant Vessels of the United States Vols. 1867-68* and *1885-86* (United States Bureau of Navigation 1868:77, 1886:128).

Excelsior is mentioned several times in the *Burlington Free Press*. Based on the historical record, the vessel had a long career as a bulk carrier on Lake Champlain. In 1876, *The Burlington Dailey Free Press and Times* remarks on the schooner *Excelsior* making its first trip on March 28th, 1860 (*The Burlington Daily Free Press and Times* 1867:8). Another account of the *Burlington Dailey Free Press and Times* mentions four boilers that had arrived in Rutland, Vermont from South Boston Massachusetts waiting to be shipped by *Excelsior* to the Port Henry Iron Works Company in New York (The Burlington Dailey Free Press and Times 1870a:3). On April 18th, 1870, *Excelsior* "took advantage of a favorable wind, and started for Port Henry yesterday, carrying several large boilers for the iron company at that place." (*The Burlington Dailey Free Press and Times* 1870b:3) The last mention of *Excelsior* is of wreckage removed from the cove, where "the spars of the old schooner Excelsior, which was sunk at the mouth of the cove [Pine Street Canal] last fall, were removed yesterday. This was one of the largest schooners that used to ply on the lake" (*The Burlington Dailey Free Press and Times* 1885:4).

The 1990 reconnaissance survey reported the wreck as the "lower portion of a vessel hull" (Visser et al. 1990:20-21; Kane et al. 2008:91). The 2008 examination found what was earlier thought likely to be a canal boat wreck, was instead that of a mid to late 19th-century lake vessel. The vessel is broken into two sections. The forward portion of the hull lies on the northern side of the northern Pine Street Canal breakwater. The stern is located west of the 1893 breakwater. It is believed that the stern of *Excelsior* was ripped from the vessel and deposited in its current location when the basin was reopened in either 1960 or 1961.

Located at the entrance to the Pine Street Barge Canal, *Hildegarde* (VT-CH-794) was initially identified along with the other wrecks near the Barge Canal Breakwater during a Phase I Archaeological study of the Barge Canal area. The wreck is positioned between the two submerged breakwaters at the entrance to the Pine Street Barge canal near the southern wall. This vessel rests with the hull lying on its starboard side. At the stern is an iron propeller, which would indicate that the vessel was steam-driven. Due to the minimal amount of archaeological documentation, not much information exists for this vessel except for work done by Arthur Cohn. Cohn (1984) identified the wreck to be the remains of *Hildegarde*, a late 19th-century sailing yacht with a storied past.

> Built as a sailing yacht in Islip, NY in 1876, it was christened the sloop-yacht *Niantic*. It had a length of 64 ft (19.5m), a beam of 19.2ft (5.9m), a draft of 6.5ft (2m), and had a registered gross displacement of 42 tons. In 1902 she was registered in New York City as a sloop yacht with a crew of seven (Cohn 1984).

The *Merchant Vessels of the United States* list *Hildegarde* with an official number of 130070, call number K.C.F.S. and rigged as a sloop yacht. The gross tonnage is 37.91 tons with a net tonnage of 36.02. The length of the vessel is 58.2ft (17.7m), the breadth is 19.3ft (5.8m), and depth of 6.5ft (1.9m). It is listed as being built in 1876 at Islip, N.Y. with the homeport of New

York, N.Y (United States Bureau of Navigation 1886:158). The *Merchant Vessels of the United States Vols. 1934 – 35* list *Hildegarde* as a steam schooner with a gross tonnage of 46 tons and a net tonnage of 39 tons. The length of the vessel is 64.0 ft (19.5m), the breadth is 19.2ft (5.8m), and depth of 6.5ft (1.9). It is still listed as being built in 1876 at Islip, N.Y. with the homeport of Burlington, Vt. The vessel is listed for freight service with a crew of 3, a total of 75 horsepower, and the owner is Herbert Pashby who lived at 398 St. Paul Street (United States Bureau of Marine Inspection and Navigation 1936:80-81).

The vessel was transported into the Lake Champlain around 1915 by Clarence Morgan of New York City, who was affiliated with the New York Central Railroad and had a large estate on Shelburne Point. During the Great Depression of the 1930s, Mr. Morgan experienced financial difficulties and the estate was abandoned along with *Hildegarde*. It became the property of Proctor's Boatyard on the southside of the Burlington Canal basin when it was converted into a steam-screw ferry boat with an engine and boiler from a decommissioned vessel at Rouses Point, New York. *Hildegarde* was operated as a ferry and made various trips from Chimney Point, Vermont to Port Henry, New York and possibly from Arnold's Bay, Vermont to Westport, New York. As time progressed, the vessel was converted to a working tug boat for a stone barge operated by Herb "One Arm" Pashbee during the 1930s. For the rest of the vessel's career, it moved stone barges from Fiske's Landing at Isle La Motte to Burlington Harbor, where the stone was transferred to railroad flatcars and transported to the Rutland stone mills (Kane et al. 2004:93).

Aside from the information already found regarding the three construction barges, no other pertinent information was able to be found. Much of the following data is from the 2004 survey conducted by the Lake Champlain Maritime Museum. Barge 1 (VT-CH-795) is 87ft

(26.5m) long and 32ft (9.7m) in beam. This is the length on keel rather than the length on deck. It is oriented lengthwise approximately 20 degrees from north. The sides are disarticulated and lie to the north and east of the bottom. Both ends are also extant, although they have detached from the bottom of the hull (Kane et al. 2004).

Barge 2 (VT-CH-793) is largely incomplete, but a measurement taken from the chine log was 73ft (22.2m) long. It lies alongside the southern portion of the submerged breakwater. Some riders and longitudinal stringers are still intact, though much of the bottom planking is beneath the sand. The two ends are present, collapsed and flat on the bottom. One side may be present, lying across the northeastern portion of the wreck, and possibly underneath VT-CH-795 to its north. The remains of construction barge 3 lie parallel to the breakwater, closer to shore than VT-CH-793. Only a few timbers were apparent protruding from the sand however, its construction seemed consistent with the other barges. No measurements were recorded on this vessel (Kane et al. 2004).

Conclusion

Burlington, Vermont is a historic maritime port city that developed from a small town in the late 18th century to a thriving economic hub. It connected the interior and eastern seaboard of the United States along with Canada to the north, allowing for an extended network of commerce. As a center for trade, vessels of all types traveled in and out of the port delivering goods and raw materials. During the 19th century, sailing canal boats, steamships, and rail traffic steadily replaced traditional sailing craft limited in their range to coastal lake trade. As newer technologies like the steam engine and petroleum-powered vessels and cars advanced, canal boats, older steamships, even rail service began to be affected as they could not compete.

As the port reached its commercial zenith in the late 19th century and early 20th century, it began shifting away from industrial use to one of recreation. Much of the older infrastructure fell into decline including obsolete vessels, which ended up being discarded all along the Burlington Waterfront. As a representative example of this, the Pine Street Barge Canal Basin Ship Graveyard was an integral part of the larger port infrastructure. However, the effects of time and the change in technology, industry, and economics led to the diminished use of the area. As older vessels reached the end of their use-lives, the derelict basin in the Pine Street Canal area became a dumping ground for abandoned vessels. While not much of the vessels exist today, they still impart invaluable information as archaeological sites that incorporate a trend in the use and evolution of ships associated with commercial activities in the Burlington Waterfront.

CHAPTER 3: THE THEORY OF SITE FORMATION PROCESSES AND THEIR APPLICATION TO SHIP ABANDONMENT AND GRAVEYARDS

Introduction

Archaeological site formation processes refer to the events and processes that generate archaeological sites and the actions that affect and influence them post-deposition. Split into two separate groups of *cultural formation processes* and *non-cultural formation processes*, they explain the effects of human behavior and environmental factors that influence the change of artifacts. These processes "transform items formally, spatially, quantitatively, and relationally" (Schiffer 1987:11). As a concept attributed to Michael Schiffer during the 1970s, it has been adopted and used extensively by archaeologists ever since. Its applicability to underwater and maritime-related sites is also essential in order to properly assess and interpret these sites. David J. Stewart (1999) provides an outline of the depositional and post-depositional processes in maritime archaeological sites along with an example of the formation processes.

Keith Muckelroy's (1978a, 1978b) concept of site formation processes explain the marine environmental processes, human interference, extracting filters, and scrambling devices involved in maritime site formations. It provides a general framework for understanding events during and after the wrecking of a ship and how the archaeological site is affected as it sinks along with salvage, the disintegration of materials, seabed depositional characteristics, and methods of excavation. Muckelroy's theories are elaborated on further by archaeologists like I.A.K. Ward, P. Lacombe, and P. Veth (1999). Using a flow chart modified with physical, biological and chemical processes, they consider other variables that explain the process rather than the outcome of site formation.

Martin Gibbs (2006) also expounds upon the site formation processes of Muckelroy. Human behavioral responses can be explained using disaster studies models in pre-impact and post-impact stages to interpret the archaeological formation of a wreck site. Gibb's three other major stages of recoil, rescue, and post-trauma provide more of a comprehensive approach to explain potential cultural responses after the shipwreck event. Processes of salvage and recovery are also included in this model to infuse behavioral interpretations in site formation processes instead of scientifically grounded explanations.

While these concepts provide good foundations to the study of site formation processes, the vessels contained within the Pine Street Barge Canal Breakwater are abandoned ships rather than wrecked ships. The vessels in the Pine Street Barge Canal Breakwater are the result of ships that have come to the end of their use-lives due to changes in society, economics, and technology. While some historical evidence of abandonment is evident, such as *Excelsior's* record of enrollment from 1884 mentioning the abandonment of the vessel in Burlington, archaeological signatures from the actual processes need to be ascertained. Nathan Richards' (2008) observations regarding watercraft abandonment, ship graveyards, and behavioral patterns provide foundational information for the paradigms of abandonment. The theoretical concepts of site formation processes and ship abandonment will be useful in the study of this thesis.

Site Formation Processes

In order to make sense of the notion of the archaeological site formation process, we must first look to Michael Schiffer's book *Formation Processes of the Archaeological Record* (1987). Schiffer explains that for contemporary researchers to have a better understanding of the archaeological and historical record, there needs to be a better understanding of *systemic* and *archaeological* contexts. The *systemic* context reflects artifacts when they are actively engaged in a behavioral system. On the other hand, artifacts that interface with the natural environment in a depositional setting are regarded as existing in an *archaeological* context. Envisaging artifacts as having routes that move from both systemic context (or "use"), and archaeological context (or "non-use"), archaeologists are constantly exposed to both themes. In general, objects move from the systemic to the archaeological context, but there are instances when objects move back and forth from both contexts (Schiffer 1987:3-4). However, what specifically are the elements involved in making these two different but complementary records and variability within them?

The factors responsible for generating the historical and archaeological record are known as *formation processes* (Schiffer 1987:7). There are two distinct operations that affect the depositional record accordingly. One is known as *cultural formation processes* or *c-transforms*, which are "processes of human behavior that affect or transform artifacts after their initial period of use in a given activity" (Schiffer 1987:7). This process also preserves artifacts in the systemic context to create the historic record through reuse, the archaeological record through the deposition of artifacts, and any consequent cultural alterations of material in both records (Schiffer 1987:7). *Non-cultural formation processes*, or *n-transforms*, are influenced by all occurrences in the natural environment that affect the archaeological record. This formation process always affects artifacts in systemic and archaeological contexts by influencing decay patterns, changes in sedimentation, natural disturbances, and the accumulation of ecological evidence that can be used to ascertain ancient environmental conditions (Schiffer 1987:7).

Elaborating on *cultural formation processes*, several different processes are attributed to cultural formations. They include reuse processes, discard processes, reclamation processes, and disturbance processes. All these processes affect the ultimate deposition of artifacts and the entire archaeological site. The systemic context and historical record are also affected. These processes and the differences between them are explained below.

Schiffer defines *reuse processes* as “a change in the user or use or form of an artifact, following its initial use” (Schiffer 1987:28). Over time, as an artifact is used for whatever its intended purpose, it will break down to the point where it no longer serves as a useful or functional item. When this occurs, the artifact can be reused for some other intent or role. One of the major features of reuse process is that it gives new value to used artifacts and keeps them within a systemic context. Reuse processes with artifacts generate the historical record, with the items eventually entering the archaeological context (Schiffer 1987:28). Behavioral differences exist within the framework of a diversity of reuse processes and are specifically defined.

Lateral cycling is defined as an artifact or artifacts that change ownership from one user to another or from one social group to another without the artifact changing in its intended use or form (Schiffer 1987:28). Evidence of this process is seen in many societies and can be identified through various means such as gifting, sales, exchanges, and robbery. However, as an artifact goes through lateral cycling, it is not changed in any way in the formal dimension and creates issues for identification. Recycling is another reuse process defined as “an activity whereby secondary material is introduced as a raw material into an industrial process in which it is transformed into a new product in such a manner that its original identity is lost” (Schiffer 1987:29). The process of recycling will change the appearance and function of an artifact where the secondary material can no longer be used and can become waste from the transformation into new products.

Another reuse process is termed *secondary use,* where artifacts can acquire new uses without heavy modifications to its original form. Schiffer (1987:30) explains that artifacts sometimes alter in form in such a way that makes them suitable for secondary uses, such as use related deterioration, disintegration, and the care of the artifact. Evidence of use wear patterns will be present based on the ways the artifact is used physically or may not be present at all if it is used for religious or symbolic purposes. *Conservatory processes* is another example of secondary use where the usage and function of an artifact or a collection of artifacts changes to such a degree that continuous conservation is required (Schiffer 1987:32). Conservatory processes can occur on a singular level with an individual collecting and preserving artifacts for personal purposes or on a larger scale, such as a museum collecting groups of artifacts intended for public education or academic research.

The processes of reuse such as lateral cycling, recycling, secondary use, and conservation are based off mechanisms that allow the alteration of used objects as they are exchanged from person to person or on the societal scale. Societies around the world have developed a variety of reuse mechanisms such as gifting, markets, swaps, auctions, gambling, and other methods (Schiffer 1987:36). However, reuse mechanisms also incorporate a host of variability within the term's scope. Money is not needed to transfer or exchange an object as it can be gifted or stolen. Economically and socially, the function of reuse mechanisms differs. Transactions through reuse mechanisms also differ in how they are recorded, such as using written receipts for documentation. Additionally, the size of a society, class differences, inequality, and social mobility influence reuse mechanisms in the transferal of artifacts that follow downward flow patterns from higher classes to lower classes. Transfer rates are variable with the possibility of upward flow or backflow of artifacts based on symbolic functions (Schiffer 1987:38-39).

Cultural deposition makes up the second component to site formation processes and comprises of a diverse set of processes where outputs, or intentionally discarded artifacts, are converted from the systemic context to the archaeological context (Schiffer 1987:47). Discard, loss and abandonment processes are methods of describing how artifacts lose their techno-functional and symbolic values. As additional ways to describe the transformative processes in artifacts, they explain behavioral models of material accretion.

Discard processes occur when an artifact can no longer fulfill symbolic or a functional role, leading the artifact to become outdated as it no longer can perform a use (Schiffer 1987:47-48). From the symbolic view, an artifact can lose its meaning if a ship becomes outclassed by a newer type and style. For the techno-functional role, the value of an object can be lost if it breaks because of use or deterioration, leading to a reduction in the overall quality or performance of the object. Various mathematical models represent waste production and accumulation rates in discard equations, such as the basic calculation below:

$$F_D = \frac{S}{L},$$

Where F_D equals the discard rate of an artifact type in a settlement, S equals the average number of that artifact type normally in use, also known as a *systemic number*. L equals the use life and is given in temporal units proportionate with the rate of discard used for F_D (Schiffer 1987:53). Additionally, discard processes are associated with variables of primary and secondary disposal sites based on regular maintenance intervals, unplanned events, social and ethnic class hierarchies, and symbolical determinism (Schiffer 1987:58-72).

Loss processes is defined as the unanticipated separation of an artifact from an individual (Schiffer 1987:76). As with the discard process, equations are used to explain the course of the loss event and have two independent components. One is the chance that the artifact is already lost in the first place and likelihood that it will never be recovered by its original user (Schiffer

1987:76). A variable that impacts the rate of artifact loss and reclamation relates to the size of the object, with larger items having a higher rate of recovery than smaller items. Another is the consistency of the surface of the depositional environment, where natural landscapes with differing soil compositions or even marine environments may limit the potential for recovery. Other environments such as dense floored interiors or catches can increase the likelihood that an artifact or assembly of items may be found (Schiffer 1987:77-79).

As another cultural disposition process, *abandonment* is defined as an event in which a place such as a settlement, structure, or a task-oriented site is changed into an archaeological context (Schiffer 1987:89). Abandonment can occur either in emergency events to preserve human life or as intentional acts in response to the deterioration of a home or area. Areas may also still occupy some form of use or an entirely new function well after it is deserted. The addition of artifacts to the archaeological record introduces two separate processes: one is termed *de facto refuse* and the other is *curate behavior*. *De facto reuse* is the process in which all cultural material that has a degree of usability or reuse potential is abandoned along with the entire site. *Curate behavior* is a process where items of viable use are removed and conveyed from the abandoned site to another area (Schiffer 1987:89).

Reclamation is another cultural transformation process where artifacts and material are changed from the archaeological context back to the systemic context (Schiffer 1987:99). The reversal in the transformation process is attributed to a variety of methods and variables. They include occupational variability, reoccupation and salvage, scavenging, displaced refuse, collecting, and pothunting (Schiffer 1987:100-114). Reclamation processes are nearly analogous to reuse processes, but the exact workings of both paradigms are hard to distinguish. While artifacts may be reclaimed from the archaeological record and reused in the systemic context, certain reclamation processes can leave behind remains and can create or disturb deposits.

Occupational variability and reoccupation related to the reuse of a *place* which varies from short and long duration of reoccupation and can involve singular or multiple components of use (Schiffer 1987:100). Patterning of reoccupied sites can be inferred along with observations based on the specific or multiple uses of a site, such as short-term hunting encampments to regularly used quarry sites. Reincorporation is based on the repeated occupation of an abandoned site by the same social group, where much of the left-over infrastructure and refuse is reused (Schiffer 1987:100). Other social groups may also reoccupy a site due to favorable qualities such as natural rock shelters or freshwater sources. Salvage processes occur as artifacts and entire structures are reclaimed from an earlier occupation of people at a site (Schiffer 1987:105). Salvage and reclamation of material can vary in frequency and degree, with whole buildings being salvaged to minimal reuse due to a lack of resources.

Scavenging is another reclamation process where accrual of usable material and refuse is utilized by a group of people (Schiffer 1987:107). Though the material is of little value as it cannot be fully repurposed to its original use, the material can be used in other advantageous ways such as construction. Displaced refuse is also representative of filler material, where refuse pits of structural debris are reincorporated into the creation or maintenance of a structure (Schiffer 1987:111). Collecting and pothunting are processes where the scavenging of material and artifacts are transformed from an archaeological site into the systemic context located away from the site. There are differences between both terms as collecting refers to processes “that involve the disturbance, removal, and transport of surface materials”, whereas pothunting is “the disturbance, reclamation, and transport of subsurface material” (Schiffer 1987:114). These processes are present worldwide and often associated with looting practices of archaeological sites.

Disturbance is the final cultural transformation processes and results in an artifact or whole site being altered by both cultural behaviors as well as environmental processes. An example of a cultural behavior and the effects of an environmental process on an archaeological site is the plowing of a field, which exposes an archaeological midden to deteriorating weather cycles (Schiffer 1987). The material typically stays within the archaeological context but will migrate from one location to another and may be modified or altered as well (Schiffer 1987:121). Earthmoving processes, surficial disturbances such as trampling and plowing, and complex modifications to the land like road development or mining are all examples of disturbance behaviors (Schiffer 1987:122-136).

Furthering the discussion of transformation processes, *non-cultural formation processes* or *n-transforms*, focus solely on the environmental processes that affect archaeological sites. The environment can influence site formation processes of artifacts on the individual level, the entire site, or a whole region. Variability exists within all levels of environmental formation processes with effects like *deterioration, decay, alteration,* and *modification* (Schiffer 1987:143). Natural Non-cultural formation processes can either physically, biologically, or chemically change the characteristics of artifacts or entire sites. Non-cultural transformation processes can aid in the preservation of artifacts as well.

For individual artifacts, the nature of the depositional environment has a significant impact on the formation processes. For example, artifacts found buried in anaerobic sediment have a higher chance of preservation than material that is unburied and exposed to the elements. The constitution of artifacts can also influence their preservation, such as non-perishable items made of metal surviving much longer in the archaeological context versus perishable items like organics, which can deteriorate much faster. However, it must be stressed that under the right environmental conditions, perishable materials can be preserved better than non-perishable materials (Schiffer 1987:147). Three general agents of deterioration are attributed to n-transformations and are chemical, physical, and biological. Chemical agents are universal in both the systemic and archaeological context and can be facilitated by water, air, temperatures, pollution, acidic and base soils. Physical agents are also common modes of archaeological modification and include natural disasters such as earthquakes, windstorms, floods, and thermal radiation from the sun. Biological agents include organisms like bacteria, fungus, insects, animals, and plant root systems (Schiffer 1987:148-150).

Environmental formation processes can also affect sites and entire regions as in situ middens can be transformed into secondary deposits. This occurs through an environmental system such as flooding, which transports material into a new deposit from its primary dispositional location (Schiffer 1987:199). Soils and sediments can be moved, mixed, and redeposited in a variety of processes classed under the term *pedoturbation* (Schiffer 1987:200). Animals and invertebrate organisms trampling and burrowing through soils and sediments can drastically alter archaeological sites. The force exerted by the growing roots of plants and trees can move or destroy sites. Cryoturbation is the term for disturbance processes related to freeze and thaw action of the ground, as temperatures fluctuations can generate frost heaves that move buried natural and archaeological material up toward the surface. Gravity is responsible for various process affecting sites by pulling sediments and material in a downward sloping action either at a rapid or sluggish rate (Schiffer 1987:206-216).

Schiffer notes that there are many other formation processes that exist and continue to be thought of as alternatives to interpreting the archaeological record. *Cultural transformation processes* provide a wide variety of means to explain behaviors of materials moving from the systemic into the archaeological context. *Non-cultural formation processes* also incorporate an array of methods that affect archaeological sites from the individual object to an entire region. The transformative position is a process that can either distort or transform archaeological materials formally, spatially, quantitatively, and relationally (Schiffer 1987:10). While these ideas and assumptions are specifically applied to terrestrial sites, it refines the groundwork for archaeologists to orient site formation processes in a maritime archaeological context.

Site Formation Processes and Maritime Archaeology Sites

Over the past few decades, work on maritime archaeological sites has revealed a whole host of different depositional processes along with modified cultural transformation and non-cultural transformation processes. Since Michael Schiffer's work on identifying and describing site formation theory, countless underwater archaeological sites have been excavated with evidence of completely new site formation processes. Citing Schiffer (1987), Muckelroy (1978b), and others, Stewart provides a general overview of elements that influence the formation of archaeological sites. Stewart outlines accretion processes that are responsible for creating submerged archaeological sites. Using Schiffer's models, post-depositional formation processes are also explained with both cultural and environmental processes (Stewart 1999).

Stewart provides an outline of the depositional processes in maritime archaeological sites along with an example of the formation processes, the nature of the submerged deposit, and examples with references as seen in Figure 3.1. The actual wrecking event can be catastrophic and is varied in the processes with effects on the ship itself and associated contents. For example, a ship may sink relatively intact with lighter buoyant material floating away while a disintegration or capsizing event will scatter most material over a large area. Scuttling, or abandonment, are examples of intentional deposition which can yield much of the original ship material if it could not be removed at the time of when the vessel sank, or the vessel may be devoid of material as a hulk. The vessel may fall victim to sinking from water inundation, where a slow gradual flood will displace most artifacts from their original context versus a rapid inundation, which will surprisingly preserve most material in place. Lastly, disassociated non-shipwreck material such as garbage represents the disposal of refuse that does not have any distinct patterning (Stewart 1999:568-574).

Table I. Depositional processes.[a]

Formation Process	Nature of Submerged Deposit	Example	Reference
Shipwreck			
Intact	Fairly coherent; loss of buoyant material on deck	Yassıada, 7th century	Bass and van Doorninck, 1982
Disintegration	Very scattered; loss of buoyant material on deck and within hull	*Kennermerland*	Muckelroy, 1975, 1978
Capsize	Cargo widely scattered; hull substantially intact, possibly in a different location; loss of most lighter material	Sheytan Deresi?	Bass, 1976
Intentional Deposition	Hull often substantially intact; removal of usable items before deposition; possible addition of refuse	Skuldelev Ships	Olsen and Crumlin-Pedersen, 1967, 1978
Inundation			
Gradual	Destruction of artifacts and loss of spatial context	Agios Petros	Flemming, 1985; Gifford, 1990
Rapid	Substantially intact	Athlit Yam	Galili et al., 1993
Refuse	Patterns of artifacts that were not associated together originally	Dokos?	Wachsmann, 1988:205

[a] Note that the nature of submerged deposit category represents generalities only; the exact effects vary due to the environmental context of each particular site.

FIGURE 3.1. Depositional processes. (Stewart 1999:569).

Even with the deposition of artifacts at an archaeological site, deposited material can move back and forth through the archaeological and systemic contexts. Elaborating on the post-depositional formation processes, Stewart outlines them in Figure 3.2, starting with cultural formation processes of reclamation, construction, fishing, dredging, refuse and loss. Reclamation of artifacts and materials from a site is usually done through the actions of salvage, looting, and archaeological recovery. Construction, dredging, and fishing are all highly destructive processes where the building of a pier, the removal of submerged soils, and dragging of fishing nets can significantly alter submerged sites.

Table II. Postdepositional formation processes.

Formation Process	Possible Effects	Example	Reference
Cultural			
Reclamation	Loss of movable objects; trampling damage; movement of artifacts	1715 Spanish Plate Fleet	Cockrell and Murphy, 1978; Murphy, 1983
Construction	Destruction of site		
Fishing	Dragging of artifacts; addition of fishing implements	Bozburun	Hocker, 1995
Dredging	Destruction of sites in harbors or shipping channels		
Refuse and loss	Addition of material to existing sites	Byzantine anchor on the Bronze Age Uluburun wreck	Pulak, 1993:11
Environmental			
Marine borers	Destruction of wood	Most wrecks located in warm waters	Robinson, 1981; Turner and Johnson, 1971
Bioturbation	Some damage, especially to organic materials; stratigraphic displacement	*Kennermerland*	Ferrari and Adams, 1990
Waves, tides, and currents	Heavy wear to artifacts due to water abrasion; loss of spatial patterning		Waters, 1992:275–280
Colluvial action	Downward movement of artifacts	Bozburun	Hocker, 1995

FIGURE 3.2. Table II. Post depositional formation processes. (Stewart 1999:584).

Trash and waste thrown into aquatic environments also add to existing sites or create whole new ones. Environmental and non-cultural transformation processes, such as wood-boring organisms of the Teredinidae family, can destroy wooden structures. Physical processes of waves, currents, and tides within shallow areas can destroy sites through erosion caused by the constant movement of water over time. Currents can also wash artifacts out and away from sites with the effects of gravity on sloped bottomlands pulling materials downward (Stewart 1999:574-584).

Keith Muckelroy helped to establish site formation processes for use in the interpretation of maritime archaeological sites in his article on “The Archaeology of Shipwrecks” in *Maritime Archaeology: A Reader of Substantive and Theoretical Contributions*. He states that a “shipwreck is the event by which a highly organized and dynamic assemblage of artifacts is transformed into a static and disorganized state with long term stability” (Muckelroy 1978a:267). Influenced by a variety of processes affecting the shipwreck event before, during, and after, researchers need to understand them to make sense of the site. Only then can the data be properly interpreted. An understanding of other factors such as marine environmental processes, human interference, extracting filters, and scrambling devices are also needed. Muckelroy outlines these processes in a flow diagram that represents the evolution of a shipwreck as seen in Figure 3.3.

In his flow diagram, the processes that first affects a shipwreck event and results in the loss of material from a maritime archaeological site are wrecking, salvage operations, and the disintegration of perishables. The wrecking process is both an extracting filter and scrambling device that involves the ship and other related material sinking as well as those that float away (Muckelroy 1978a:269). However, the ship itself within the wrecking process can sink either fully intact, nearly intact, or disintegrate on the surface of the water and then sink. Salvage operations also influence the formation of shipwrecks, developing in a myriad of historically documented (and undocumented) methods that differ from site to site (Muckelroy 1978a:275).

The process of perishable disintegration is heavily based on the underwater environmental characteristics like the biochemical effects on the preservation of artifacts, galvanic coupling between metals, the intrusion of marine growths, and the constitution of the seabed floor (Muckelroy 1978a:275-276).

Scrambling processes like the characteristics of site reordering processes during wrecking and the nature of seabed movement also affect the site formation of a shipwreck. Along with serving as an extracting filter, wrecking can encompass a variety of depositional processes. A ship may simply be inundated with water and sink intact with minimal materials floating away from the ship, or it could have more of a violent event, such as collision with an object, reef, or geologic formation.

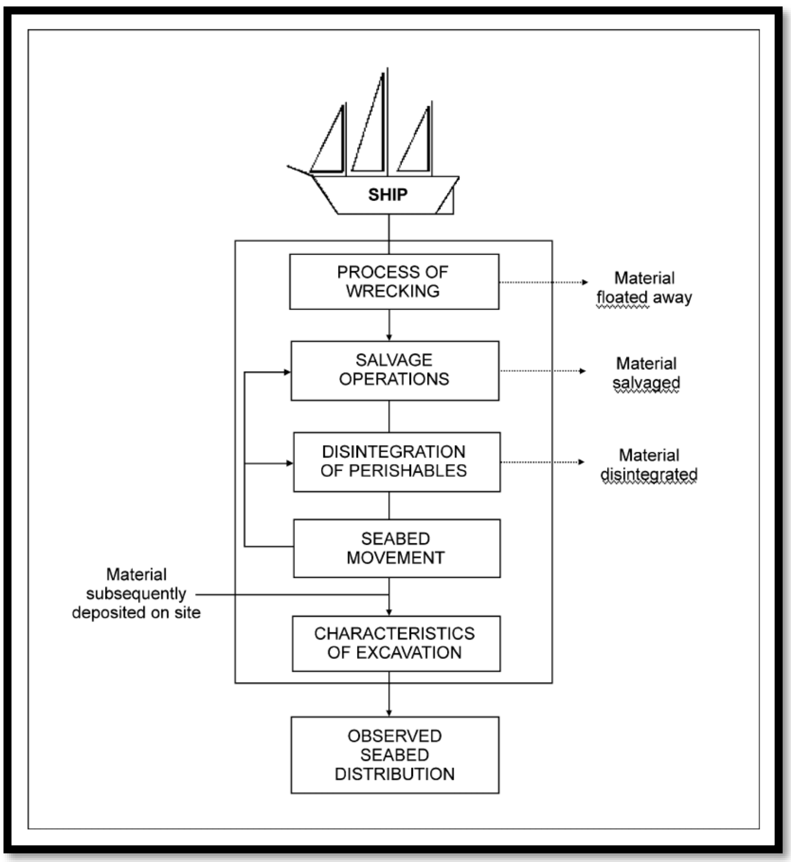


FIGURE 3.3. Muckelroy's wreck site formation diagram. (Muckelroy 1978a:269).

Shipwreck settlement patterns influenced by environmental factors like wave movement also affect the site in seabed distribution (Muckelroy 1978a:278). The geomorphology of the site, sediment disruption, current motions, swells, and marine life activities play a major role in the rearrangement of archaeological sites. Most importantly, the methods of study and excavation have ramifications as a both extracting and scrambling process on a wreck site (Muckelroy 1978a:283-289).

In his chapter “The Analysis of Sea-Bed Distributions Discontinuous Sites,” Muckelroy explains how the process of analyzing the reorganization of archaeological material located on the seabed floor is restructured even further with irregular sites that lack clear and defined structural framework (Muckelroy 1978b). The scatter patterns are likely to be larger and more disunified if a vessel breaks up over a longer expanse. In addition, variable environments on the seafloor affect the nature of preservation with archaeological remains. Without any real theoretical framework to explain a discontinuous wreck site, Muckelroy provides several forms of analytical models used to explain his work on the *Kennemerland* wreck site. Using statistical evaluations based on the locations or archaeological material *in situ*, significant patterns can be found to enhance interpretations of discontinuous sites.

The *Kennemerland* site represents a widely scattered area of archaeological deposits, a pattern that is consistent with the breakup of the vessel over a distance and the accumulation of the material in the seabed. Because of this, there is the possibility of plausible theoretical deductions or *a priori* base, that can explain a representative level of significance in the distribution of the material (Muckelroy 1978b:472). Based on systematic excavations of a large area, a total of seven sites were excavated with varying degrees of distinct artifact classes. The resulting data was tabulated with the location of the artifacts, the total number of classes in each site, their density per square meter, and the total number of the class of finds recovered from each site (Muckelroy 1978b:474). To process the data based on the environmental characteristics of a site, the sites were aggregated on a common feature and interpreted trends between them (Muckelroy 1978b:472).

Use of gridded meter squares over the site led to the discovery of robust patterns of class distribution over the site, as calculations using techniques like the Coefficient of Jaccard were used to denote patterns and correlations in the presence and absence of artifacts (Muckelroy 1978b:477-481). Other statistical techniques such as dendrograms and Euclidean distance measures to connect artifacts located at varying distances were used to determine the original location of artifacts on the ship before the wrecking event (Muckelroy 1978b:483).

Discontinuous sites are complex in nature and can be difficult in making inferences of how material from the systemic context transformed into the archaeological context. Muckelroy's work with the artifact distribution of the *Kennemerland* wreck has proven to be useful in extrapolating data, patterns, and formations of material on the seabed floor. However, he mentions that not all statistical models are satisfactory in the ability for them to find correlates or patterns to accurately make inferences on sites. Additionally, Muckelroy attests that more powerful techniques and processes exist using computers to deduce how observed patterning was made.

Ward, Lacombe, and Veth outline a methodological approach using Muckelroy's shipwreck evolution flow chart modified to consider other variables that ascribe the process rather than the outcome of site formation. While predictive modeling for wreck disintegration is useful as a process-oriented, temporally and spatially independent paradigm, they argue that it does not fully account for the "processes" of wreck disarticulation (Ward et al. 1999). Using some of the principles outlined in Muckelroy's flow chart, the physical, biological and chemical processes are incorporated. Physical processes include the hydrodynamic environment and sedimentary composition, biological processes look at the positive and negative influences that marine organisms have on the preservation of a wreck, and the chemical processes examine the effects of the anoxic and oxic oceanic environs on archaeological material (Ward et al. 1999:216-218).

Physical processes within the hydrodynamic environment of the ocean can have significant impacts on a wreck site in combination with the effects of sedimentation. The hydrodynamic environment is separated into two spheres generated by climactic processes: high-energy environments and low-energy environments (Ward et al. 1999:217). Within the high-energy environment, the physical characteristics of degradation from waves, currents, and sedimentary erosion seriously affect the rate of deterioration of submerged materials (Ward et al. 1999:217). Low-energy environments are regarded as more stable, tending to be less destructive over longer periods of time yet heavily influenced by biological and chemical factors (Ward et al. 1999:218). The "sediment budget" is explained as the frequency of supply or removal of various types and sizes of sediments within the wreck site (Ward et al. 1999:216). Conjoined with the hydrodynamic environment, erosion, and accumulation of sediments can be quantitively measured in the destruction and preservation of a site.

Biological and chemical deterioration processes are separate systems, yet also intrinsically linked regarding the effects on submerged wreck sites. Marine micro-organisms can either promote the physical breakdown of a vessel or aid beneficially to the stability of a wreck (Ward et al. 1999). Direct processes from wood boring organisms such as the teredo worm and bacteriological coatings drastically breakdown archaeological materials while indirect process from sediment covered material promotes anaerobic life, effectively preserving archaeological remains. Chemical processes of saltwater can also lead to direct and indirect results such as the corrosive chemical deterioration on shipwrecks through aerobic acidification or generation of oxygen devoid (anoxic) environments for buried materials in sediment (Ward et al. 1999). Both aerobic and anaerobic underwater environments are never uniform over time, are subject to change, and variable in terms of their effects on the destruction of materials.

In Martin Gibb's (2006) article "Cultural Site Formation Processes in Maritime Archaeology: Disaster Response, Salvage and Muckelroy 30 Years on", the cultural processes that influence a shipwreck event are investigated and outlined in conjunction with Muckelroy's evolution model for shipwreck site formation (2006). Like Ward et al., Gibbs adopts this theoretical approach but argues that human behaviors have not been fully investigated in their applicability to wreck processes. As seen in Figure 3.4, disaster studies models in pre-impact and post-impact stages and human responses are utilized to interpret the archaeological formation of a wreck site (Gibbs 2006). Gibbs also uses three other major stages to explain possible cultural responses after the shipwreck event such as the recoil, rescue and post-trauma stage (Gibbs 2006). Processes of salvage and recovery are also included in this model to infuse behavioral interpretations in site formation processes instead of scientifically grounded explanations.

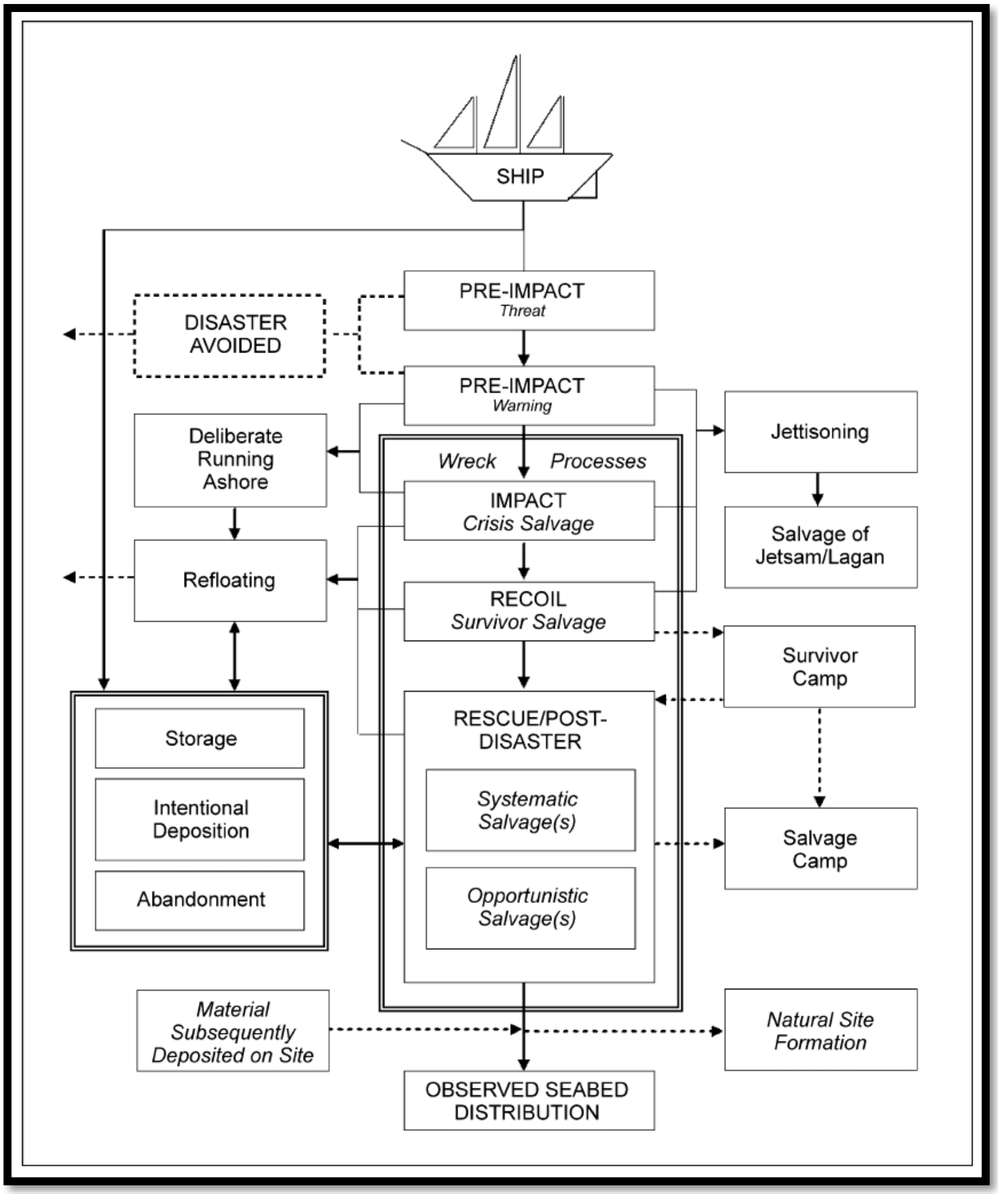


FIGURE 3.4. Ward, Lacombe, and Veth modified wreck site formation diagram (Gibbs 2006:16).

The pre-impact stage is identified as a timeframe occurring before the shipwreck event separated into a threat phase and a warning phase (Gibbs 2006:4). The pre-impact threat stage incorporates short and long-term temporal actions where potential dangers are assessed that have the possibility to occur at any time during a ship's voyage. Assessment includes a careful review of plotted courses, alternative routes, proper time of the year to sail, possibly weather, preparation of the ship, crew, and passengers for the mitigation of any potential danger. The pre-impact warning stage is implemented as a host of potential active responses when imminent disaster is about to occur. Responses to avoiding immediate threats of disaster could include major changes of a ship's course, slowing or stopping the vessel completely. Heavier items and material in the ship could be thrown overboard to lighten the ship, the vessel could possibly be run aground to prevent significant loss of life, the ship may be abandoned or outside intervening factors such as rescue could occur as well (Gibbs 2006:9-11).

The impact stage incorporates human behaviors and decision-making processes that occur when the threat of danger is immediate and unavoidable. Response strategies are dependent upon the nature of the disaster, whether it is natural, intentional and can include decisions to either remain on the vessel to save it (along with people) or the decision of abandonment when all possibility of salvage is lost. The recoil stage occurs right after impact, focusing on the situational awareness of shipwreck survivors and their ability to cope and adapt. Those who survived the impact stage may undertake limited strategies such as creating a survivor camp and re-organizing people within a hierarchy of leadership, attempting to refit the vessel if possible and salvaging materials to aid in survival. The rescue and post-disaster phase marks the conclusion of the shipwreck event and involves the rescue of any survivors along with their physical and mental recovery from the traumatic experience. Salvage of the wreck may also occur if there is the potential for economic recovery (Gibbs 2006:11-15).

Site Formation Theory and Use in Ship Graveyards

The vessels in the Pine Street Barge Canal Breakwater are not examples of ships that have undergone a wrecking process. Information gathered for historical and general research of the five vessels in the graveyard suggests that the vessels were abandoned. Historically, ships all over the world have been abandoned based on human behaviors that reflect a wide variety of decision-making processes (Richards 2008:7-8). The abandonment of a vessel can also be representative of large-scale changes in social, economic, and technological aspects of human society (Richards 2008:8). Abandonment has a wide variety of definitions and variables which relate to both wrecked vessels and deliberately discarded ships. Using several common themes, the paradigms of Schiffer's site formations processes, along with archaeological signatures of use and discard, the theory of abandonment in Nathan Richards work in ship graveyards will be discussed.

Within the current archaeological studies of abandoned ships are three site types that include "isolated ship finds, discarded and recycled disarticulated vessels components, and accumulations of watercraft known popularly as ships' graveyards, marine bone-yards, and rotten rows" (Richards 2008:19). Common themes of behavioral qualities can be found on a variety of levels such as the ritual discard of a vessel, as the case of Scandinavian boats like the Sutton Hoo ships that were used sacrificially as graves. Examples of intact hulls of boats used in the reclamation of land surrounding waterways for building supports, foundations, and terrestrial structures are examples of structural adaptation. Salvage of component parts from a useless vessel proves that a vessel still has worth whereas recycling is another way of reusing parts of a ship. The creation of ships' graveyards is a byproduct of vessels deliberately sunk for strategic purposes in times of war, such as making underwater barriers to ports. Graveyards can also be made over time within remote sites and accumulated areas due to the archaic nature of a vessel due to changes in trade and economics (Richards 2008:19-32).

Richards elaborates upon ideas from Schiffer's cultural and natural transformation processes used as fundamental ideologies for site formations. These processes encompass *reuse*, *discard*, *loss, abandonment*, *reclamation*, and *disturbance* processes (Richards 2008:54). While he recognizes that these processes are equally important to the study of site formation, only three of them are essential to watercraft abandonment. They are "evidence of activities during use, those that are evidence of the process of abandonment, and those that are evidence of activities after abandonment" (Richards 2008:54-55).

Evidence of activities of use is found by examining *reuse* and *discard* processes. Reuse processes are defined as behaviors that modify the *form*, *use,* or *user* of a specific artifact. Behaviors may incorporate different reuse processes in a maritime context such as *lateral cycling*, or the shift in ownership of a vessel still used for commerce, and *recycling*, where the materials of a ship are transformed and reused for another form and/or function through salvage. *Secondary use processes* are those where there is a minimal change to the function of cultural material, such as the conversion of a ship for an alternative purpose and *conservatory processes*, where material no longer has value for functional use, but instead is valuable for historical reasons (Richards 2008:54-55).

The process of abandonment is defined as "the process whereby a place — an activity area, structure, or entire settlement — is transformed into an archaeological context" (Richards 2008:55). Abandonment processes are also considered to be discard processes, where an artifact no longer can serve any meaningful purpose or function. Sites with discarded vessels are important because of their value in spatial and relational dimensions where archaeological data can be inferred from a singular or recurrent association to their depositional location. It is important to note that while abandonment and discard processes are analogous, they do have distinct differences. Abandonment relates to the cessation in use of an entire region, such as a shipyard, specifically for the use of depositing abandoned watercraft (Richards 2008:56-58).

Richards states that "archaeological signatures" are evident on deposited vessels and provide indications of site formation processes, behavioral change, use, alteration, and discard. Signatures of use have a variety of meanings, as one relates to the creation of a vessel for a specific function with conversions and modifications representative of changes in technology and economic conditions at the time the vessel was in the systemic context (Richards 2008:119). These processes are essential to understanding the change in the use of ships over time and the reasons for discard and post abandonment practices.

In Figure 3.5, examples of site formation processes acting on watercraft in their systemic context are provided from Richards *Ships Graveyards: Abandoned Watercraft and the Archaeological Site Formation Process* (2008) are given based on the use-life of a vessel and post abandonment processes. As a vessel is constructed, its uses are based on the initial intended function of the vessel in one of two phases: *primary mercantile*, as the vessel, is made for a commercial or mercantile function like a cargo schooner and *primary support,* where the vessel is made for non-commercial reasons and only for support like a work barge (Richards 2008:120).

Vessels can undergo lateral cycling processes that lead to a secondary use and function in *primary mercantile* and *primary support* phases, with the former referring to the process of modifying a vessel into a new mercantile role or trade such as conversion from cargo to passenger carriers. The latter refers to the modification of a support vessel to a function for non-commercial purposes. Primary roles for vessels undergo transformation processes that change the vessel's original *form* into a new secondary *function,* relating to Schiffer's site formation paradigms of secondary use and lateral cycling (Schiffer 1987; Richards 2008:120). Eventually, as the vessel deteriorates over time, it will fall into disuse due to changes in the technological and economic climate and will enter pre-depositional salvage and abandonment processes.

Discard processes also yield archaeological signatures of abandonment of vessels as outlined in Figure 3.6 by the various transformative processes that contribute to the changes in a vessel between its systemic and archaeological context. As a vessel deteriorates and falls into disuse, pre-depositional processes of salvage and destruction will systematically dismantle the vessel of either some are all component parts (Richards 2008:145). The minimization of the overall structure, hull reduction and methods of placement assurance are other incorporated processes of abandonment that reflect wide-scale trends in technological and economic change. Along with being able to derive inferences on the technology used in methods of disposal, behavioral processes can be discerned as well,

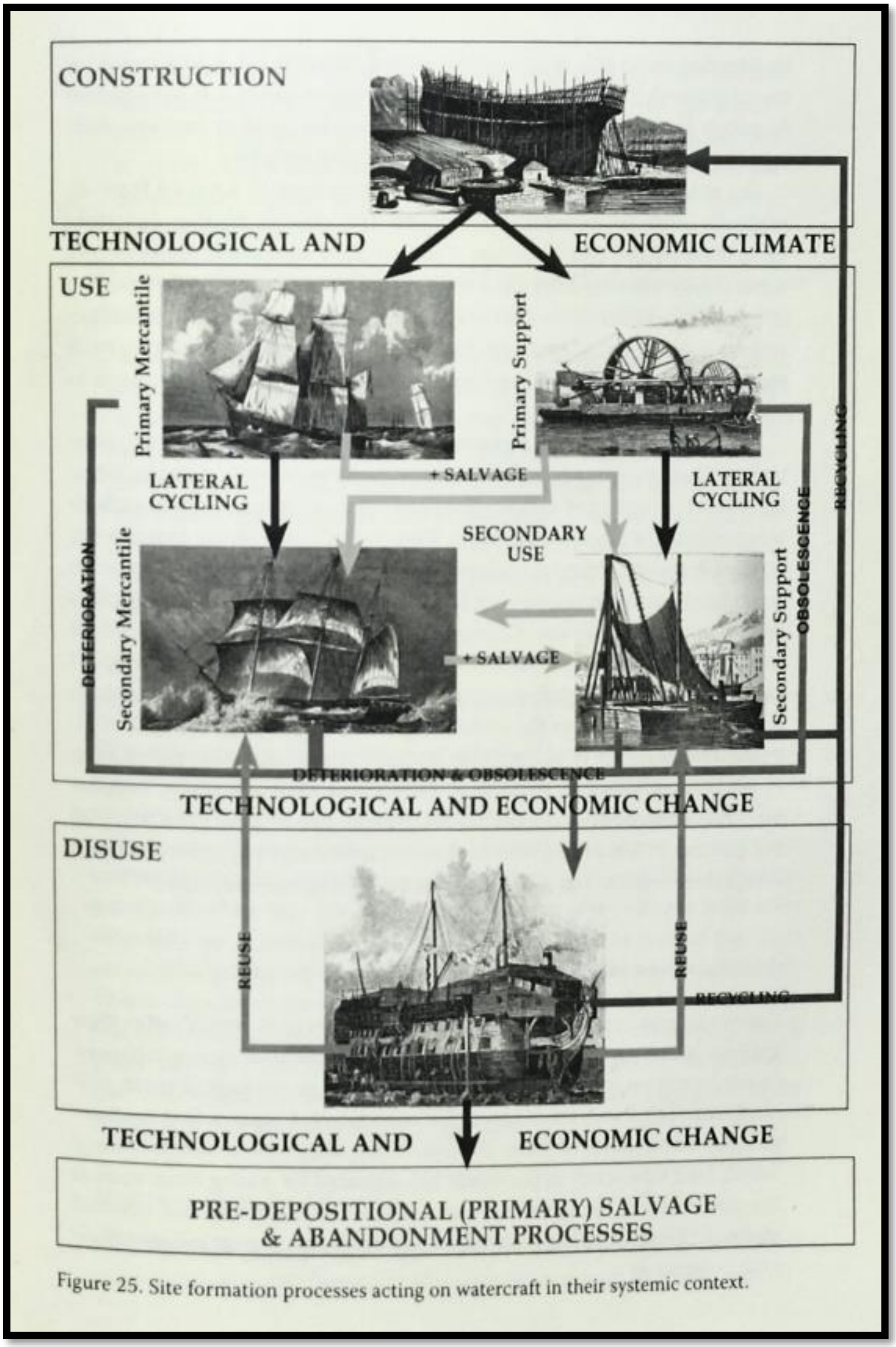


FIGURE 3.5. Example of site formation processes acting on watercraft in their systemic context. (Richards 2006:119).

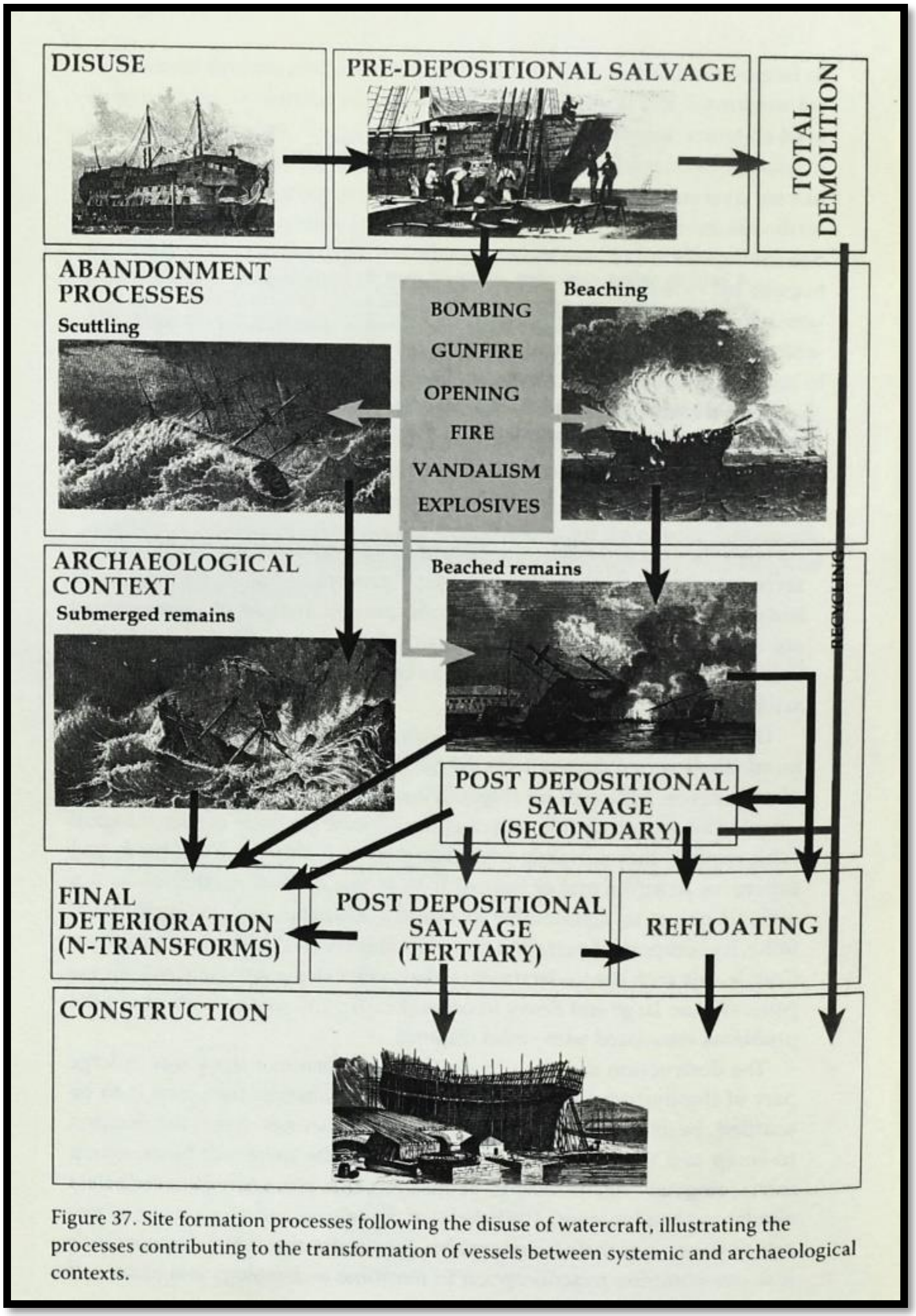


Figure 37. Site formation processes following the disuse of watercraft, illustrating the processes contributing to the transformation of vessels between systemic and archaeological contexts.

FIGURE 3.6. Site formation processes following the disuse of watercraft, illustrating the processes contributing to the transformation of vessels between systemic and archaeological contexts (Richards 2006:146).

As a vessel is abandoned, salvage and scrapping occur where all objects and material of value and some form of reusability is deliberately removed from the vessel. Salvage can occur at three separate phases with *primary salvage*, or *pre-depositional salvage*, occurring before the vessel is abandoned. *Secondary salvage* or *post-depositional salvage* occurs usually right after the vessel is abandoned with tertiary salvage occurring as opportunistic activities over an extended amount of time (Richards 2008:155). The hulls and structures can also be reduced to such a size in the form of *harm minimization*, where the vessel is cut down as a safety measure for reducing threats to navigation (Richards 2008:1147-148). Placement methods of assurance like fire, piling, filling, and explosives or other hull breaching material are used for assuring that a vessel is properly disposed of with the appropriate environmental location for the vessel selected (Richards 2008:162-172).

Conclusion

Cultural formation processes and *non-cultural formation processes* are concepts within the paradigm of site formation that explain the effects of human behavior and environmental factors that change artifacts. Attributed to Michael Schiffer and used extensively by terrestrial and maritime archaeologists, it is a complex series of processes that "transform items formally, spatially, quantitatively, and relationally" (1987:11). Its applicability to underwater and maritime-related sites is also essential as a concept to properly assess and interpret these sites. Muckelroy's (1978a;1978b) work in maritime site formation processes and discontinuous sites provide excellent theoretical models to understanding the stages and effects of a vessel wrecking. Work done by Stewart (1999), Ward, Lacombe, and Veth (1999) along with Gibbs (2006) present modified versions of Muckelroy's theories on depositional and post-depositional processes in maritime archaeological sites.

However, the theories on ship abandonment, graveyards, and behavioral patterns from the work of Nathan Richards (2008) establish more practical conceptions to explain the *cultural* *formation processes* related to the abandoned vessels in the Pine Street Barge Canal Breakwater. Because of changes in Burlington based on social, economic, and technological trends, these vessels were abandoned. The vessels eventually came to the end of their useful lives and were deposited within the confines of the basin just off the Burlington waterfront by the Barge Canal. While historic research on the remains of the five vessels found evidence of abandonment, archaeological signatures from the actual processes need to be ascertained.

It is the understanding that the extant remains of the lake schooner *Excelsior* (VT-CH-796), the steam converted schooner yacht *Hildegarde* (VT-CH-794) and the three work barges (VT-CH-793, VT-CH-795, and VT-CH-797) all hypothetically have signatures of abandonment. Signatures related to evidence of use during the vessels working lives, evidence during the process of abandonment, and post-abandonment activities technically should be discernable on the archaeological remains. The formation of the vessels has also been influenced by *non-cultural transformations*, as the location of the boats is within a relatively protected, but dynamic environment. Sediment buildup and removal, colonization by zebra mussels (Dreissena polymorpha), and ice formations and thaws are examples of environmental processes. Utilizing the theoretical concepts of site formation processes and ship abandonment will help the study of this thesis.

CHAPTER 4: METHODOLOGY

Introduction

The research methodology outlined for this study incorporates three sequential phases of historical research, followed by archaeological research and fieldwork methodology, concluding with a methodology for analysis. The historic research methodology incorporates primary and secondary resources gathered from a variety of sources like the Howe Library of the University of Vermont, reviews of books, internet searches, searches through records of Burlington City Hall, and the Archives of the Lake Champlain Maritime Museum. Resources from Joyner Library at East Carolina University was also used with records from the *Merchant Vessels of the United States*, *The American Yacht List*, *Lloyds Register of American Yachts*, *Annual Reports of the Army Corps of Engineers*, and various secondary sources.

The archaeological research was conducted through a review of previous archaeological data recorded from the Historic Preservation Program of the University of Vermont, the Champlain Maritime Society, and the Lake Champlain Maritime Museum. Fieldwork for data collection consists of *in situ* documentation using videography and a proforma sheet to record signatures of abandonment and other pertinent information. The gathered data on the systemic context of the vessels is analyzed in Chapter 5 while the archaeological context is covered in Chapter 6. Each phase is outlined below.

Historical Research

Research for this project was undertaken using information from a host of sources. The Special Collections at the University of Vermont's Howe Library has a collection of primary resources in the form of maps used to interpret the historical development of the Pine Street Barge Canal

Breakwater site (Sanborn Map Company 1869, 1885, 1906, 1919). Additionally, the Center for Digital Initiatives provided digitized historic maps of the city of Burlington and the waterfront (Young 1830; Johnson 1833; Presdee & Edwards 1853; Pierce 1862; Beers et al. 1869; Hopkins 1890). Using maps that span from the late 18th century through the 20th century, the changes in the waterfront, particularly the Pine Street Barge Canal and adjoining waterfront, was assessed to establish trends in the change and use of the Burlington waterfront.

A variety of books and internet sources was used to find information on the history of Burlington, Vermont. The best sources came from *The Vermont Historical Gazetteer: A Magazine Embracing the History of Each Town, Civil, Ecclesiastical, Biographical, and Military, Vol. 1* (Hemenway 1867) and *History of Chittenden County with Some Illustrations and Biographical Sketches of Some of Its Prominent Men and Pioneers* (Rann 1886). Both books provide a comprehensive history of Burlington and the Champlain Valley from the early settlement to the late 19th century. *Lake Champlain's Sailing Canal Boats: An Illustrated Journey From Burlington Bay to the Hudson River* provided a comprehensive history of Lake Champlain as a secondary source.

Burlington City Hall and Directory records were used only minimally to find information on the vessels in the Pine Street Barge Canal Breakwater and other relevant research. Only one historic map was found documenting the waterfront of Burlington before it was significantly expanded in the 19th century (Coit and Johnson 1798).

Research was also conducted at the Lake Champlain Maritime Museum for primary source material related to the project. Aside from information gathered in the archaeological reports generated by archaeologists at the museum (Cohn 1984; Crisman 1986; Visser et al. 1990; Frink 1991; Kane et al. 2008; ARCADIS 2010; Kane et al. 2010; Sabick 2011, 2014; Lake

Champlain Maritime Museum 2017a, 2017b), a great deal of research was found in the Peter A. Barranco Collection. Mr. Barranco was a nautical archaeologist and historian who worked on researching and documenting the history of vessels all throughout Lake Champlain. Over the past few years, he donated his entire collection of research to the Lake Champlain Maritime Museum. These sources include lists of vessel registration information on *Excelsior* and *Hildegarde* along with historic marine charts and maps.

Information for the five vessels located in the Pine Street Barge Canal Breakwater was also found from the *Merchant Vessels of the United States* (United States Bureau of Navigation 1868:77, 1869:77, 1871:85, 1873:91, 1874:97, 1875:104, 1877:198, 1878:78, 1879:66, 1880:60, 1881:64, 1882:65, 1883:66, 1884:124, 1885:131, 1886:128; United States Bureau of Marine Inspection and Navigation 1870, 1872, 1879, 1883, 1884), *The American Yacht List*(1888, 1889, 1891, 1896, 1897), Lloyds Register of American Yachts (1914, 1917). Information in these registries was found for *Excelsior* and *Hildegarde,* yet no information was found for the three Turner & Breivogel barges. However, there is a listing of the tugboat *JOVI* in the *Merchant Vessels of the United States* register with Turner & Breivogel of Grand Avenue in Falmouth, M.A. as the managing owners (United States Bureau of Customs 1963:1192). A substantial amount of research on the barges was acquired from a series of newspaper articles covering the rehabilitation of the Burlington Bay Breakwater (*The Burlington Free Press* 1962a:15, 1962b:10, 1962c:15, 1962d:11, 1962e:15, 1962f:17, 1962g:26, 1963a:13, 1963b:11, 1963c:11, 1963d:11, 1964a:6, 1964b:19, 1964c:22, 1964d:11, 1964e:17, 1964f:16).

As research is lacking based on Turner and Breivogel, an internet search was made during the summer of 2017 to find information. Searching in Falmouth, Massachusetts where the company was in the 1960s, it was found the company no longer exists (Don Breivogel 2017;

Yellow Pages 2017). The son of one of the business partners, Mr. Don Breivogel, was found by his business listing and contacted (Don Breivogel 2017, pers. comm.). He stated that he remembered his father doing work for the Army Corps of Engineers with the three barges used in the breakwater rehabilitation project of the 1960s. Mr. Breivogel looked for information in his home related to the project but could not find anything. The Army Corps of Engineers of the New England District offices in New York was contacted (Jim D'Ambrosio 2017, per. comm.) along with the office in Essex, Vermont (Tina Sedney 2017, per. comm.) for information based on the contract with Turner and Breivogel, Incorporated. They could not find any relevant information.

Archaeological Research

A wealth of previous research already exists, primarily from several archaeological resource assessments conducted by the Lake Champlain Maritime Museum, and the Vermont Division for Historic Preservation (Cohn 1984; Crisman 1986; Visser et al. 1990; Frink 1991; Kane et al. 2008, 2010; ARCADIS 2010; Sabick 2011, 2014; Lake Champlain Maritime Museum 2017a, 2017b). Figure 4.1 depicts a preliminary plan view of the Pine Street Canal Breakwater site made by Erick Tichonuk, Sarah Lyman, Chris Sabick and Adam Kane. Additionally, a field school at the Pine Street Barge Canal Breakwater site was held by the Lake Champlain Maritime Museum in 2013 in which the author of this thesis was a part of. This information was used to interpret the archaeological context of the site and provide a baseline for research.

The Diving and Water Safety Office at East Carolina University was consulted in the winter of 2018 on dive planning for fieldwork (Keusenkothen and Nunn 2018, per. comm.). Permission was approved for the site, which included an assessment of the dive site, depth (not going past 10 feet), use of air, location of the wrecks, local environmental conditions, and safety contacts in the event of an emergency.

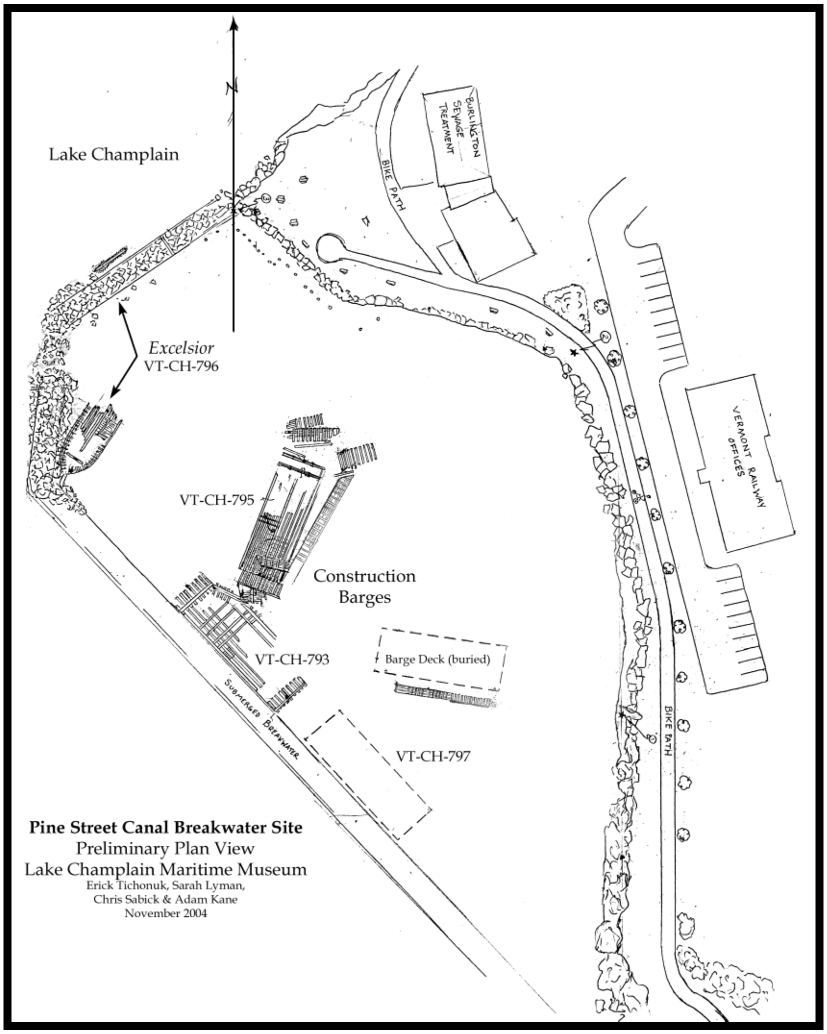


FIGURE 4.1. Preliminary Plan view of the Pine Street Canal Breakwater site by Erick Tichonuk, Sarah Lyman, Chris Sabick and Adam Kane (Image courtesy of the Lake Champlain Maritime Museum).

For each day of fieldwork, a dive plan was maintained throughout along with a dive log. Since the thesis did not use any grant funding for the fieldwork from East Carolina University, The Diving and Water Safety Office stated that the project can include divers not affiliated with University. Nevertheless, proper diving safety standards and protocol will be followed. A towed dive buoy, a first aid kit, an emergency oxygen kit, and cellular phone with emergency contact information will be provided for the entire course of the fieldwork. A dive safety officer from Waterfront Dive Center of Burlington, Vermont was able to be contacted to supervise the safety of divers during fieldwork on a needed basis.

In addition to this, the Vermont Division for Historic Preservation was contacted regarding permission to conduct archaeological work. The state archaeologist of Vermont, Francis Jess Robinson, issued the archaeology permit No. 2017-5 on July 22nd, 2017 with the understanding that it can be used as an extension for fieldwork in the summer of 2018. Appendix A depicts pages one and two of the archaeology permit No. 2017-5. Mary O'Neil, the Principal Planner for Development Review of the City of Burlington, was also contacted and permission was secured by the city to conduct work at the site. Vermont Rail System was also contacted to secure permission to use their office parking next to the site as a staging area.

Fieldwork for the Pine Street Barge Canal Basin Graveyard was conducted from July 5th, 2018 to July 19th, 2018. Most of the work was done during the weekdays with one extra day on August 2nd, 2018 to take GPS points of the last remaining vessels. Fellow Maritime Studies Program graduate George Martin Huss II assisted for most of the fieldwork in the month of July. The following individuals also assisted sporadically throughout the entire project:

- Cherilyn Gilligan, Archaeologist at the Maritime Research Institute, Lake Champlain Maritime Museum.
- Rebecca Hunt, graduate from the Public Archaeology Program at Binghamton University and summer 2018 Fellow at the Lake Champlain Maritime Museum.
- Mason Parody, graduate from the Nautical Archaeology Program at Texas A&M.
- Patricia Reid, Collections Manager, and Development & Administrative Assistant, Lake Champlain Maritime Museum.

- Madeline Roth, Archaeologist and graduate from the Maritime Studies Program at East Carolina University.
- Christopher Sabick, Archaeological Director of the Maritime Research Institute, Lake Champlain Maritime Museum.

Some possible limitations include recording misinterpreted signatures not related to behavioral signatures found from deliberate dismantlement and abandonment processes. These signatures could be related to the cause of natural processes like ice movement or damage caused by propeller cuts from passing vessels on ship architectural elements near the surface. Human interference post-deposition may also be a factor. Since the area within the Pine Street Barge Canal Breakwater is also environmentally dynamic, only a limited portion of the vessels are exposed seasonally while other sections are buried in sediment. This, along with zebra mussel colonies covering the vessels will obscure architectural elements with dismantlement or abandonment signatures. Another limitation might be visibility, given the fact that the water quality of the area is known to be poor. Conditions in the past have been bad, especially in the spring and early summer seasons when massive runoff and biota from the waterfront heavily obscure visibility.

Diving was conducted over the course of five days each week with two dives scheduled for each day. Access to the site was based on the shore where divers had ease of staging and access to the site. Initial reconnaissance of the site identified the locations of the five wrecks. Small markers buoys weighted with five-pound dive weights were placed near the location of each wreck to assisted as navigational aids above water. The overgrowth of Eurasian milfoil, an invasive plant species in Lake Champlain, was assessed on each site to determine the degree of visual obstruction of the wrecks. If was determined that a significant amount obstructs the ability to acquire clear photographs and video, warranting removal.

A series of global positioning system points were taken on each vessel using a handheld Garmin© GPS 64s unit. The GPS unit has an accuracy of 16 ft to 33 ft (5m to 10m). Because most of the vessel remains are heavily disarticulated and dispersed throughout the site, multiple points were taken on the most extant parts. Listed below in Table 4.1 are the names of each ship, its corresponding Vermont state archaeological site number, location of where the GPS mark was taken, and GPS points in degrees decimal minutes format.

TABLE 4.1. GPS data gathered from The Pine Street Barge Canal Basin Ship Graveyard.

Vessel Name and Vermont Archaeological Site Number	**Location of GPS Mark**	**GPS Mark Number**	**GPS Mark (Degree and Decimal Minutes)**
Excelsior (VT-CH-796)	Within Northern Breakwater Basin, Bow Section	015	N44° 28.210’ W073° 13.281’
Excelsior (VT-CH-796)	Within Northern Breakwater Basin, Amidships Section	016	N44° 28.216’ W073° 13.283’
Excelsior (VT-CH-796)	Outside of Northern Breakwater Basin, Northern-most point of Upside-Down Section	013	N44° 28.241’ W073° 13.293’
Excelsior (VT-CH-796)	Outside of Northern Breakwater Basin, Southern-most point of Upside-Down Section	014	N44° 28.237’ W073° 13.298’
Hildegarde (VT-CH-794)	Rudder and Propeller Assemblage	010	N44° 28.159’ W073° 13.269’
Hildegarde (VT-CH-794)	Aft Port Side	011	N44° 28.160’ W073° 13.258’
Hildegarde (VT-CH-794)	Foreward Port Side	012	N44° 28.160’ W073° 13.253’
Brievogel and Turner Barge VT-CH-793	Northern-most Point	017	N44° 28.196’ W073° 13.246’
Brievogel and Turner Barge VT-CH-793	Southern-most Point	018	N44° 28.191’ W073° 13.256’

Brievogel and Turner Barge VT-CH-795	Eastern-most Point	023	N44° 28.200’ W073° 13.213’
Brievogel and Turner Barge VT-CH-795	Western-most Point	024	N44° 28.200’ W073° 13.218’
Brievogel and Turner Barge VT-CH-797, First Section	Northern-most Point	025	N44° 28.181’ W073° 13.225’
Brievogel and Turner Barge VT-CH-797, First Section	Southern-most Point	026	N44° 28.180’ W073° 13.224’
Brievogel and Turner Barge VT-CH-797, Second Section	Middle Point of Remains	027	N44° 28.186’ W073° 13.212’

During each day of work, a dive log was kept along with a field logbook of comprehensive notes detailing the tasks for the day. The location of the site, date, weather, task details and results of tasks undertaken for the day was included in the field logbook. Proforma recording forms with blank mylar sheets affixed to clipboards was used to write down information observed from the vessel remains. The site proforma as seen in Figure 4.2 was employed to document all site information and site formation signatures. Examples from the Museum of London (Milne et al. 1994), Richards (2002a, 2008), and Seeb (2007) provided a foundation for the proforma. It was modified to suit the author’s needs for use in the Pine Street Barge Canal Basin Graveyard. The proforma incorporates a composite form of relevant descriptive information used to document each vessel. If there is not any relevant information to put onto the proforma sheet for any of the vessels, the words “N/A,” or not applicable, will be written.

Due to the proximal location of *Excelsior* VT-CH-795 and the Turner and Brievogel Barges VT-CH-793, VT-CH-795 and VT-CH-797 to the shoreline, they were worked on first. *Hildegarde* (VT-CH-794) was difficult to find in the initial phases of fieldwork. However, it was eventually located much farther out from the cluster of vessels within the basin of the northern breakwater. Undertaken on each vessel were a series of preparation work for underwater photography and video recording to document the vessels. All vessels had a thick covering of milfoil that was hand removed by teams of two divers staged near each of the vessels remains. The overgrowth was deposited away from each site toward shore and revealed features on each of the archaeological sites.

Pine Street Barge Canal Basin Graveyard Recording Form					
Site:			**VT-CH#**	**Date:**	**Depth:**
Diver Initials:	**Dive Buddy:**		**Form #**	**Time:**	**Visibility:**
Site Description:		**Weather:**	**Temperature:**	**Notes:**	
Vessel Name:		**Alt. Name:**		**Other ID Info:**	
Position:	East:		North:		Datum:
Dimensions (FT)	Length:	Beam:	Draft:		
Class:	Sail	Steam	**Barge**	Canal Boat	**Type:**
Hull:	Clinker	Carvel	Other	Unknown	
Material:					
Propulsion:	Powered	Sail	Towed	Unknown	
Propulsion Feature:	Engine	Boiler	Maststeps #	Masts #	Other
Engine Type:	Steam	Gasoline	Diesel	Unknown	
Engine Description:	**Engine Features:**	**Measurements:** **L:** **B:** **D:**	Primary or Secondary?	Other?	**Additional Notes:**
Construction Elements:	Bow	Stern	Port	Starboard	**Scantlings: L; D; W;**
Keel:	Desc:				L; D; W;
Keelson:					L; D; W;
Ext. Planking					L; D; W;
Av. Strake:					L; D; W;
Metal Knee:					L; D; W;
Timber Knee:					L; D; W;
Frames:					L; D; W;
Insitu Frames:		Port	S. Board	Spacing	
Orient, (Bow to Stern)	°	**Fastenings:**		**Caulking:**	
Toolmarks:		**Surface Treatment:**		**Artifacts:**	
Abandonment Signatures:	Burnt	Explosion	Holes	Modification	Other
Description:					
Fill Description:					
Salvage:		**Salvage Description:**			
Documentation:	Photo #:	**Comments / ID Marks:**			
Additional Observations:		**Drawing**: Profile Plan Elevation Section			
					Checked Form?

FIGURE 4.2. Proforma documentation sheet for recording vessels in the Pine Street Barge Canal Basin Graveyard (Image by author).

For the vessels located within the Pine Street Barge Canal Basin Graveyard, a modified technique for photogrammetry recording was done to create a 1:1 ratio constrained photo model of each vessel. Based on conversations with Dan Bishop (Bishop 2018, per. comm.), a doctorate degree candidate at the Nautical Archaeology Program at Texas A&M, he suggested a methodology based on techniques used by other archaeologists (Yamafune 2016; Yamafune et al. 2016). A network consisting of several 4 1/4" by 4 1/4" coded tiles were placed randomly throughout each archaeological site along with several one-meter metal scale bars placed along the perimeter of the vessel remains (Figure 4.3). This was done to establish control for both scale and distortion of the photogrammetric model in addition to providing context between the physical site and archaeological remains. An example is displayed in Figure 4.4 with several coded targets and scale bars set around the upside-down section of *Excelsior's* stern

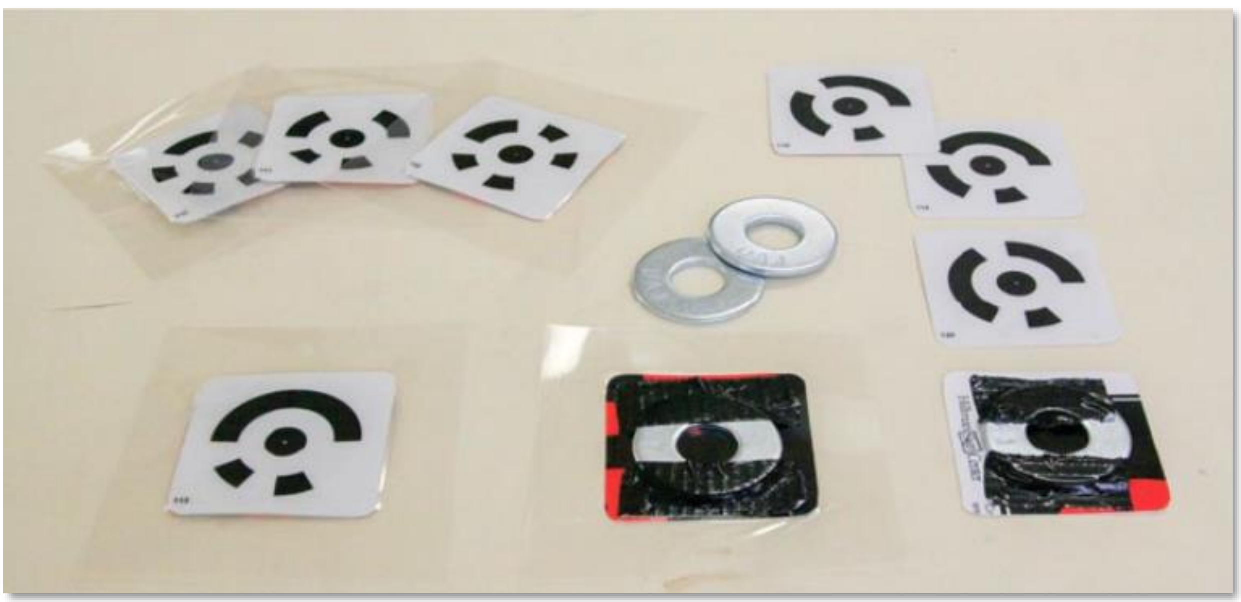


FIGURE 4.3. Coded targets used by Kotaro Yamafune (Yamafune et al 2016:715).

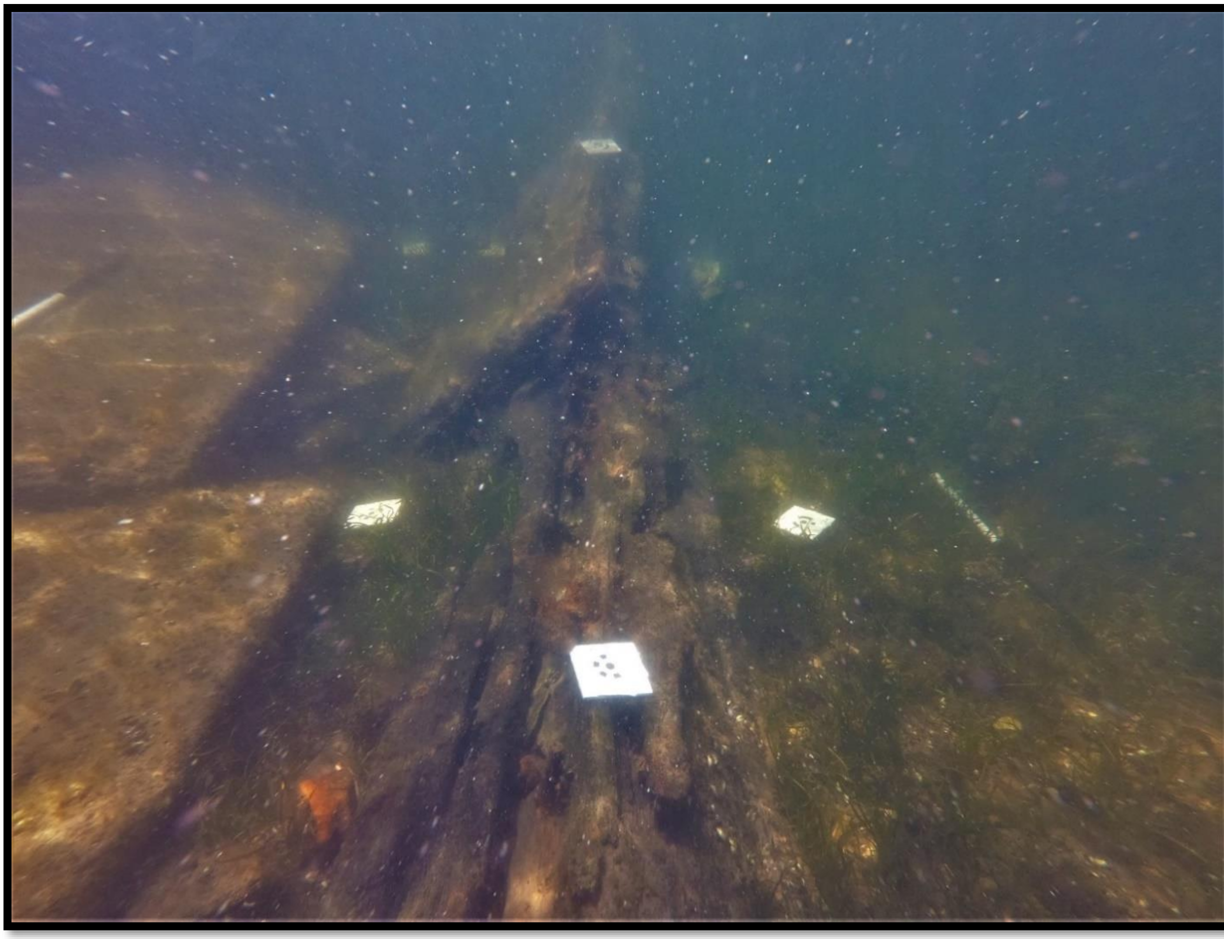


FIGURE 4.4. Coded targets and scale bars on the upside-down section of *Excelsior's* stern (Image by Paul Willard Gates).

Adopted by Kotaro et al. (2016), the swim plan for taking overlapping photographs of each vessel and control point network consisted of three phases without the use of an auxiliary swim path. A visual representation of this is depicted in Figure 4.5. Once all the control points were set, a swimming path was undertaken by the photographer in a rectangular sweep around the perimeter of the vessel. A transversal path was done at the southern edge of the site perimeter from east to west with a space of 1 foot in between each turn. Finally, a longitudinal swim path was done starting at the southwestern edge of the perimeter from south to north with a space of 1 foot in between each turn. The overlapping swim path ensured accurate coverage of each vessel in the graveyard.

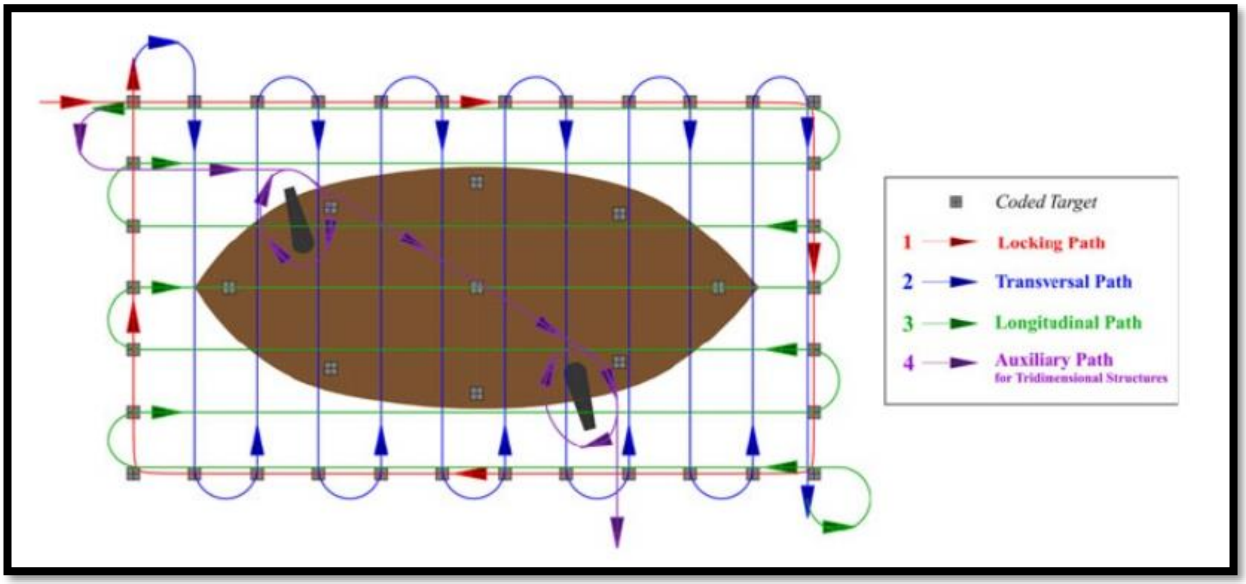


FIGURE 4.5. Swim plan for photogrammetry work used by Kotaro Yamafune (Yamafune et al. 2016:715).

Recording of the vessels was done using two GoPro© Hero 5 and 6 cameras with waterproof housing and green water dive lens filters. Affixed to the cameras was an extendable hinged handle for comfort and control of the camera. Each camera was set on time-lapse mode at intervals of 0.5 seconds with the lens set at a linear field of view. White balance was set on auto, the color was set at the highest, the image sharpness set at high, and the ISO set at the highest setting. One diver was responsible for camera work while the other diver recorded notes and information on the documentation proforma sheet.

Additionally, site formation signatures reflective of *cultural* and *non-cultural* site formation processes were documented. Systematic surveys of each vessel were done to ascertain signature locations. Once a location was found, it was marked with an orange construction flag and photographed using a handle-mounted waterproof GoPro© camera with a scaled North arrow. The gathered information was recorded by divers on mylar proforma sheets affixed to one side of a clipboard by duct tape using mechanical pencils attached with string. Figure 4.6 depicts an example of a photograph taken of site formation signature on the remains of *Hildegarde*. All data was downloaded on a 6-terabyte hard drive.

FIGURE 4.6. Example of site formation signature of *secondary salvage* on *Hildegarde's* portside remains (Image by Paul Willard Gates).

Analysis Methodology of Data

This section provides the methodologies undertaken for the analysis methodologies used for the data gathered for Chapter 5 and 6. Historical research found through primary and secondary sources was used to outline the history of *Excelsior*, *Hildegarde*, and the Turner & Breivogel barges in Chapter 5. From the histories of each ship, it provided information on the use-lives of the vessels in their systemic context. In addition, representative examples of the vessels were created using Adobe© Illustrator. Based on online drawings, plan views of *Excelsior*, *Hildegarde*, and a scow barge in a pre-depositional context before and after salvage processes highlight the architectural elements removed from each ship.

For Chapter 6, research and data gathered from the July 2018 fieldwork were processed to highlight *cultural* and *non-cultural* formation processes and the effects on the vessels in their post-depositional context. Plan views of each vessel in their post-abandonment context highlight the extant architectural features before they enter their archaeological context. Archaeological site maps depicting the vessels in their current condition illustrates locations of abandonment signatures related to *cultural* and *non-cultural* formation processes. Historic statistical data and research were gathered and graphed to provide correlation data of ship abandonment trends related to changes in economics, industry, and technology. A more detailed summary of the analysis methodologies is explained in the following paragraphs.

Research collated for the systemic context of the ships in the Pine Street Barge Canal Basin Graveyard was done to review the histories of *Excelsior*, *Hildegarde*, and the Turner & Breivogel barges. Primary and secondary sources provided history on the use of each vessel within its lifetime. For example, the registration information from the *Merchant Vessels of the United States* records was placed into tables showing the histories of *Excelsior* and *Hildegarde*. Data in the tables include the years of operation, signal letters, rig type, dimensions, tonnages, homeport listing, where built, and when built. *Hildegarde* had additional information provided from *The American Yacht List* and Lloyds Register of American Yachts. No registry data was found for the Turner & Breivogel barges, yet good research was found through newspaper articles from the *Burlington Free Press*.

Each vessel had a scaled model made showing plan views of the ships in pre-depositional context. Modified models with faded out features of the vessels in pre-depositional context after *pre-depositional salvage* was also made. This provides good examples illustrating the breakdown of the vessels through *primary salvage* processes. All the ships did not have specific construction plans, so representative examples of similarly classes ships aided in drafting using Adobe© Illustrator. Drafting *Excelsior* as an intact vessel utilized information gathered on the construction elements in the lines and sail plans from North River Schooner in *Wooden Ship-Building* (Desmond 1998:200). The lines and sections of the vessel in addition to the sail plans are depicted in Figures 4.7 and 4.8. As a comparative example to *Excelsior,* the North River Schooner is representative of a shoal draft centerboard sailing ships used on the Hudson River for heavy cargo transportation during the 19th century.

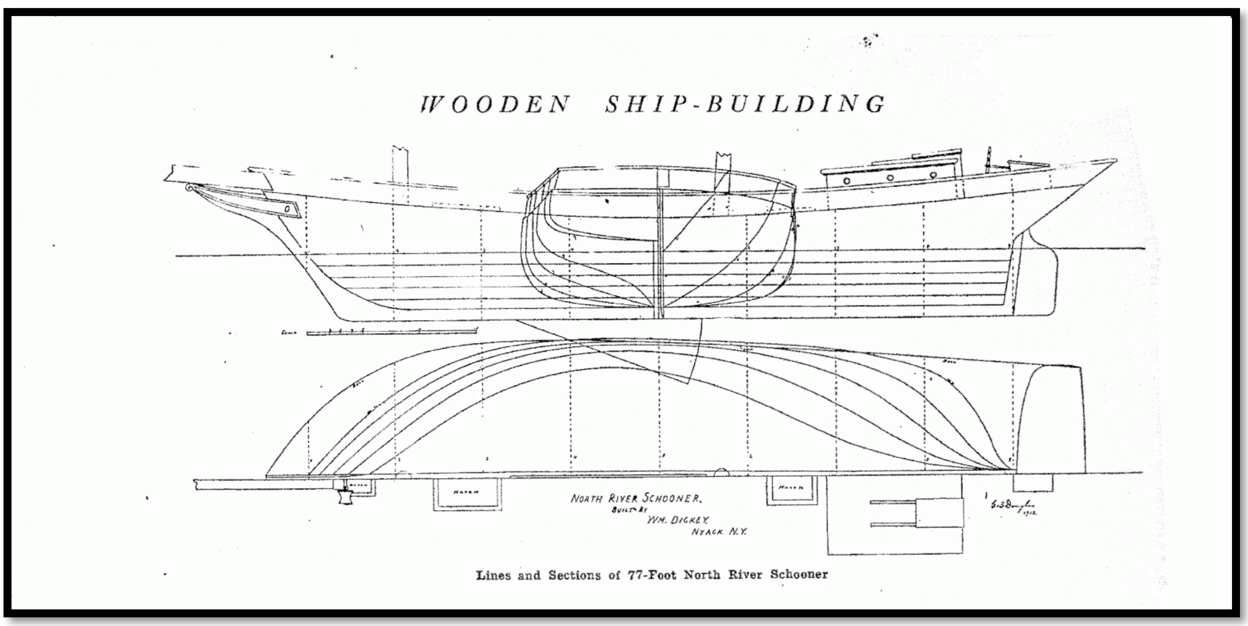


FIGURE 4.7. Lines and Sections of 77 - foot North River Schooner (Desmond 1998:200).

To draft a representative model of *Hildegarde* in its pre-depositional context, historic photographs and digitized lines from the sloop yacht *Pocahontas* in Figure 4.9 was used to draft the full hull profile for *Hildegarde*. As a comparative vessel, *Pocahontas* was built in 1881 at the behest of officers from the New York Yacht Club as a racing yacht.

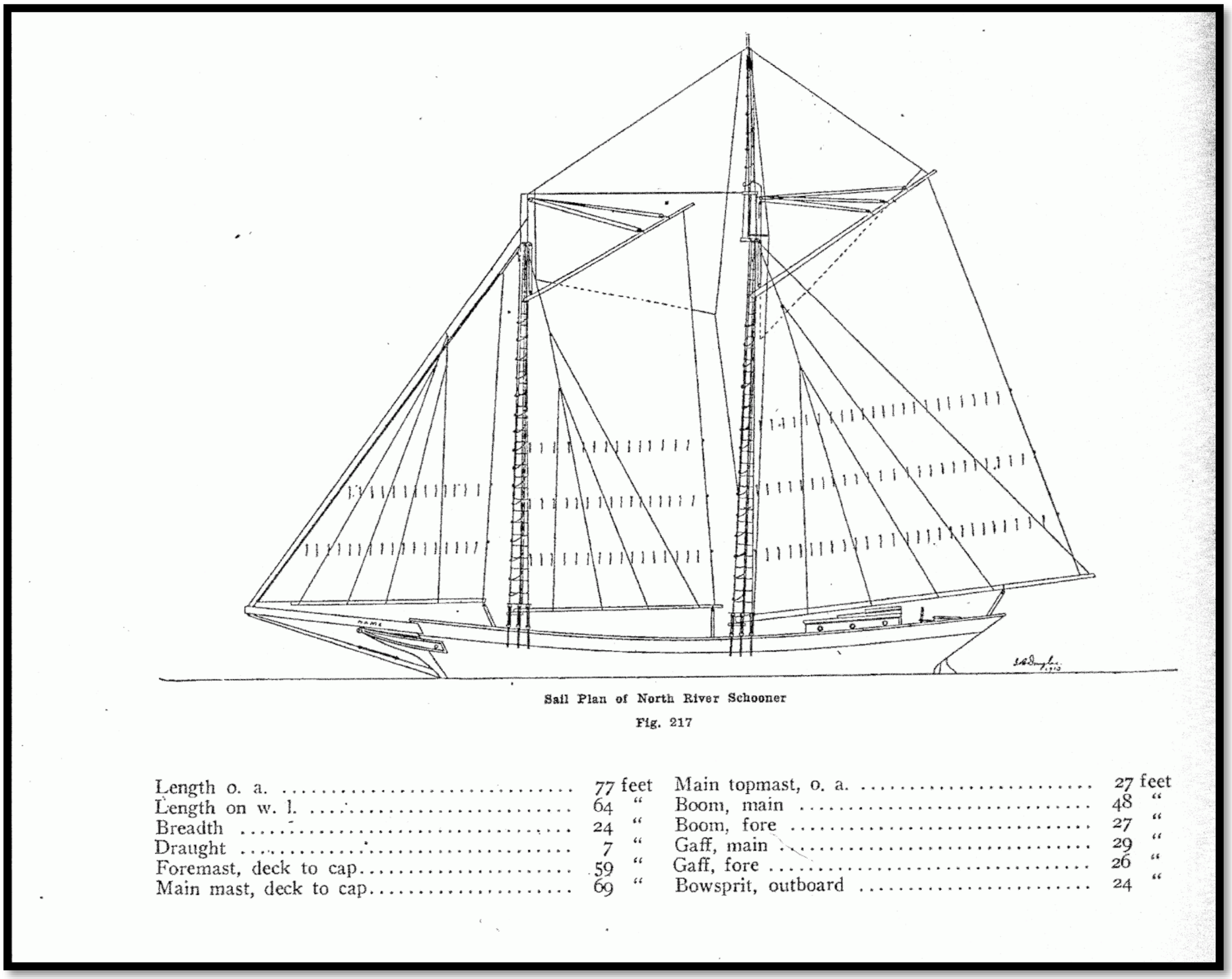


FIGURE 4.8. Sail Plan of North River Schooner (Desmond 1998:200).

With similar dimensions to *Hildegarde*, *Pocahontas* competed at trail races in 1881 against the sloop yachts *Hildegarde*, *Gracie*, and *Mischief* (Gary 2019). The photographs in Figures 4.10 through 4.12 depicting *Hildegarde* as a steam ferry and tugboat was used along with the *Pocahontas* lines to create another representative model of the ship after it was converted from a sloop yacht. Drafting the architectural features for a representative model of the barges in their pre-depositional context was made using images in Figures 4.13 and 4.14.

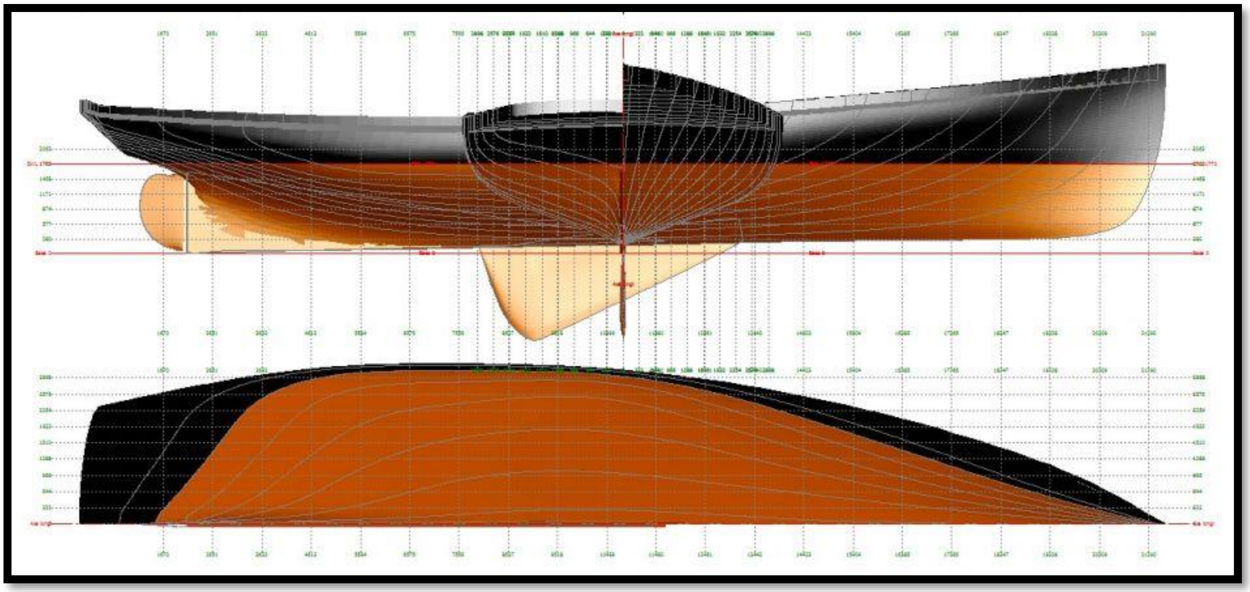


FIGURE 4.9. Digitized lines of *Pocahontas* (Image by Yves Gary).

FIGURE 4.10. *Hildegarde* with passengers and a car, early 1900s (Lake Champlain Maritime Museum 2014:52).

FIGURE 4.11. *Hildegarde* as a tug assisting a sail equipped barge, early 1930s (Photo courtesy of Arthur Cohn and the Lake Champlain Maritime Museum).

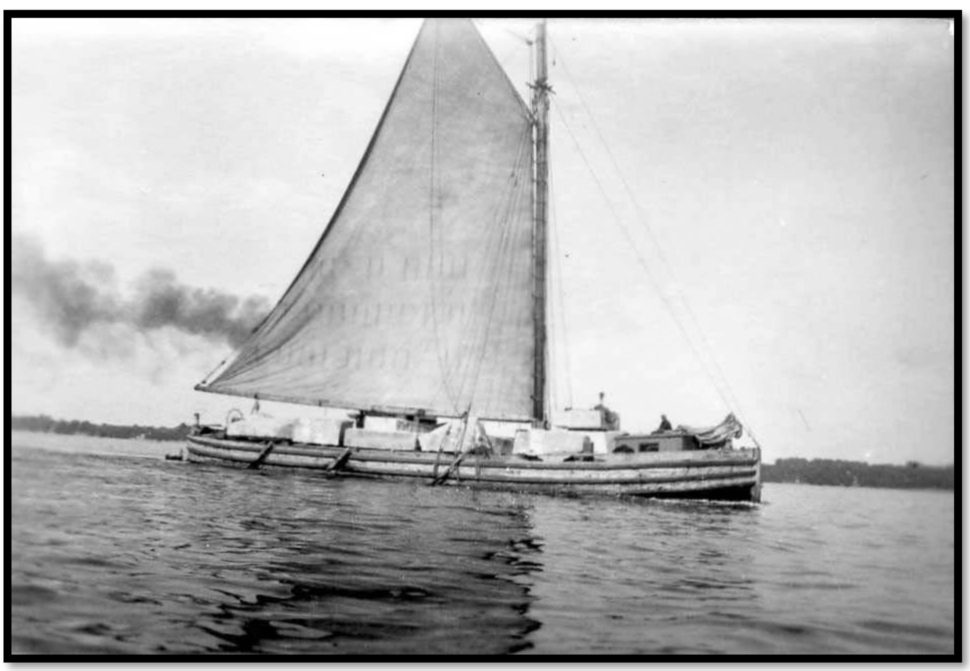


FIGURE 4.12. *Hildegarde* behind a sail equipped barge loaded with stone, early 1930s (Photo courtesy of Arthur Cohn and the Lake Champlain Maritime Museum).

Construction plans from 1921 of a wooden deck scow employed for street cleaning as seen in Figure 4.13 were used as a reference for the pre-depositional model (James Jr. and Duncan 1999:148). Additionally, a profile draft of a derrick lighter from the Feeney collection at the Hudson River Maritime Museum depicted in Figure 4.14 was utilized as a comparative barge (Kane et al. 2001:21). An orthophoto in figure 4.15 from a photogrammetry model of barge VT-CH-793 aided in the construction of architectural elements like the chine log, futtocks, and transverse riders.

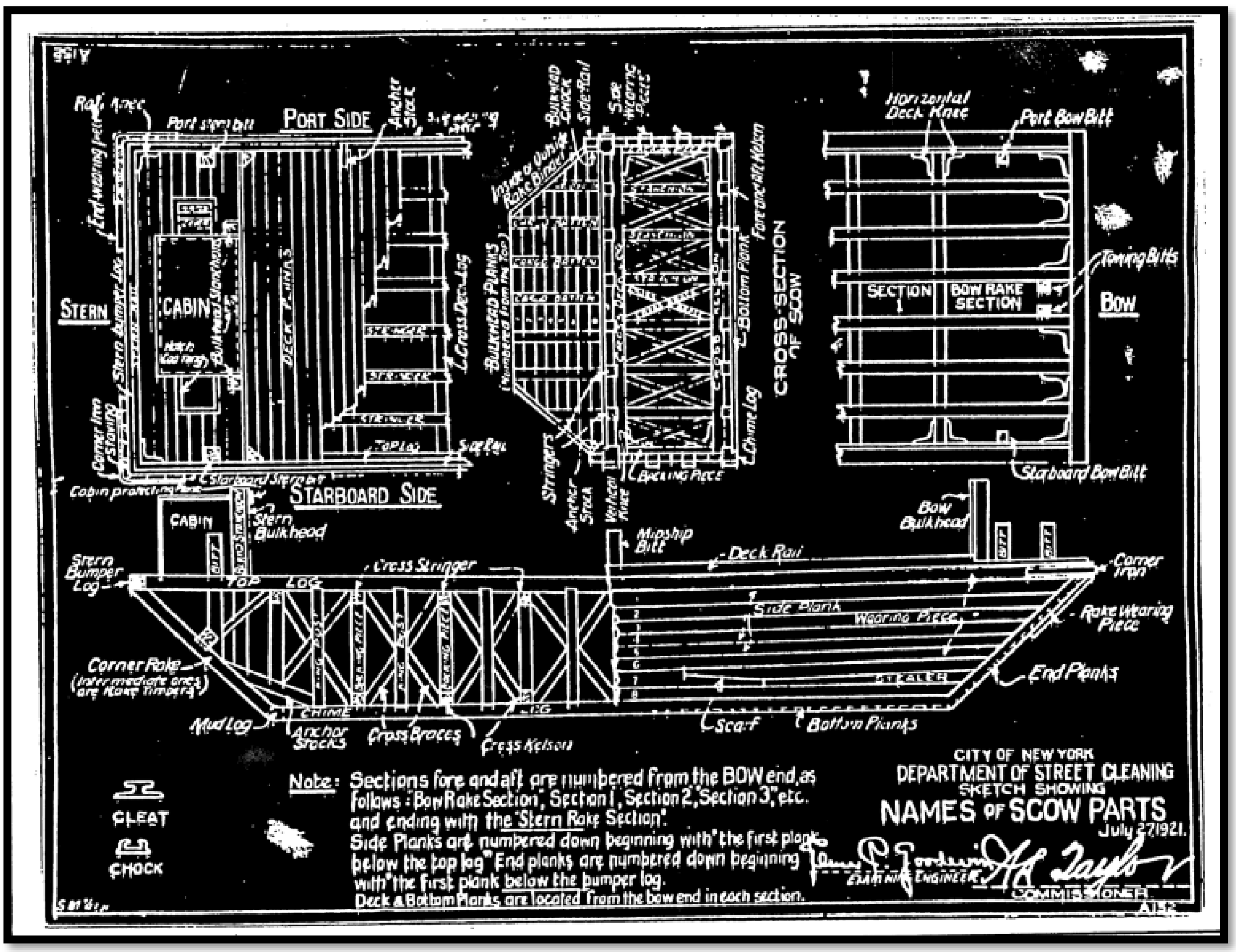


FIGURE 4.13. Plan of a 1921 street cleaning scow (Image by New York City Department of Street Cleaning 1921).

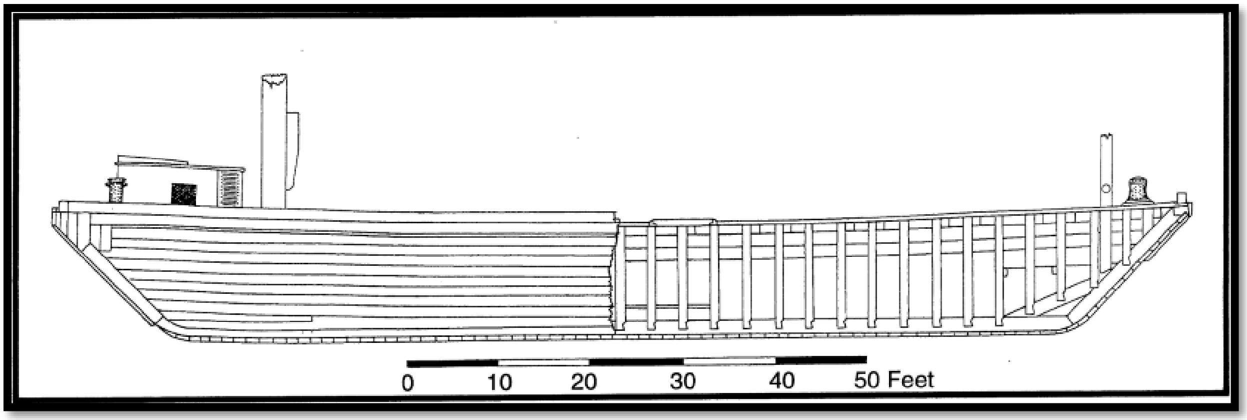


FIGURE 4.14. Profile of a derrick lighter scow (Image by Hudson River Maritime Museum, inked by Adam Kane).

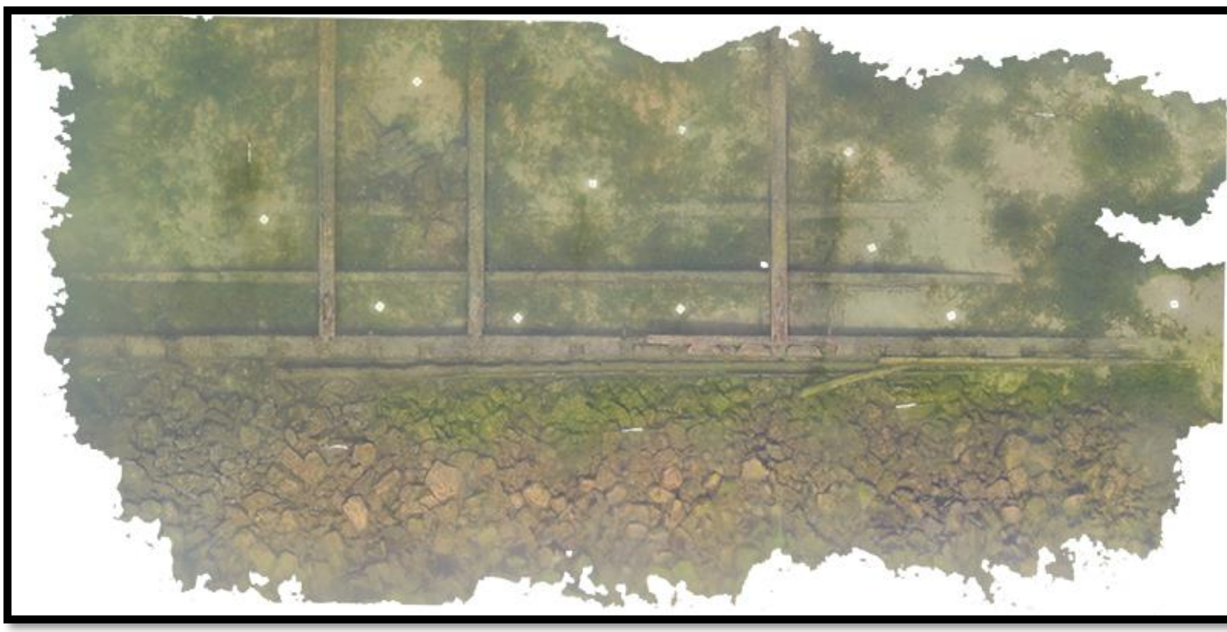


FIGURE 4.15. Orthometric photo of Turner & Breivogel barge VT-CH-793 (Image by Paul W. Gates and Nathan Richards).

Research and data gathered from the July 2018 fieldwork were processed to highlight *cultural* and *non-cultural* formation processes and the effects on the vessels in their post-depositional context. The vessels had individual site plans made in their post-abandonment context to demonstrate the extant architectural features before they enter their archaeological context. Using plans from comparative vessel types discussed above for pre-depositional context of each ship, scale post-depositional models of *Excelsior*, *Hildegarde*, and the Turner &

Breivogel barges are annotated to show extant remains after *secondary salvage* processes. The remnant architectural features.

Archaeological site maps modified from drafts made by archaeologists from the Lake Champlain Maritime Museum, digital photographs and video from fieldwork and limited models made through *Agisoft PhotoScan* depict the vessels in their current condition. Illustrated on each site map are the locations of abandonment signatures related to *cultural* and *non-cultural* formation processes. Observed and recorded *in situ*, the signature locations are included in tables that describe the location on the section of the vessel, the signature location number, the type of site formation signature, and the name of the transformation process. Annotated digital photographs edited using Adobe© Photoshop are included in the analysis of the archaeological remains to highlight the site formation signatures.

Three-dimensional modeling using *Agisoft PhotoScan Professional edition®* (photogrammetry), and Adobe© Illustrator modeling was undertaken. Photogrammetry is used all over the world for rendering entire underwater archaeological sites in three-dimensional models using multiple images that are stitched together into point clouds from digital media (Drap 2012; Yamafune 2016; Yamafune et al. 2016). However, techniques in photogrammetry are constantly changing and newer methods are being experimented with the aim of reducing overall time and effort in acquiring good high-quality imagery (Aragón et al. 2017). Additionally, newer methods aim to simplify and streamline data acquisition by removing any extraneous tasks.

The time-lapse photographs taken during fieldwork in July 2018 and processed through *Agisoft* primarily failed with only a few sections of the vessels being built as a three-dimensional model. There was difficulty in aligning series of photographs with *Agisoft* during processing.

Even with the photographs digitally edited through Adobe© Photoshop for contrast, color balance, light levels, image sharpening, noise reduction, de-speckling, and dust and scratch removal, most of the photos could not align. Given the difficulty experienced in creating three-dimensional models, use of *Agisoft PhotoScan* was halted in favor of building profile and plan models of the vessels.

A discussion on discerned patterns from the archaeological remains of *Excelsior*, *Hildegarde*, and the Turner & Breivogel barges concludes the overview of the *post-depositional* site formation processes. Reviewing the archaeological remains, the present architectural features are identified and listed. The absent features are also acknowledged and discussed. From the presence and absence of vessels parts, trends are examined with speculations about reasons why each vessel is in its current condition.

The abandonment of the vessels is connected temporally to historic trends from the early 19th century to the late 20th century. Trends will relate to changes in social, economic, and technological themes in shipping, transportation, and industry in the Burlington Waterfront. Trends will also be examined according to their relevance in broader movements in the United States of America. Plotted bar graphs with the time of vessel abandonment was made to compare the following: social changes in the Burlington Waterfront as an industrial center to the recreational use it embodies today; trends in cycles of economic prosperity and decline; total tons and value of imported and exported domestic and international goods; and technological changes to ship design and function.

CHAPTER FIVE: SYSTEMIC CONTEXT OF THE SHIPS OF THE PINE STREET BARGE CANAL BASIN SHIP GRAVEYARD

Introduction

The Pine Street Barge Canal Basin Ship Graveyard encompasses a collection of abandoned vessels that span over 168 years. This chapter provides information on the use-lives of the ships (an elaboration of their systemic context). Each of the vessel's distinctive history and use-life contributes to a better understanding of formation processes occurring on *Excelsior*, *Hildegarde*, and the Turner & Breivogel barges in the systemic context. The function of these vessels can be distinguished from their remains as "archaeological signatures." These signatures provide evidence of site formation processes and behavioral patterns related to the use, modification, and discard of the vessels (Richards 2008:118).

As a primary source, the *Merchant Vessels of the United States* provided information on the vessel histories such as their registration numbers, vessel types, names, owners, measurements, ports of origin, and home ports. Other historical information is collected from newspapers and secondary sources. A discussion of the site formation processes of each vessel in *pre-depositional* contexts will outline the circumstances leading up to their deliberate abandonment. Signatures conveyed by site formation processes and behavioral patterns related to the use, modification, and discard of the vessels in the assemblage of watercraft are described. Representative diagrams created from similarly classed vessels analogous to *Excelsior*, *Hildegarde*, and the Turner & Breivogel barges show how each vessel was affected by transformation processes.

Excelsior (VT-CH-796) Ship History (1850 – 1886)

Title L of the Regulation of Vessels in Domestic Commerce, R.S. 4319 provided information on the records of enrollment for *Excelsior* (Jarvis 1886:38). The vessel is listed as a two-masted, single deck lake schooner and operated as a cargo vessel in Lake Champlain from 1850 to 1884. Built in Willisboro N.Y. in 1850, *Excelsior* was given the official number 8092. The shipbuilder could not be found. The enrollment describes the ship as having a crew of 5, one deck and two masts and being a schooner-rigged vessel with a mounded bow, plain head, and a transom molded stern. Measurements included a length of 87ft (26.5m), breadth of 25ft (7.6m), and depth of 7ft (2.1m). Gross tonnage is listed as 99.08 with a net tonnage of 94.13 (United States Bureau of Marine Inspection and Navigation 1884).

Displayed in Table 5.1, the registration history of *Excelsior* is tabulated according to listings of the vessel from the *Merchant Vessels of the United States* and from the records of enrollment. No records of enrollment from 1850 to 1867 were found. Additionally, records from 1870, 1872, and 1876 could not be found. In Table 5.2, enrollment records from the United States Bureau of Marine Inspection and Navigation are tabulated from available records from 1870, 1872, 1879, 1883, 1884.

There are currently no known historical photographs of *Excelsior*. However, a substitute photo of the similarly classed schooner *American* provides an example of *Excelsior* appearing as an intact ship. Cohn includes a photograph in his book *Lake Champlain's Sailing Canal Boats* of the schooner *America* as seen in Figure 5.1. Research from the *Merchant Vessels of the United States* lists *America* as a schooner with the official number 1100 with a tonnage of 88.16 and a home port of Whitehall, New York (United States Bureau of Navigation 1868:15, 1869:15. 1871:16).

Table 5.1. Registration history of *Excelsior* (VT-CH-796) as outlined in enrollment records of the United States Bureau of Marine Inspection and Navigation. Note: n/l means not listed (United States Bureau of Marine Inspection and Navigation 1868:77, 1869:77, 1871:85, 1873:91, 1874:97, 1875:104, 1877:198, 1878:78, 1879:66, 1880:60, 1881:64, 1882:65, 1883:66, 1884:124, 1885:131, 1886:128).

Year	Official Number	Signal Letters	Rig	Length	Breadth	Depth	Tonnage	Home Port	Where Built	When Built
1850 - 1867	RECORD DOES NOT EXIST									
1868	8092	N/L	Schooner	N/L	N/L	N/L	99.08	Whitehall, N.Y.	N/L	N/L
1869	"	"	"	"	"	"	"	"	"	"
1870	RECORD DOES NOT EXIST									
1871	"	"	"	"	"	"	"	"	"	"
1872	RECORD DOES NOT EXIST									
1873 - 1875	"	"	"	"	"	"	"	"	"	"
1876	RECORD DOES NOT EXIST									
1877 - 1883	"	"	"	"	"	"	"	"	"	"
1884	"	"	"	87 ft	25 ft	7ft	"	"	Wellsboro, N.Y.	"
1885	"	"	"	"	"	"	G 99.08	Burlington, V.T.	Willsboro, N.Y.	"
1886	"	N/A	Schooner	"	"	"	99.08/ N 94.13	"	"	1850

Table 5.2. Registration history of *Excelsior* (VT-CH-796) as outlined in enrollment records of the United States Bureau of Marine Inspection and Navigation. Note: n/l means not listed (United States Bureau of Marine Inspection and Navigation 1870, 1872, 1879, 1883, 1884).

Year	Official Number	Rig / Decks / Masts / Crew	Length	Breadth	Depth	Husband or Managing Owner	Master	Port of Surrender	Cause Granted for Enrollment / # / When	Former Enrollment # / When	Cause of Surrender	Tonnage (Gross / Net)	Home Port	Where Built	When Built
1850 - 1869	RECORD DOES NOT EXIST														
1870	N / L	N / L	N / L	N / L	N / L	W.P. Foote	O. Landon	N / L	Property Changed / 12 / 14 July 1870	16 / 1 May 1868	Owner Changed	N / L	N / L	N / L	N / L
1871	RECORD DOES NOT EXIST														
1872	“	V	“	“	“	R. L. Landon	R. L. Landon	Plattsburgh, N.Y.	Owner / 38 / 7 Sept 1872	12 / 14 July 1870	Paper Lost	“	“	“	“
1873 - 1878	RECORD DOES NOT EXIST														
1879	“	“	“	“	“	R. L. Landon	H. Dupee	Burlington, V.T.	Paper Lost / 22 / 10 Nov. 1879	38 / 7 Sept 1872	Paper Lost	“	“	“	“
1880 - 1882	RECORD DOES NOT EXIST														
1883	“	“	“	“	“	M. A. Kiernan	H. Dupee	Burlington, V.T.	Permanent Enrollment / 4 / 20 May 1884	22/ 10 Nov. 1879	Vessel Abandoned	“	“	“	“
1884	8092	Schooner / 1 / 2 / 5	87 ft	25 ft	7ft	Mary A. Kiernan	Henry Dupee	Burlington, V.T.	Owner Changed / 4 / 30 June 1885	12/ 10 Nov. 1879	Vessel Abandoned	99.08 / 94.13	Burlington, V.T.	Willsboro, N.Y. / 1850	1850
1885	RECORD DOES NOT EXIST														

In 1873, the home port changes to Plattsburgh, New York (United States Bureau of Navigation 1873:17, 1874:18, 1875:18, 1877:14, 1878:13, 1879:11). In 1880, the vessel is listed as having a new home port of Essex, New York (United States Bureau of Navigation 1880:11, 1881:11, 1882:11, 1883:11).

There are currently no known historical photographs of *Excelsior*. However, a substitute photo of the similarly classed schooner *American* provides an example of *Excelsior* appearing as an intact ship. Cohn includes a photograph in his book *Lake Champlain's Sailing Canal Boats* of the schooner *America* as seen in Figure 5.1 (Cohn 2003:xiv). Research from the *Merchant Vessels of the United States* lists *American* as a schooner with the official number 1100 with a tonnage of 88.16 and a home port of Whitehall, New York (United States Bureau of Navigation 1868:15, 1869:15. 1871:16). In 1873, the home port changes to Plattsburgh, New York (United States Bureau of Navigation 1873:17, 1874:18, 1875:18, 1877:14, 1878:13, 1879:11). In 1880, the vessel is listed as having a new home port of Essex, New York (United States Bureau of Navigation 1880:11, 1881:11, 1882:11, 1883:11).

Later years of the *Merchant Vessels of the United States* lists *American* as built in 1848 in Wilisborough, New York and listed as a schooner in the *Merchant Vessels of the United States* with the official number 1100 (United States Bureau of Navigation 1884:70). The gross tonnage is 88.16 and the vessel has a length of 88.1 ft (26.8 m), a breadth of 24.0 ft (7.3m), and a depth of 6 ft (1.8 m) (United States Bureau of Navigation 1885:73, 1886:71). Curiously, in 1886 the name of the vessel is listed as *American* while in 1887, the home port changes to Plattsburgh, New York (United States Bureau of Navigation 1887:62, 1888:61). Given the nearly identical dimensions to *Excelsior* along with the fact both vessels are schooners built in the same geographic location, *American* was used as a comparative vessel to identify the remains of *Excelsior*.

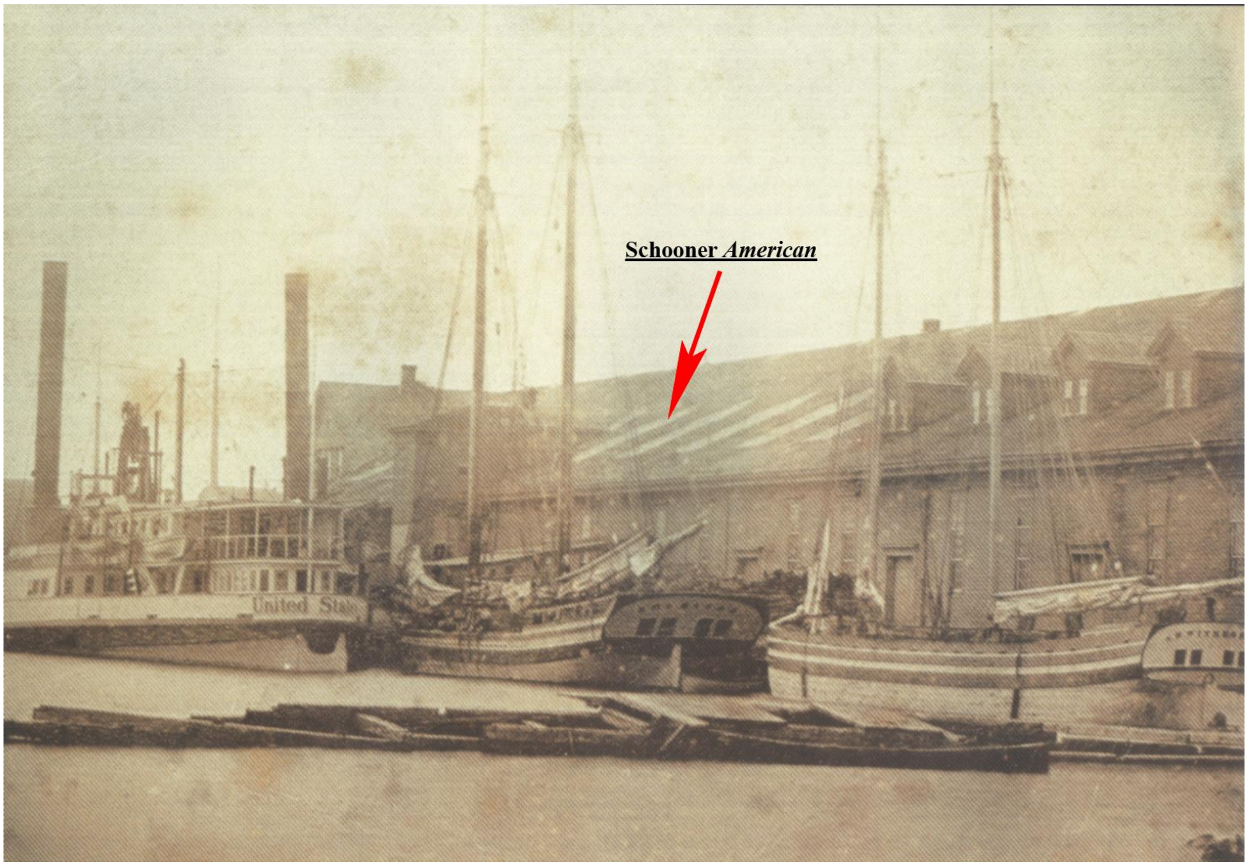


FIGURE 5.1. *American* at dock with the steamship *United States* to the left and the canal schooner *S. H. Witherbee* to the right in Rouses Point, New York, circa 1865 (Cohn 2003:xiv).

To better understand *Excelsior* as an intact vessel, information was gathered on the construction elements in the lines and sail plans from the "North River Schooner" in *Wooden Ship-Building* (Desmond 1998:200). The lines and sections of the vessel in addition to the sail plans are depicted in Figures 5.2 and 5.3. As a comparative example to *Excelsior*, the "North River Schooner" is representative of a shoal draft centerboard sailing ships used on the Hudson River for heavy cargo transportation during the 19th century. The centerboard gave the ship the ability to counteract lateral winds while under sail, serving like a keel and preventing it from

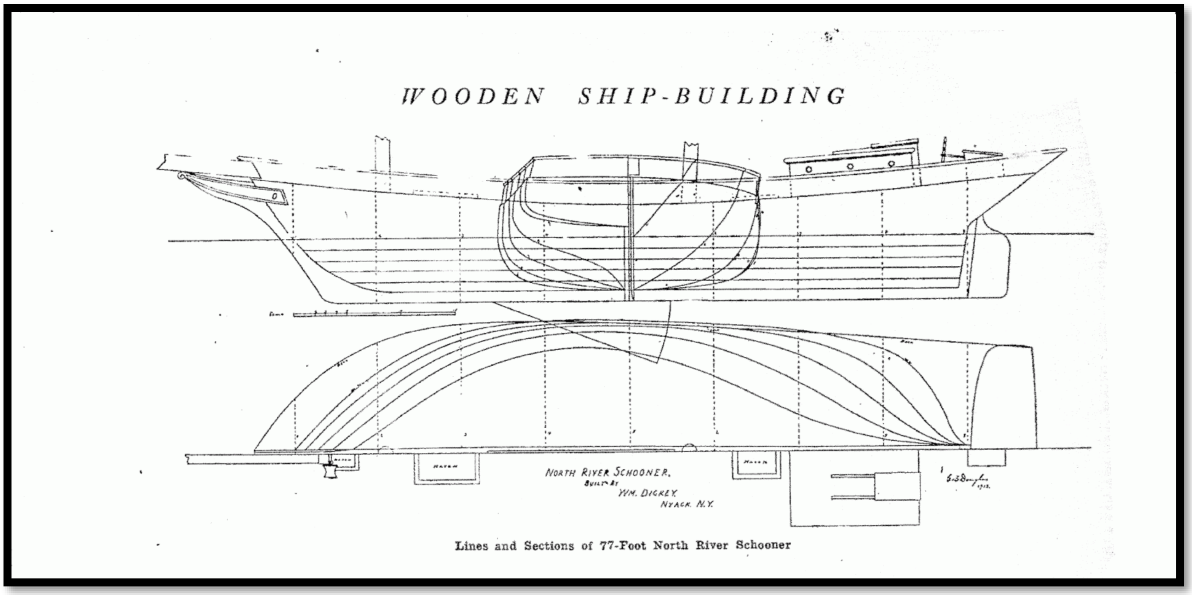
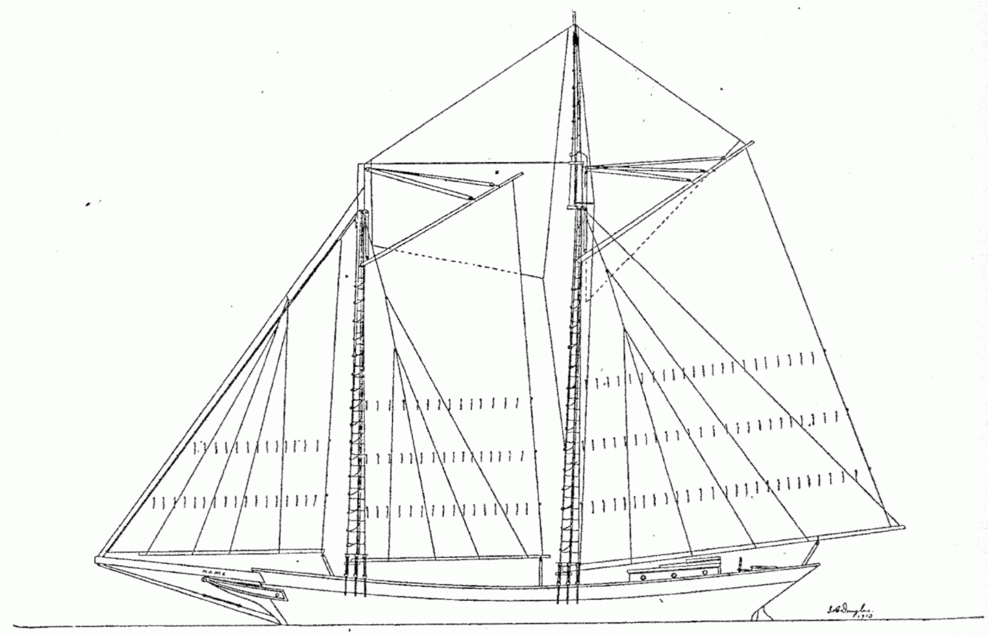


FIGURE 5.2. Lines and Sections of 77 - foot North River Schooner (Desmond 1998:200).



Sail Plan of North River Schooner

Fig. 217

Length o. a.	77 feet	Main topmast, o. a.	27 feet
Length on w. l.	64 "	Boom, main	48 "
Breadth	24 "	Boom, fore	27 "
Draught	7 "	Gaff, main	29 "
Foremast, deck to cap	59 "	Gaff, fore	26 "
Main mast, deck to cap	69 "	Bowsprit, outboard	24 "

FIGURE 5.3. Sail Plan of North River Schooner (Desmond 1998:200).

moving sideways. When in shallow waters, the centerboard could be retracted to allow the vessel to offload cargo while at a port or even beached (The Model Shipwright 2019).

This regional watercraft was used extensively in conjunction with sloops for transportation of people and goods along the Hudson River in Northern New York. *The Sloops on the Hudson* describes the construction features of Northern River schooners:

> The North River schooner was built on somewhat the same plan as the sloop, having a center board, and her bowsprit carried out almost horizontal, and one head-sail, the single jib, attached to a jib-boom, as with the sloop. She carried no foretopmast. The skippers contended themselves with a maintop sail only and set it like a sloop's. The foresail was of good size compared with the mainsail and not a mere "ribbon" such as the racing schooner yacht now carries. The quarter-deck was replaced in the later schooners by a cabin trunk, lighted from the side and end, affording smaller and less pleasant accommodations than those below the quarter decks of the old packet sloops and their large windows for light and air at the stern (Verplanck et al. 1908:35).

Furthermore, Northern River schooners operated well under fair or beam winds and were faster under sail than sloops. The schooner sail rigging was easier to handle than the sloop sail rig, requiring a smaller crew to operate the vessel. Many of the early schooners were converted to sloops to curtail operation expenses. After 1865, a newer variant of the schooner was produced for service on the Hudson River with the similar sail rig, yet the ship had a sharper bow, a wider beam, and shallower draft. This gave the vessel greater carrying capacity and allowed for cargo to be carried on deck rather than in the hold, maximizing ease of loading and unloading (Verplanck et al. 1908:37-38).

Excelsior is mentioned several times in the *Burlington Free Press.* The vessel had a long career as a bulk carrier on Lake Champlain. An account of navigation on Lake Champlain remarks on the schooner *Excelsior* making its first trip on 28 March 1860 (*The Burlington Daily Free Press and Times* 1867:8). Alvin Colvin of Port Kent mentions the first trips of the schooner *Excelsior* on the same date as listed above and the last trips on 21 January 1866 (Smith 1885:265). Regarding the type of cargo *Excelsior* carried, this account mentions the following:

> The Iron Business – Four boilers, three large and a smaller one, have arrived at the Rutland depot from South Boston, awaiting the opening of the lake when, they are to be shipped on the "Excelsior" to Port Henry for the iron works company. Two other boilers are yet to arrive for the same company. A trip hammer was also on the same train, consigned for the Keesville nail company (*Burlington Daily Free Press and Times* 1870a).

On 18 April 1870, the *Excelsior* "took advantage of a favorable wind, and started for Port Henry yesterday, carrying several large boilers for the iron company at that place" (*The Burlington Daily Free Press and Times* 1870b). *Excelsior* is mentioned again in the *Plattsburgh Republican*, stating that "the schooner *Excelsior* has gone into winter quarters at Plattsburgh. The vessel was built at Willisboro Bay in 1853 by Captain Landon and is 110 feet long by 28 feet wide – one of the largest sailboats on the lake" (*Plattsburgh Republican* 1881:1). Another New York newspaper accounts the following:

> The old Schooner *Excelsior*, well known to many of our readers, is again engaged this season freighting limestone from Westport to the Cedar Point furnaces. She is one of the very oldest vessels on the lake, and is commanded by Captain Dupry, who has been on board of her every season for 22 years (*The Essex County Republican* 1883:1).

One of the last mentions of the *Excelsior* is of when the wreckage of the vessel was removed from the cove, where "the spars of the old schooner Excelsior, which was sunk at the mouth of the cove [Pine Street Canal] last fall, were removed yesterday. This was one of the largest schooners that used to ply on the lake" (*The Burlington Dailey Free Press and Times* 1885). Lastly, *Excelsior* is remarked on in the obituary for Captain John Sheldon. The obituary has a segment from Captain Orin Landon, who recounts an experience with Captain Sheldon.

> It was the darkest night I ever experienced, said Captain Landon, and the *Excelsior* had on a valuable cargo. John was sailing the *Excelsior*, and I was merely going down with him. It was but natural that I should feel uneasy. I could not see a hand before me on deck; I could not even find John, and a feeling of great insecurity came over me as I said to the helmsman for the third time: *We had better lie to, Sir, till morning, this is dangerous business.* At this, my third interference, a voice of a Bengal tiger growled out of the darkness: Capt. Landon, do you go down below, and do you stay there. No doubt John had been lying down on the bow, face downward, and his practiced eye had determined his exact whereabouts. But I was suddenly relieved of all disposition to interfere, continued

> the gentlemanly ship owner. *I stayed below*, and early next morning, when the storm struck, we were lying safe along Burlington wharf, my confidence in John was stronger than ever (*The Essex County Republican* 1888:1).

Through the limited documentation that exists, records show that *Excelsior* served a long career as a bulk cargo carrier on Lake Champlain. As a centerboard rigged schooner made in Willsboro, New York in 1850, it hauled boilers for the iron works in Port Henry and limestone to the furnaces in Cedar Point. Traversing between ports on both the New York and Vermont sides of the lake, it most likely was engaged in freighting other heavy cargo. While records were not found in relation to the design of *Excelsior*, it is most likely a regional modification of the shoal draft centerboard sailing ships used on the Hudson River during the 19th century. This type of vessel, like the North River Schooner, were important ships used in heavy cargo transport. The vessel changed ownership several times throughout the course of its life before it was finally abandoned in the port of Burlington, Vermont in 1884.

Understanding *Excelsior's* Systemic Context

The main stage of *Excelsior's* use-life may be referred to as its *primary mercantile* phase, where the creation of a vessel is meant to match its projected function (Richards 2008:120). Based on information from the historic record, *Excelsior* was used as a sailing bulk cargo carrier and experienced the reuse process termed *lateral cycling*. Schiffer defines reuse as “a change in the user or use or form of an artifact, following its initial use” (Schiffer 1987:27). The activity of reuse keeps items within the systemic context until they are ultimately discarded and become part of the archaeological record. As a type of reuse process, *lateral cycling* is the change in an artifact's user (Schiffer 1987:29). From the historical record, *Excelsior* had several changes in ownership along with changes in masters (see Tables 5.1-5.2).

From the enrollment records in 1870, the owner of *Excelsior* is listed as W.P. Foote with the master as O. Landon. The enrollment was issued on 14 July 1870 due to a change in the ownership of the property. On 7 September 1872, ownership of the vessel changed again with R. L. Landon listed as both the owner and master. On 10 November 1879, new enrollment was issued for *Excelsior* with R. L. Landon continuing to serve as the owner but, H. Dupee is the new master. On 20 May 1884, there is a change of ownership to M.A. Kiernan with H. Dupee continuing to serve as master. The enrollment issued is due to its abandonment. A final enrollment was issued on 30 June 1885.

At the end of its working life, *Excelsior* underwent a *discard process*. Schiffer defines does not happen, then the artifact is transformed into the archaeological context (Schiffer 1987:47). More specifically, a process of *discard* can ascribe how the vessel is deposited in a systemic context and the *pre-depositional salvage* behaviors that occur before it is abandoned along with their related signatures (Schiffer 1987:47, 103-105; Richards 2008:145-162). Since any movable items of value are absent from the vessel remains, it has undergone *pre-depositional salvage*, where the ship would be in floating shape so to safely remove all portable material. *Primary salvage* of this material happened before the vessel was finally abandoned (Richards 2008:155). Figure 5.4 shows a representative model of *Excelsior* based on the lines, sections, and sail plans of the North River Schooner diagrams in Figures 5.2 and 5.3. While this is a conjectural representation of what *Excelsior* might have appeared as, it illustrates the vessel in its pre-depositional context.

Figure 5.5 displays the same representative model, but features are faded out to illustrate what architectural elements were removed through *primary salvage*. This model of *Excelsior* is broken into individual parts that constitute the construction features of the vessel. Parts of the deck like the cabin and the ship's wheel are absent from the vessel as they were most likely removed. Other features essential to the operation of the vessel under sail such as the bowsprit, fore, and aft mast are also absent. Additionally, the sails, chain plates, rigging, jibs, booms, blocks, and other rigging elements would be removed.

The processes of reducing a vessel down to its smallest size systematically are also referred to as *structural minimization* or *hull reduction* (Richards 2008:148). Once *Excelsior* was broken down to the point where the remains sunk, the vessel finally entered the archaeological context. The removal of the architectural elements during *secondary salvage* will be discussed in the next chapter.

***Hildegarde* (VT-CH-794) Ship History (1876 – 1937)**

As displayed in Tables 5.3- 5.5, the registration history of *Hildegarde* is tabulated. Much of the information from the listings of the *Merchant Vessels of the United States* aided in outlining the vessel's history. *The American Yacht List* and *Lloyds Register of American Yachts* provided additional information. Formerly known as *Niantic*, *Hildegarde* has the official number of 130070 and the call number K.C.F.S. *Hildegarde's* original configuration was as a center board sloop yacht with one deck and one mast. The gross tonnage was 37.91 while the net tonnage was 36.02. The length of the vessel was 58.2ft (17.7m), the breadth was 19.2ft (5.8m), and depth was 6ft (1.8m).

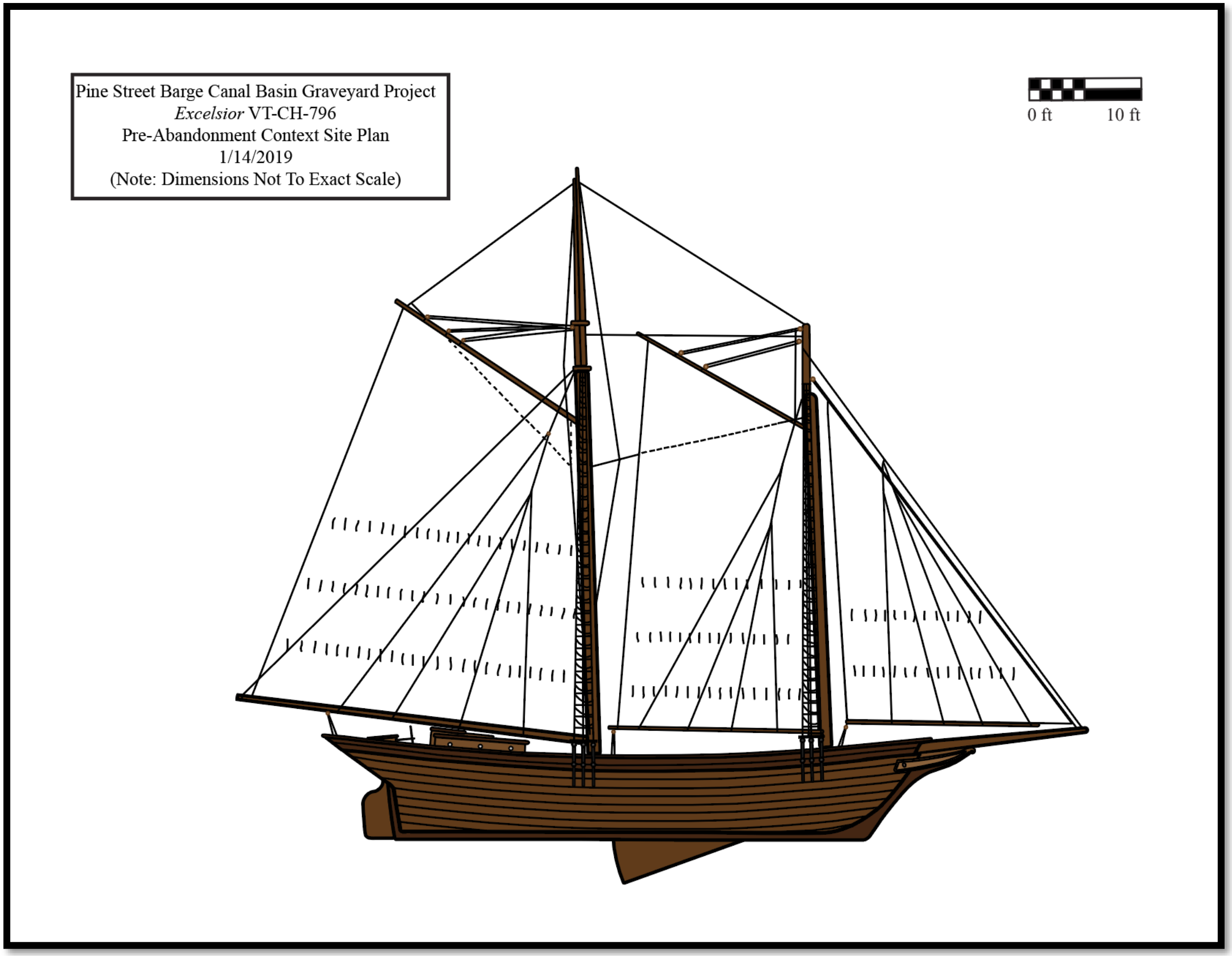


FIGURE 5.4. Model of a representative example of *Excelsior* in pre-depositional context during its *primary mercantile* phase (Image by Author).

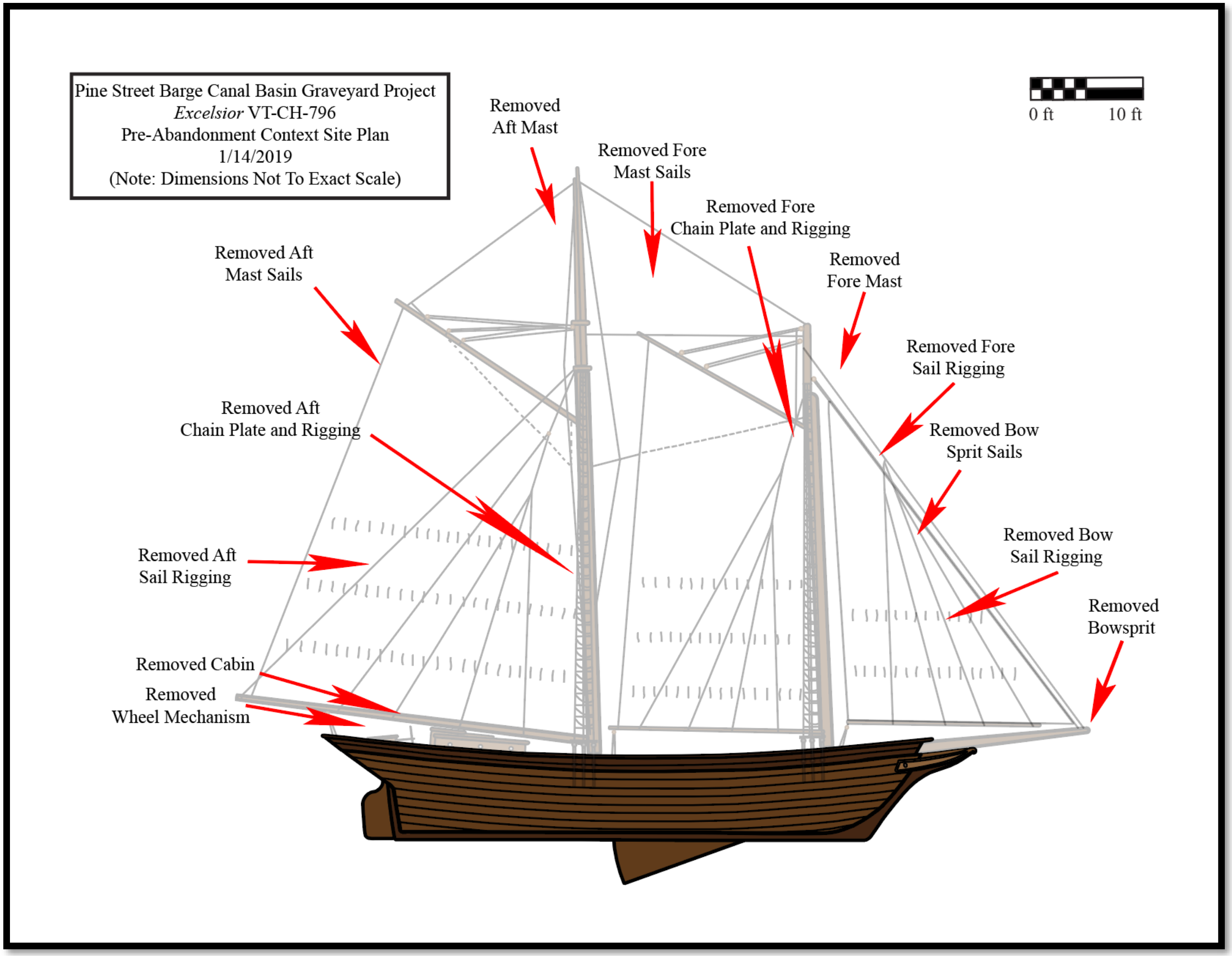


FIGURE 5.5. Model of a representative example of *Excelsior* in pre-depositional context after *pre-depositional salvage* (Image by Author).

Table 5.3. Registration history of *Hildegarde* (VT-CH-794) as outlined in Merchant Vessels of the United States. note: n/l means not listed (United States Bureau of Navigation 1877:198, 1878:190, 1879:160, 1880:86, 1881:91, 1882:93, 1883:94, 1884:152, 1885:162, 1886:158, 1888:141, 1889:48-138, 1890:136, 1891:49-140, 1892:143; 1893:49, 1894:143, 1895:90, 1896:89, 1897:86, 1898:85, 1899:84, 1901:85, 1902:84, 1903:80, 1904:78, 1905:78, 1906:73, 1907:67, 1908:62, 1909:60, 1912:46, 1913:43, 1914:40, 1915:35, 1916:34, 1917:32, 1918:246, 1919:252, 1920:253, 1921:257, 1922:252, 1923:201, 1924:51, 1925:100-101, 1926:100-101; 1927:94-95; 1928:94-95; 1929:94-95, 1930:88-89, 1931:88-89, 1932:90-91; United States Bureau of Navigation And Steamboat Inspection 1933:88-89, 1934:86-87, 1935:86-87; United States Bureau of Marine Inspection and Navigation 1936:80-81, 1937:44-531).

Year	Official Number	Signal Letters	Rig	Decks / Masts	Length	Breadth	Depth	Owner	Address of Owner	Crew	Gross Tonnage	Net Tonnage	Horsepower	Home Port	Where Built	When Built	Additional Information
1876	RECORD DOES NOT EXIST																
1877	130070	N/L	Sloop Yacht	N/L	N/L	N/L	N/L	N/L	N/L	N/L	37.91	N/L	N/L	New York, N.Y.	N/L	N/L	N/L
1878 - 1879	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“
1880	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	Renamed *Hildegarde*
1881 - 1883	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“
1884	“	“	“	“	“	“	“	“	“	“	“	36.02	“	“	Islip, N.Y.	1876	“
1885	“	“	“	“	58.2ft	19.3ft	6.5ft	“	“	“	“	“	“	“	“	“	“
1886	“	K.C.F.S .	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“
1887	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	Formerly Sloop Yacht *Niantic*
1888	RECORD DOES NOT EXIST																
1889	“	“	“	1D / 1M	“	“	“	James C. Bergen	N/L	N/L	“	“	“	“	“	“	“
1890 - 1893	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“
1894	“	“	“	N/L	64 ft	19.2ft	“	“	“	“	42.19	40.09	“	“	“	“	“
1895	“	“	“	“	“	“	“	N/L	“	“	“	“	“	“	“	“	“
1896 - 1898	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“
1899	“	“	“	N/L	“	“	“	N/L	N/L	N/L	“	“	N/L	“	“	“	“
1900	RECORD NOT EXIST																
1901	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“
1902	“	“	“	“	“	“	“	“	“	7	42	40	“	“	“	“	“
1903	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“
1904 - 1905	“	N/L	“	“	“	“	“	“	“	“	“	“	“	Perth Amboy, N.J.	“	“	“

1906	“	“	“	“	“	“	“	“	“	“	“	“	“	New York, N.Y.	“	“	“
1907 - 1909	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“
1910	RECORD DOES NOT EXIST																
1911	RECORD DOES NOT EXIST																
1912	“	K.C.F.S .	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“
1913 - 1917	“	“	“	“	“	“	“	“	“	2	“	“	“	“	“	“	“
1918	“	“	Gas Screw	“	“	“	“	“	“	3	46	39	100	“	“	“	Listed for Freight Service
1919 - 1923	“	N/L	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“
1924	“	“	Steam Screw	“	“	“	“	“	“	“	“	“	75	Rouses Point, N.Y.	“	“	“
1925 - 1929	“	“	“	“	“	“	“	West Port - Vergennes Ferry Co. (N. Y.)	West Port. N.Y.	“	“	“	“	“	“	“	“
1930 - 1936	“	“	“	“	“	“	“	Herbert Pashbee	398 St. Paul Street	“	“	“	“	Burlington, V.T.	“	“	“
1937	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	Abandoned

Table 5.4. Registration history of *Hildegarde* (VT-CH-794) as outlined in Lloyds Register of American Yachts. Note: n/l means not listed (Lloyds Register of Shipping 1903:216, 1906:259, 1912:126, 1914:121, 1917).

Year	Official Number	Signal Letters	Rig / Other Hull Details	Overall Length / Water Length	Breadth	Depth / Draught	Owner	Gross Tonnage	Net Tonnage	Home Port	Where Built	When Built	Additional Information
1876 - 1902	RECORD NOT OBSERVED												
1903	130070	K.C.F.S.	Sloop / Center Board / Sailmaker Sawyer	64ft / 75ft / 60ft 9in	19FT 2IN	6ft 5 in / 7ft	J. C. Bergen	42	40	New York, N.Y.	Islip, N.Y.	1876	Builder, A.E. Smith Designer, P. Ellsworth. Ex *Niantic*.
1904 - 1905	RECORD NOT OBSERVED												
1906	130070	K.C.F.S.	Sloop / Wood / Centerboard and Cabin Trunk / Sail Area Cut / Sailmaker Sawyer	NL / 75ft / 60ft 11n	19ft 3in	6ft 6 in / 7ft	W. W. Butcher	"	"	Belle Harbor, L.I.	"	"	Builder and Designer, A.E. Smith. Formerly *Niantic*.
1907 - 1909	RECORD NOT OBSERVED												
1910	"	N/L	"	"	"	"	N/L	"	"	"	"	"	"
1911	RECORD NOT OBSERVED												
1912	130070	K.C.F.S.	Sloop / Wood / Centerboard and Cabin Trunk / Sail Area Cut / Sailmaker Sawyer	Overall 78ft, W.L 60.11ft	19ft 3in	Depth 6.6 ft Draft 7ft	W.W. Butcher	"	"	"	"	"	"
1913	RECORD NOT OBSERVED												
1914	130070	K.C.F.S.	Sloop / Wood / Centerboard and Cabin Trunk / Sail Area Cut / Sailmaker Sawyer	Overall 78ft, W.L 60.11ft	19ft 3in	Depth 6.6 ft Draft 7ft	W.W. Butcher	"	"	Bensonhurst, N.Y.	"	"	"
1915 - 1937	RECORD NOT OBSERVED												

Table 5.5. Registration history of *Hildegarde* (VT-CH-794) as outlined in the American Yacht List. Note: n/l means not listed (Olsen 1881:41, 1882:44, 1883:46, 1884:58, 1885:62, 1886:75; Manning 1888:84, 1889:89, 1891:106, 1896:117, 1897).

Year	Official Number	Signal Letters	Rig / Other Hull Details	Length / Water Length	Breadth	Depth / Draught	Owner	Tonnage (Old / New)	Home Port	Where Built	When Built	Additional Information
1876 - 1880	RECORD NOT OBSERVED											
1881	130070	N/L	Sloop / Center Board / Sailmaker J. M. Sawyer	69ft 4 in / 60ft 6 in	19ft 2in	6ft 5 in / 5ft 5in	Herman Oelrichs	74 / 37.91	New York, N.Y.	Islip, N.Y.	1876	Builder, A.E. Smith. Late *Niantic*. Clubs 1.
1882	"	"	"	69ft 5 in / 60ft 6 in	19ft 2in	6ft / 5ft 5in	"	73.97 / 37.91	"	Islip, L.I.	"	* Clubs 1 and 23.
1883	"	"	"	"	"	"	"	"	"	"	"	"
1884	"	K.C.F.S.	"	"	"	"	"	"	"	"	"	"
1885	"	"	"Sailmaker Sawyer & Son	"	"	"	"	"	"	"	"	* Clubs 1, 5, and 23.
1886	"	"	"	"	"	"	"	"	"	"	"	"
1887	RECORD NOT OBSERVED											
1888	"	"	"	69ft 5 in / 61ft 7in	"	6ft 5in / 6ft 6in	James C. Bergen	37.91 Gross / 36.02 Net	"	"	"	"
1889	"	"	"	"	"	"	"	"	"	"	"	"
1890	RECORD NOT OBSERVED											
1891	"	"	* Sailmaker John M. Sawyer & Son,'88	"	"	6ft / 5ft 5 in	"	"	"	Islip, N.Y.	"	* Clubs 1, 9, 24.
1892 - 1895	RECORD NOT OBSERVED											
1896	"	"	Sloop / Centerboard	74ft / 61ft 6in	"	6ft 5in / 7ft	"	"	"	"	"	* Clubs 1, 10, 23, and 92. Listed as being in several races in 1895.
1897 - 1937	RECORD NOT OBSERVED											

Hildegarde is listed as being built by A. E. Smith in 1876 at Islip, N.Y. with the homeport of New York, N.Y. On 14 June 1880, the name of the vessel was officially changed from *Niantic* to *Hildegarde* (United States Congress 1880:197).

As exhibited in Figures 5.6 and 5.7, *Hildegarde* was originally built as the sailing yacht *Niantic* and was a member of several yacht clubs, including the New York Yacht Club, the Atlantic Yacht Club, the Larchmont, the Riverton, Shelter Island, and the San Francisco Yacht Clubs (Olsen 1882:44, 1883:46, 1884:58, 1885:62, 1886:75, 1891:41, 1896:117). *Hildegarde* enjoyed an early career as a racing yacht and took part in America's Cup race and trial matches from 1876 to 1885 (Cozzens 1887:79, 89, 92, 94-95).

FIGURE 5.6. *Hildegarde* in Americas Cup Race 1887 (Image by Historic New England).

FIGURE 5.7. *Hildegarde* in the Atlantic Yacht Club Regatta 1889 (Image by Historic New England).

Figure 5.8 shows a silver trophy won by *Hildegarde* during the annual race of the Seawanhaka Corinthian Yacht Club on 15 June 1889 (Northeast Auctions 2018). *Hildegarde* was also considered a predecessor to newer yacht designs and classes from 1883 to 1900. This required a vessel classed by length to have waterline measurements correspond to a lower ratio of the square root of the total allowable sail area (Stephens 1941:36-37).

FIGURE 5.8. Silver trophy bowl won by *Hildegarde* during the Seawanhaka Corinthian Yacht Club Annual Race on 15 June 1889 (Image by Northeast Auctions).

One of the vessel's first owners is listed as Herman Oelrichs (Olsen 1881:41). Oelrichs experienced some legal trouble regarding a painting of *Hildegarde*. On 11 November 1885, *The New York Times* published an article on a suit filed against Herman Oelrichs by Franklin Bassford (New York Times 1885:8). Mr. Bassford filed suit to recover $500.00 he claimed was due to him for painting a picture of the sloop yacht. The trial drew much attention from people within the local yachting circles and several witnesses were brought in to testify. Witnesses such as the Fleet Captain of the New York Yacht Club Robert Centre, disagreed with the representation of *Hildegarde* and pointed out various defects and inconsistencies. The case was handed over to the jury for final deliberations. Unfortunately, the results of the trial are not mentioned in the article.

In 1889, the ownership of *Hildegarde* was listed under James C. Bergen (United States Bureau of Navigation 1889:48-138). Ownership changes again to W. W. Butcher in 1906

(Lloyds Register of Shipping 1906:259). The register from 1925 lists a new owner as the Westport – Vergennes Ferry Co. (N.Y) with a home port in Rouses Point, N.Y. and the address of the owner in Westport, N.Y. (United States Bureau of Navigation 1925:100-101). Figure 5.9 depicts *Hildegarde* as a converted ferry, most likely done by the Westport – Vergennes Ferry Company. In 1930, ownership of *Hildegarde* once again changed, listing the new and final owner as Herbert Pashby, who lived at 398 St. Paul Street in Burlington, V.T. (United States Bureau of Navigation 1930:88-89). Mr. Pashby operated the vessel as a tugboat for a stone barge from Fiske's Landing in Isle La Motte to Burlington Harbor (Lake Champlain Maritime Museum 2014:52). Additional images of *Hildegarde* as a tugboat are shown in Figures 5.10 and 5.11.

FIGURE 5.9. *Hildegarde* with passengers and a car, early 1900s (Lake Champlain Maritime Museum 2014:52).

Hildegarde later underwent several structural changes in the length, tonnage, and rigging. The first change in tonnage and length is in 1894, where the gross tonnage is 42.19 tons, net tonnage of 40.09, and a length of 64ft (19.5m) (United States Bureau of Navigation 1894:143). There is a modification to the rigging of *Hildegarde* from a centerboard equipped sloop yacht to a gas screw rigged merchant motor vessel with a gross tonnage of 46 tons and a net tonnage of 39 tons. The vessel is listed for freight service with a crew of 3, total of 100 indicated horsepower (United States Bureau of Navigation 1918:246). In 1924, *Hildegarde* is converted to a steam screw merchant vessel with an indicated horsepower of 75 (United States Bureau of Navigation 1924:51).

FIGURE 5.10. *Hildegarde* as a tug assisting a sail equipped barge, early 1930s (Photo courtesy of Arthur Cohn and the Lake Champlain Maritime Museum).

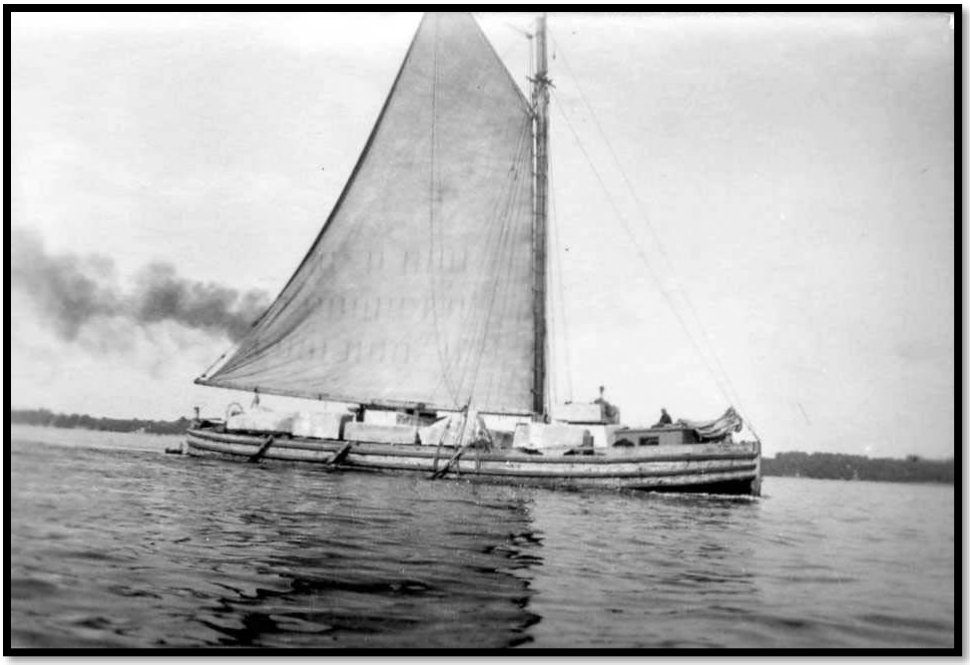


FIGURE 5.11. *Hildegarde* behind a sail equipped barge loaded with stone, early 1930s (Photo courtesy of Arthur Cohn and the Lake Champlain Maritime Museum).

The final listing of *Hildegarde* is in the 1937 register of *The Merchant Vessels of the United States*, which lists the vessel as being abandoned due to age or deterioration (United States Bureau of Marine Inspection and Navigation 1937:44-531).

Understanding *Hildegarde's* Systemic Context

During the vessel's *primary mercantile* phase, *Niantic* (changed to *Hildegarde* in 1880) was used as a racing yacht and took part in several matches. One of the primary transformation formation processes that *Hildegarde* had undergone is reuse process termed *lateral cycling* (Schiffer 1987:27). The activity of reuse maintains items within the systemic context until they are discarded and become part of the archaeological record. Like *Excelsior*, *Hildegarde* underwent the reuse process of *lateral cycling*. The following details in Table 5.6 list the series of owners and the year of ownership that *Hildegarde* had during its use-life.

Table 5.6. Ownership history of *Hildegarde* (VT-CH-794) as outlined in the American Yacht List, Merchant Vessels of the United States, and Lloyds Register of American Yachts. (1881:41; 1889:48-138; 1906:259; 1925:100-101, 1930:88-89).

Owner	Year
Herman Oelrichs	1881
James C. Bergen	1889
W. W. Butcher	1906
Westport – Vergennes Ferry Company	1935
Herbert Pashby	1930

Additionally, the vessel had undergone physical changes in length, breadth, and depth. The increase in tonnage is another indicator that the vessel is changing in configuration over time in conjunction with a change in ownership. The purpose of the vessel also changed from a sloop yacht to a gas screw equipped ship, to steam screw ship listed for freight service. Within the systemic pre-depositional context, *Hildegarde* underwent primary and secondary modification and conversion processes (Richards 2008:102). These reuse processes are associated with secondary use, where the object (in this case a ship) assumes a new use and function due to modifications (Schiffer 1987:30). Modifications to *Hildegarde* would require a substantial amount of work, effort, time, and money in order to adapt it from a sailboat to a steamship.
A representative model of *Hildegarde* in its pre-depositional context was made based off historic photographs in Figures 5.7, 5.9, and 5.10.

Additionally, digitized lines from the sloop yacht *Pocahontas* in Figure 5.12 were used to draft the full hull profile for *Hildegarde*. As a comparative vessel, *Pocahontas* was built in 1881 at the behest of officers from the New York Yacht Club as a racing yacht. With similar dimensions to *Hildegarde*, *Pocahontas* competed at trail races in 1881 against the sloop yachts *Hildegarde*, *Gracie*, and *Mischief* (Gary 2019). The model is depicted in Figure 5.13.

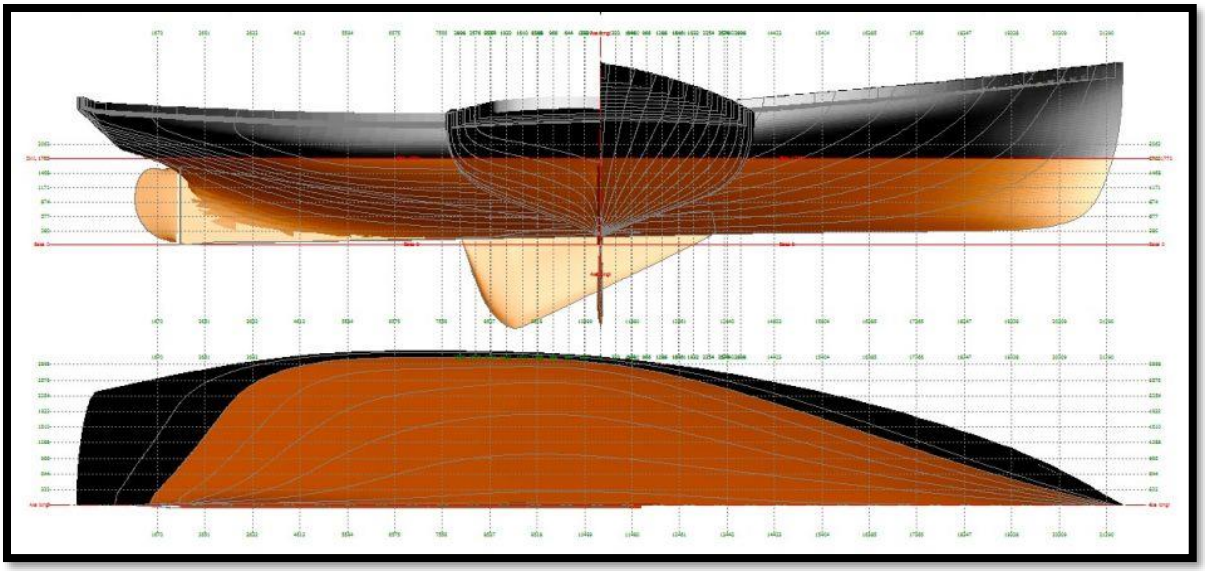


FIGURE 5.12. Digitized lines of *Pocahontas* (Image by Yves Gary).

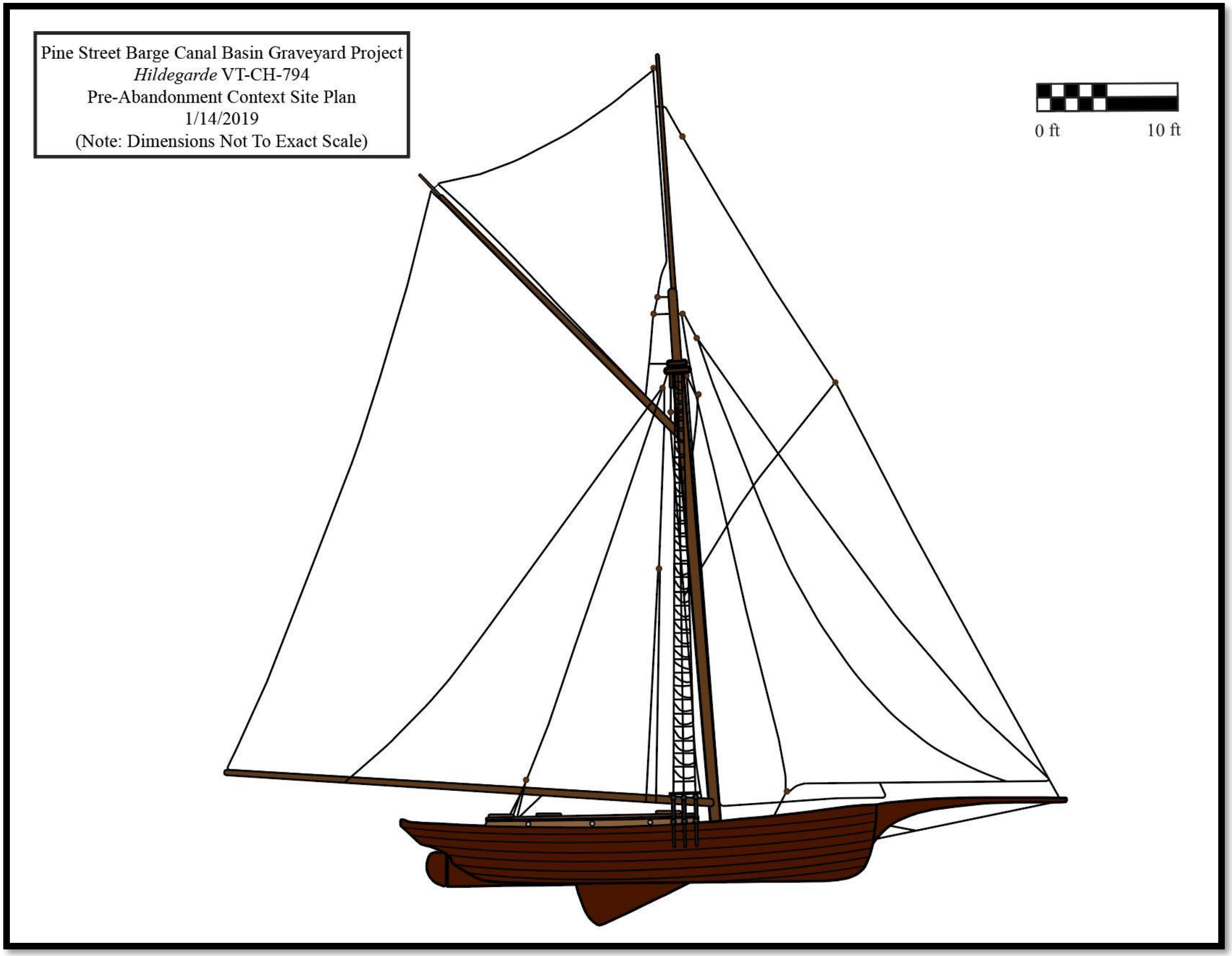


FIGURE 5.13. Model of a representative example of *Hildegarde* as a sloop yacht in pre-depositional context (Image by Author).

The model helps to provide a visual representation of the vessel in its pre-depositional context. Primary conversion and modification processes are displayed in Figure 5.14 with partially vanished features to exhibit removed architectural elements. Separated into and labeled into distinct parts, the model illustrates the features removed after *pre-depositional salvage*. Parts of the deck like the cabin are absent from the vessel as they were most likely removed. Other features essential to the operation of the vessel under sail such as the bowsprit and mainmast are also absent. Additionally, the sails, chain plate, rigging, jibs, booms, blocks, and other rigging elements would be removed.

The changes that occurred to the vessel related to modifications in the hull dimensions and materials along with modifications to the propulsion. Modification in the hull dimensions and materials usually are variations in a vessel's overall measurements and tonnage (Richards 2008:124). From the first documents that have recorded measurements, the dimensions of *Hildegarde* include a length of 58.2 ft (17.7 m), a breadth of 19.3 ft (5.8 m), a depth of 6.5 ft (1.9 m), and a weight of 36.02 net tons (United States Bureau of Navigation 1884:152, 1885:162). However, in 1894 the length increased to 64 ft (19.5 m) and the breadth was decreased to 19.2 ft (5.8 m). The tonnage increased to 40.09 net tons and 42.19 gross tons (United States Bureau of Navigation 1894:143). As mentioned above, a significant amount of effort, financial investment, energy, and time would need to be put into the modification of the vessel. The internal and external structural parts would have changed drastically, changes likely due to economic and technological considerations.

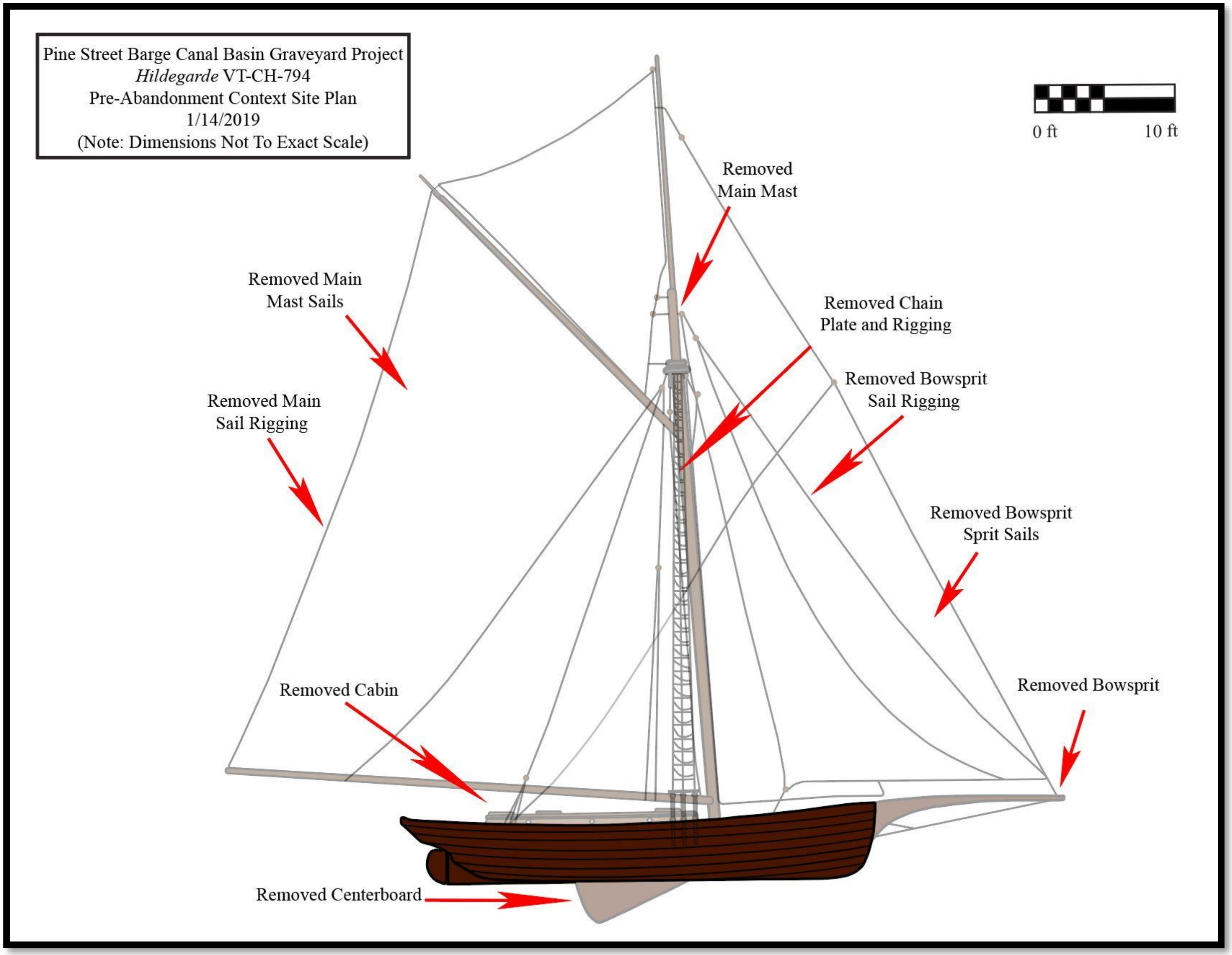


FIGURE 5.14. Model of a representative example of *Hildegarde* in pre-depositional context after *pre-depositional salvage* (Image by Author).

In 1918, the tonnage of *Hildegarde* increases again to 46 gross tons with a net tonnage of 39. This change is in relation to the modification of the propulsion system from sail to a gas-powered screw with an indicated 100 horsepower engine. The centerboard for the ship would have also been removed to make room for the engine and related components. Other modifications would have likely been done to the outer hull, the framing, and even the keel, keelson, sister keelsons, and reinforced stern and bow sections for towing. The vessel had also changed its function as a sailing ship to a ship intended for freight service (United States Bureau of Navigation 1918:246). This process of *Hildegarde*'s *primary mercantile* phase as a sloop yacht changing to a gas screw freighter is known as the *secondary mercantile* phase and is indicative of the owner's wish to maintain the ship in operational condition (Richards 2008:119-120). In 1924, another modification was made to the vessel where it was converted from a gas screw to a steam screw equipped with an indicated 75 horsepower engine (United States Bureau of Navigation 1924:51).

Figure 5.15 provides a representative illustration of *Hildegarde* as a steam tugboat in pre-depositional context after significant modification and conversion processes. The process of conversion and modification from a sailing sloop-rigged yacht to a steam tug boat would have drastically altered the top sections of the vessel. The model is based on the same historic photographs and comparative vessel line data as the model found in Figure 5.13. Even though it is a conjectural representation of *Hildegarde* as a steam screw vessel, it provides an example of the conversion and modification of the ship in its pre-depositional context. Added features include a modified and reinforced hull, bow, stern, reinforced keel, keelson, and sister keelsons.

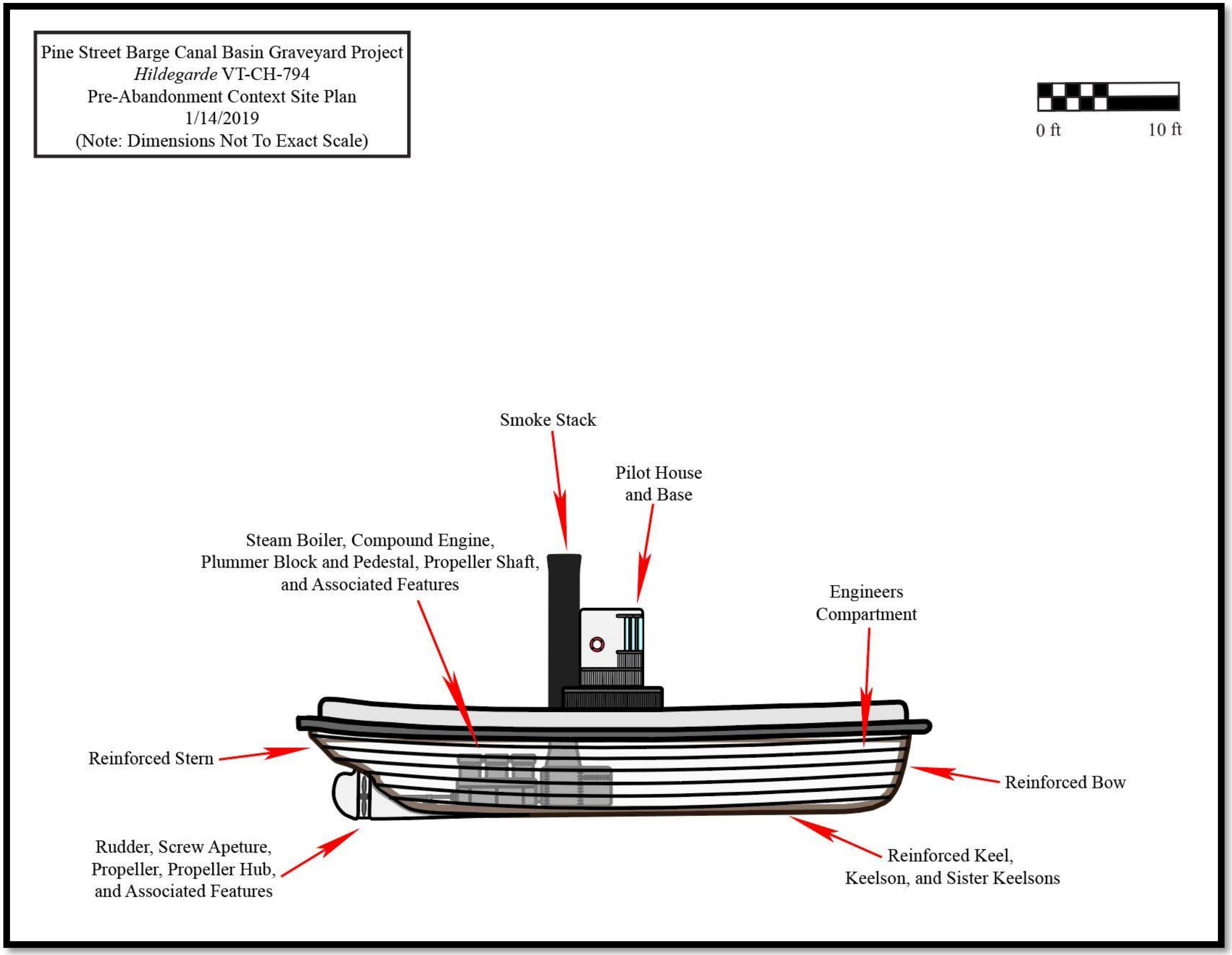


FIGURE 5.15. Model of a representative example of *Hildegarde* as a steam tugboat in pre-depositional context after primary and secondary modification and conversion processes from a sailing yacht to a steamship (Image by Author).

Other features include a rudder, propeller, propeller hub, propeller aperture, propeller shaft, plummer block and pedestal, the engineer’s compartment with the compound steam engine, boiler, smoke stack, and associated features. Completing the added features are top decking, the pilot house, and base.

Hildegarde underwent significant *pre-depositional salvage* when it was discarded and abandoned in 1937. This would have included stripping the ship of any material of value while the vessel was still in floating condition through *primary salvage* processes. Such material could have included movable items, rigging elements, deck machinery, the pilot house, decking, the upper portions of the hull, and any other super structural elements. *Primary salvage* of this material would have happened before the vessel was finally abandoned (Richards 2008:155). Figure 5.16 is a conjectural representation of *Hildegarde* as it underwent *primary salvage* processes in its pre-depositional context. The faded architectural features exhibit what was removed through salvage.

Any machinery associated with steam engine components is absent such as the compound engine, propeller shaft, plummer block and pedestal, the boiler, smoke stack, and associated equipment. Other removed parts consist of the pilot house, base, and decking. It is likely that this material would have been removed while the vessel was going through the *primary salvage* process. However, there is still a ferrous circular tube present in the starboard side of the vessel. It is unclear if more associated material is buried underneath the sediment. The ferrous propeller, rudder, stern post, and what appears to be a stuffing box for the propeller shaft are present. Given the location of the vessel remains where the water was at least 10 feet deep and the fact that this material was well below the waterline of the vessel, it may have been too difficult for salvagers to access it.

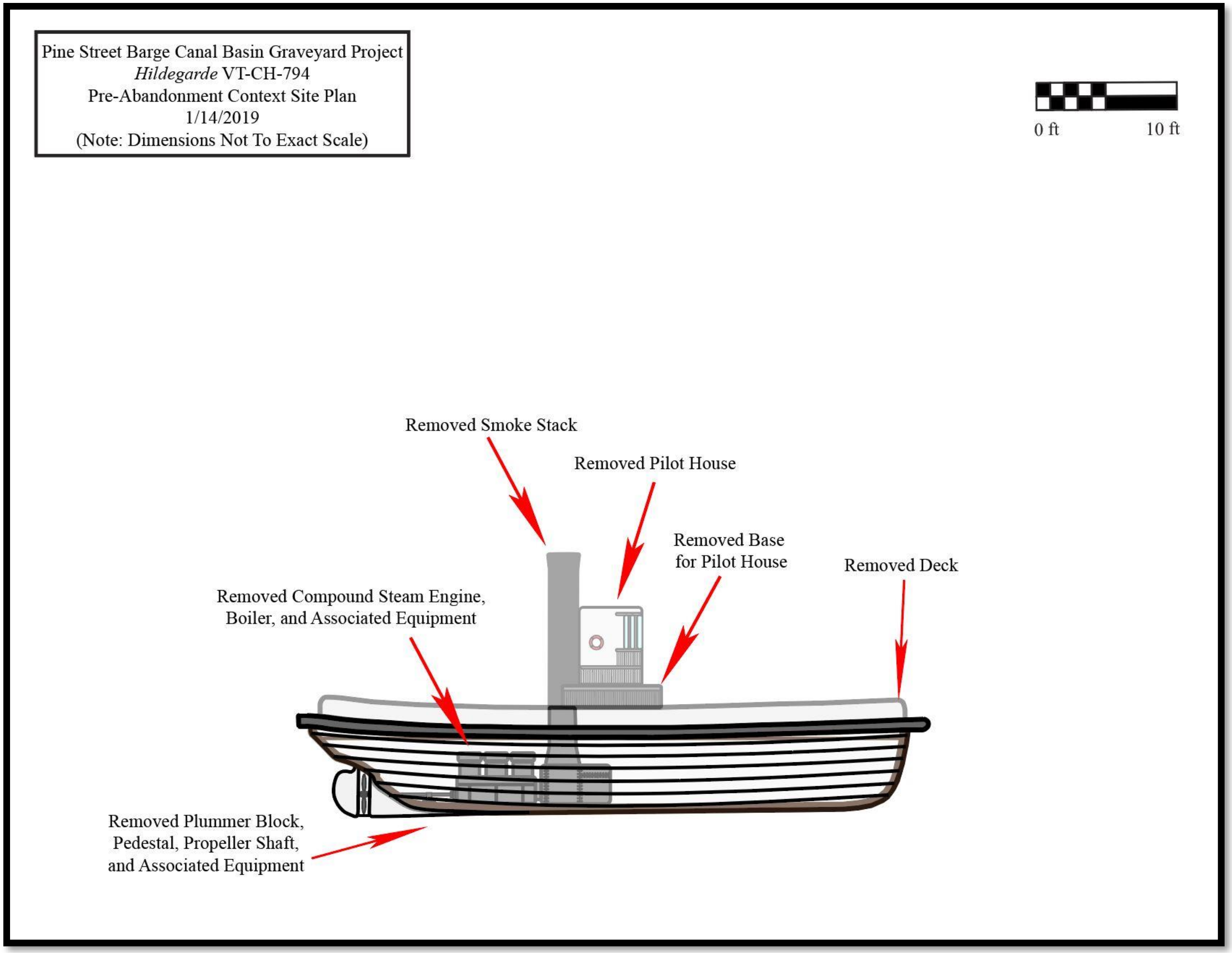


FIGURE 5.16. Model of a representative example of *Hildegarde* as a steam tugboat in pre-depositional context after *primary salvage* processes (Image by Author).

The post-depositional history and the archaeology of *Hildegarde* will be discussed in-depth in the next chapter.

Turner and Breivogel Inc., Barges History (1960 – 1964)

In the middle of the 20th century, Turner & Breivogel operated as a construction company located in Falmouth, Massachusetts. The company was involved in the Burlington Breakwater rehabilitation project. Built in 1890, the old breakwater had been battered by ice and water until a storm destroyed an 80 ft (24.4m) section in October 1959 (*The Burlington Free Press* 1963a:13). The search for suitable contractors and legislative action by Governor George D. Aiken to secure appropriations for survey work began in 1957. In the early 1960s, Turner & Breivogel were contracted by the Army Corps of Engineers to aid in the repair of the city of Burlington's Breakwater. The firm was awarded the contract at the lowest bid of $1,167,535.00. An estimated 162,000 tons of stone was calculated to be used in the reconstruction of 4,200 feet of the breakwater (*The Burlington Free Press* 1962a:15).

Negotiations between Turner & Breivogel and the city of Burlington started in July of 1962 to set a date to begin reconstruction (*The Burlington Free Press* 1962b:10). The agreed date was 1 August 1962 and the city also agreed to allow Turner & Breivogel to use Perkins Pier as a starting point for the project. Additionally, the firm would make improvements to the western side of the pier by facing it with granite and work on enhancing the southern part of the pier; (*The Burlington Free Press* 1962c:15; 1962d:11). Negotiations also covered where the stone for the rehabilitation project would come from. If the stone came from Isle La Motte, then the material would have to be hauled over the lake by barge. Yet, if the stone came from another source, it would arrive by truck and be ferried out via barge to the breakwater.

The construction of the Burlington Breakwater was documented extensively by the local newspaper (*Burlington Free Press* 1962e:15; 1962f:17; 1962g:26). L. A. Demers quarry of Winooski and the Rock of Ages quarries in Barre provided dolomite and granite for the building material, which was loaded on the Turner & Breivogel barges. Figure 5.17 shows one of the barges with an affixed tugboat being loaded with steel containers called “skips,” which carried smaller stones used in the reconstruction of the breakwater. Each barge could carry between 300 to 350 tons and was pushed out by tugs to the breakwater.

Figure 5.18 depicts one the barges operated by Turner & Breivogel hauling stone from the deck with a crane. Trucks carried in the stone daily with an average of 19 to 20 tons at a cost of $1.50 per ton (*The Burlington Free Press* 1963a:13). Using two cranes, two divers assisted in placing the stones at the base of the breakwater on the lake bottom and above on top of the breakwater. This work was not without danger. One of the crane barges tipped over after a rock punctured the hull and sunk 40 ft off the northern end of the breakwater. Another sunk near the pier the night before (*The Burlington Free Press* 1963b:11). No injuries were reported and both barges were recovered and put back into work. It is believed that these barges are present in the ship graveyard.

Divers and specialty equipment consisting of a 300 ft long barge and two cranes were needed to raise the sunken crane off the bottom of the lake (*The Burlington Free Press* 1963c:11). The crane was finally raised on 4 November 1963 by divers who had to cut off the boom of the crane before hoisting it up. The specialty barge mentioned above was brought in from New York City, where it was built in 1911 and used to ferry railroad cars across New York harbor. Figure 5.19 depicts the barge being cut in half after it helped to raise the crane.

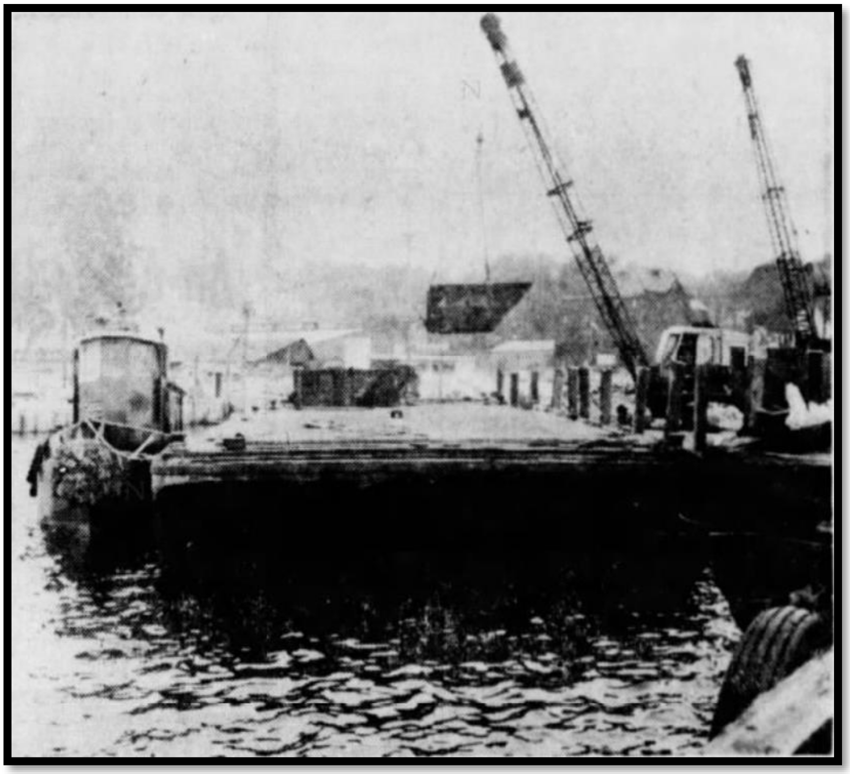


FIGURE 5.17. Turner and Breivogel barge being loaded with a “skip” (Image by *The Burlington Free Press*).

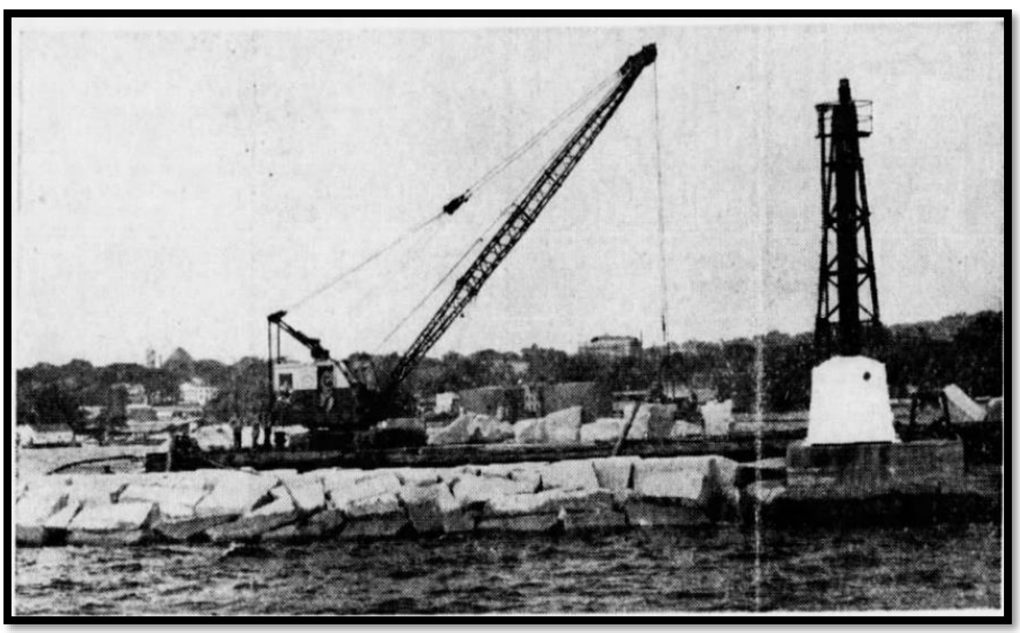


FIGURE 5.18. Turner and Breivogel crane barge moving stone (Image by *The Burlington Free Press*).

FIGURE 5.19. Turner and Breivogel 285 ft barge being cut in half (Image by *The Burlington Free Press*).

Arthur Hallman, an engineer with Turner & Breivogel, mentioned that the barge was cut into two smaller barges to ferry stone to the breakwater (*The Burlington Free Press* 1963d:11). It is unclear if this barge is present in the ship graveyard.

As work progressed, the city of Burlington announced on 9 April 1964 that the breakwater may not be ready by the end of the summer (*The Burlington Free Press* 1964a:6). On 15 May 1964, it was reported that repairs to the breakwater were on schedule and that Turner & Breivogel had made improvements to Perkins Pier, such as replacing railroad tie walls with granite blocks and installing new piles for boats to ride against (*The Burlington Free Press* 1964b:19). A fire was reported below decks on one of the barges on 8 June 1964 as it was tied off at Perkins Pier (*The Burlington Free Press* 1964c:22). Work steadily progressed and it was reported that the repair of the breakwater would be done by November 1964 (*The Burlington Free Press* 1964d:11). True to their promise, Turner and Breivogel made improvements on

Perkins Pier once the breakwater was repaired and the Army Corps of Engineers made a final check over the breakwater (*The Burlington Free Press* 1964e:17, 1964f:16).

The *Merchant Vessels of the United States* listed no information on the three barges owned and operated by Turner & Breivogel, Inc, Records from 1960 to 1970 were reviewed and no information was found on the barges used in the rehabilitation of the Burlington Breakwater. However, *Merchant Vessels of the United States* register does list Turner & Breivogel of Grand Avenue in Falmouth, M.A. as the managing owners of a vessel named *Jovi* (Official Number 283905) (United States Bureau of Customs 1963:1192). Looking further into the registry from 1963 found a listing for a vessel named *JOVI*, which has the signal and radio call letters of WT3596, was rigged as an oil screw tug. It had a gross tonnage of 35, a net tonnage of 24, along with a length of 47.3 ft (14.4 m), a breadth of 14.4 ft (4.3 m), and a depth of 8.0 ft (2.4m). It was built in 1960 in Elizabeth, N.J. and has a horsepower of 330 with a homeport of Plymouth. M.A. (United States Bureau of Customs 1963:319). The information on this vessel does not change (United States Bureau of Customs 1964:330-1240; 1965:343-1287, 1968:399-1492, 1969:419-1558). The *Merchant Vessels of the United States* register lists *Jovi* as changing ownership in 1970 to Campenella Corp at 780 Jefferson Boulevard, Warwick, Rhode Island 02887 (United States Bureau of Customs 1963:441-1364). The new home port changed to Providence, R.I.

Understanding the Systemic Context of the Turner and Brievogel Barges

Given the short use lives of the three barges and the fact that they are not listed in the *Merchant Vessels of the United States*, the vessels have not undergone as many transformation formation processes as *Excelsior* and *Hildegarde* have in their systemic contexts. The barges *primary support* phase and intended function was for use in ferrying stone and construction material for the rehabilitation project of the Burlington Breakwater. Unlike the *primary mercantile* phase, *primary support* phase refers to vessels built to serve a non-commercial use as a specially made support vessel like a towed barge or dredger (Richards 2008:120).

Once the construction project was finished in 1964, the barges were discarded and abandoned within the confines of the Pine Street Barge Canal Breakwater Basin. Discard is the process where an artifact can longer retain its function and if reuse does not happen, then the artifact is transformed to the archaeological context (Schiffer 1987:47). The process of abandonment represents how the vessel is transformed to the archaeological record through *pre* and *post-depositional salvage* behaviors along with their related signatures (Schiffer 1987:47, 103-105; Richards 2008:145-162). Evidence of *curate behavior* is also present due to the lack of movable objects, goods, crew related equipment, anchors, rigging, and portions of the hulls of each barge (Schiffer 1987:90).

Since most movable items of value are absent from the vessel remains, it has undergone *pre-depositional salvage*, where the vessel would be in floating shape in order to safely remove all portable material. *Primary salvage* of this material happened before the vessel was finally abandoned to a *post-depositional* context (Richards 2008:155). Much of the barges appear to have undergone *hull reduction* processes as much of the top sections, deck elements, and side planking is gone. Once all the barges were stripped, they entered the archaeological context.

To highlight the architectural features of the barges, a representative model of the vessels in their pre-depositional context was made based off historic photographs in Figures 5.17 and 5.18. Construction plans from 1921 of a wooden deck scow employed for street cleaning as seen in Figure 5.20 were also used as a reference for the pre-depositional model (James Jr. and Duncan 1999:148). Additionally, a profile draft of a derrick lighter from the Feeney Collection at the Hudson River Maritime Museum depicted in Figure 5.21 was utilized as a comparative barge (Kane et al. 2001:21).

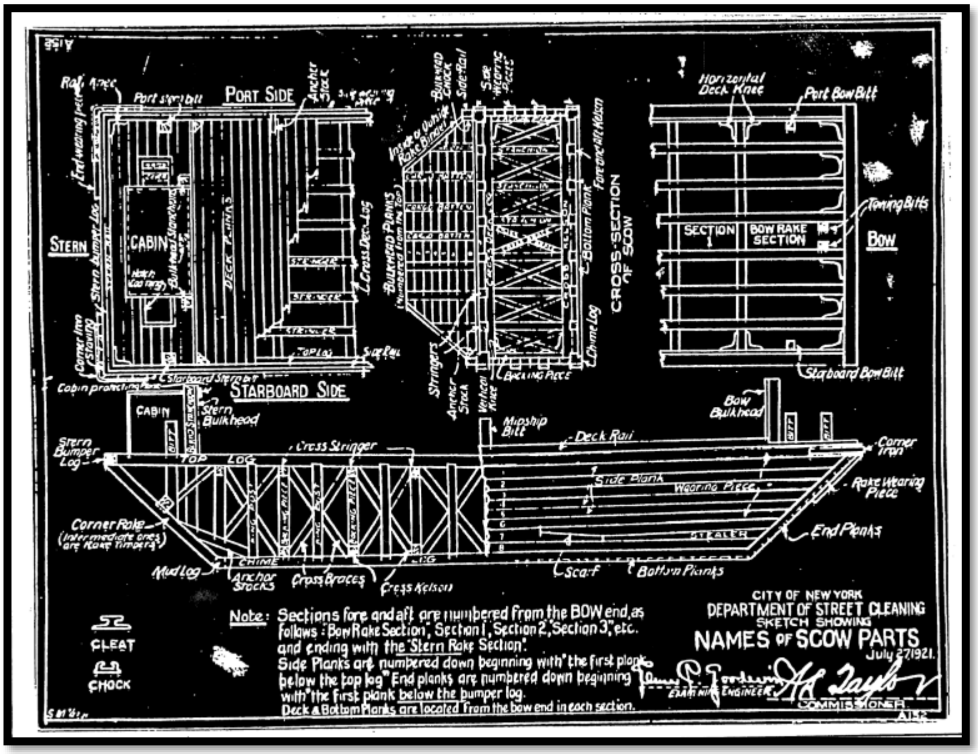


FIGURE 5.20. Plan of a 1921 street cleaning scow (Image by New York City Department of Street Cleaning 1921).

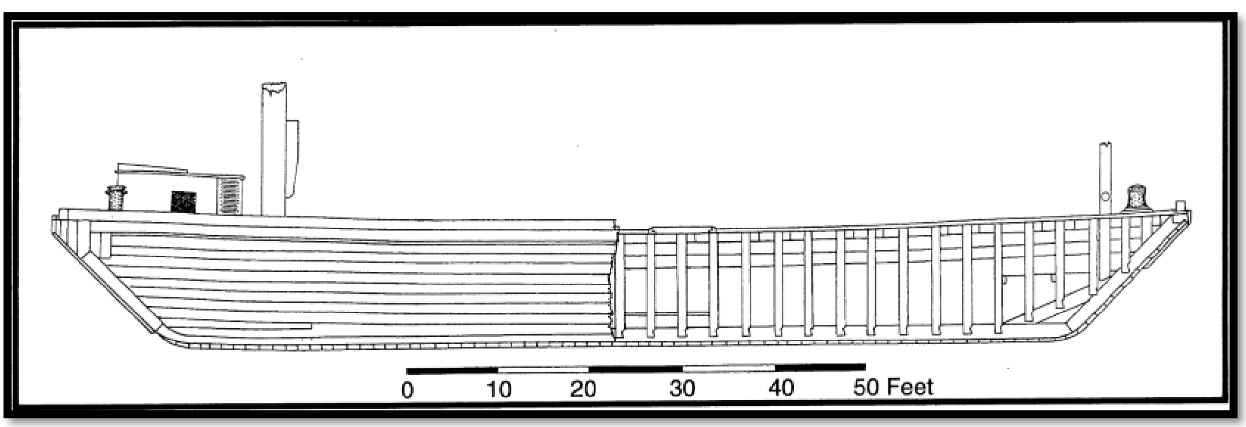


FIGURE 5.21. Profile of a derrick lighter scow (Image by Hudson River Maritime Museum, inked by Adam Kane).

Figure 5.22 depicts a general representation of the Turner & Breivogel barge. This conjectural representation provides a better understanding of the vessel in its pre-depositional context. Figure 5.23 displays the same representative model however; features are faded out to demonstrate what architectural elements were removed through *primary salvage* processes. The model of the of Turner & Breivogel barge is broken into individual parts that constitute the construction features of the vessel. The deck is absent from all three barges along with the bollards and associated materials. Most of the superstructure of the hull is absent, including the deck rail, top log, and side planking. Additionally, part of the stern and bow consisting of the bumper logs, corner irons, and corner rakes are removed.

A subject that will be explored in greater detail in the next chapter are some peculiarities with the objects that remain on the archaeological sites of the barges. For example, it is interesting that some of the barge remains still have much of the framing structures intact, such as chine logs, longitudinal stringers, transverse riders, and bottom planking. Several deck elements are still present near the vessel remains, such as barge VT-CH-797. A large iron bollard with two bits is still attached to what appears to be the deck of the barge. Hand fanning also revealed braided steel cable near this section yet, it is unclear as to how much of the cable there is. The site plan made by archaeologists from the Lake Champlain Maritime Museum in 2004 shows that there is a significant portion of the deck remains buried near barge VT-CH-797. It is unclear if the barges underwent *secondary salvage* as they were still in their *post-depositional* context (Richards 2008:156).

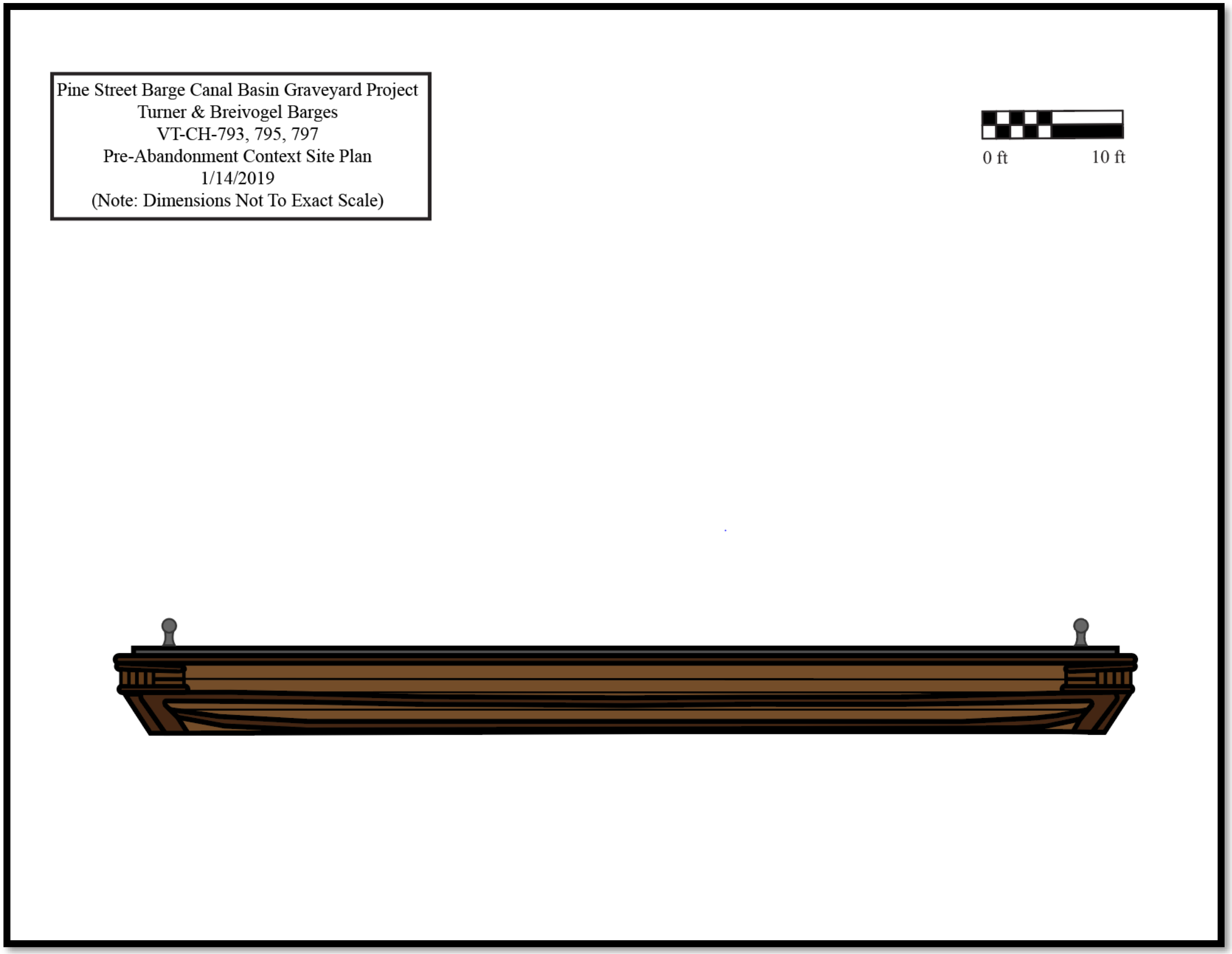


FIGURE 5.22. Model of a representative example of Turner & Breivogel Barge in pre-depositional context (Image by Author).

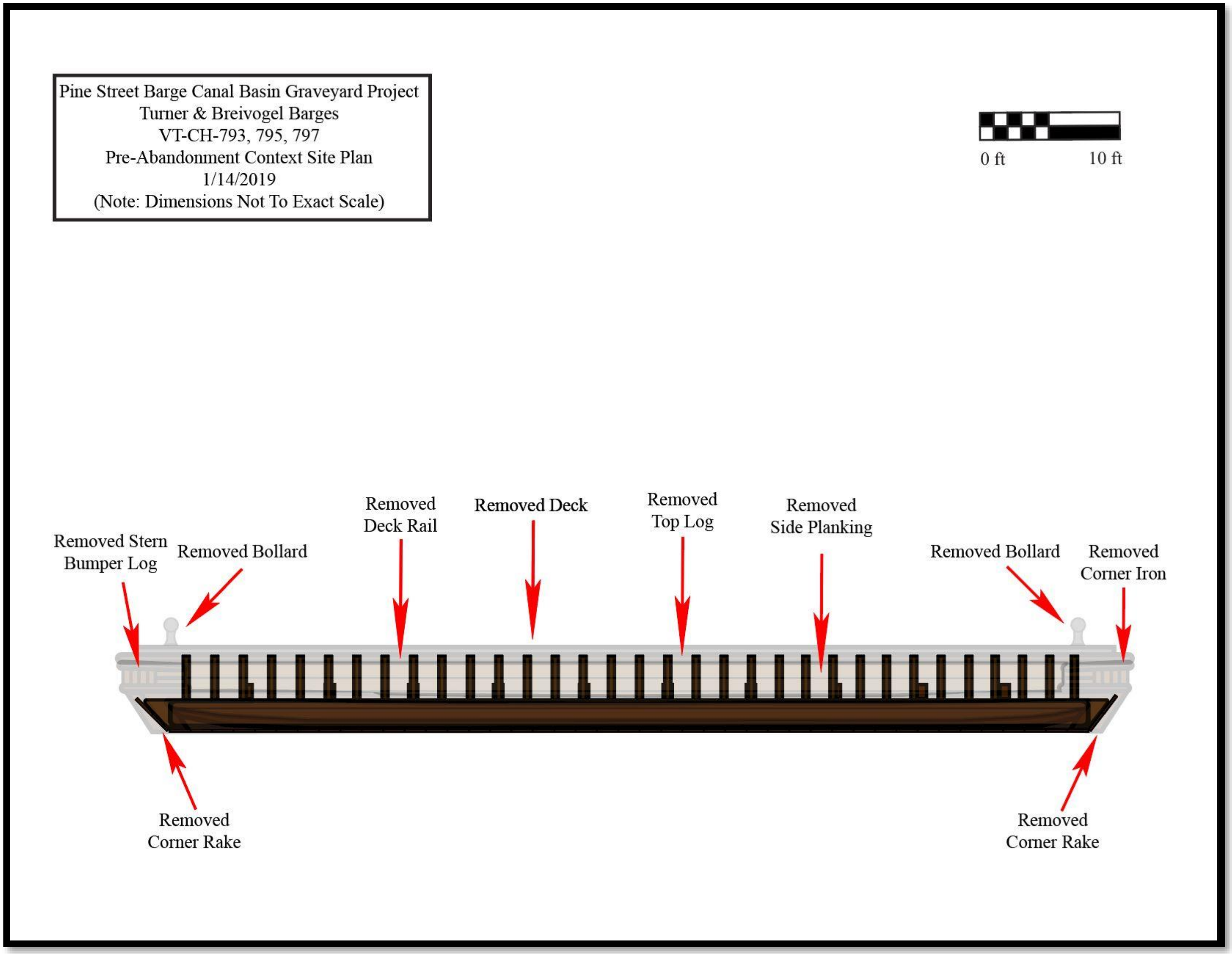


FIGURE 5.23. Model of a representative example of Turner & Breivogel Barge in pre-depositional context after *pre-depositional salvage* (Image by Author).

Conclusion

The five vessels in the Pine Street Barge Canal Breakwater Basin have distinct use-lives that span from the middle of the 19th century to the second half of the 20th century. Research gathered on the use-lives of the ships in their systemic contexts provides a rich history for these vessels and enhances conceptions of formation processes. This information is important because it can be ascribed through *lateral cycling*, the formation process of re-use that both *Excelsior* and *Hildegarde* underwent during the *pre-abandonment* phase. It also provides an understanding of the *primary mercantile* functions of the ships, wherein the case of *Hildegarde*, it experienced both *primary mercantile* and *secondary mercantile* transitions during its use-life. The Turner & Breivogel barges *primary support* function as construction ships used in the rehabilitation of the Burlington Breakwater project also provides a better understanding of the vessels in the systemic context before abandonment.

In terms of discerned patterns based on the systemic context of the vessels in the Pine Street Barge Cana Basin Ship Graveyard, both *Excelsior* and *Hildegarde* had very long use-lives. *Excelsior* was used for a total 34 years, not including the final listing of the ship in 1886 based on the *Merchant Vessels of the United States*. For a traditional lake schooner used in heavy freight to survive that long in an age where rail use and sailing canal boats were in direct competition is surprising. It indicates a behavior on part of the owners to invest in the ship for commercial purposes and financial interests. Of course, given the age of the vessel and the decision of the very last owner to abandon it in the port of Burlington shows that it had ultimately reached the end of its ability to be used for waterborne freight transport.

What is even more surprising is the length of time *Hildegarde* was used, which is 61 years based on the build and abandonment years from *Merchant Vessels of the United States*. As a private racing sloop that operated in the waters of New York City and Long Island, New York, it gained fame and fortune early on it its career. As mentioned above, it underwent both *primary mercantile* and *secondary mercantile* transitions from a sailing vessel, to a gas equipped screw freighter, to a steam screw ferry, and finally a tugboat. The changes that occurred related to modifications in the hull dimensions along with modifications to the propulsion are reflective of a considerable effort, financial investment, energy, and time put into the vessel. The internal and external structural parts would have changed drastically, changes likely due to economic and technological considerations. The various owners of *Hildegarde* desire to keep the vessel financially viable is a very clear behavioral pattern.

The use-lives of the Turner & Breivogel barges was only about 4 to 5 years based on accounts from *The Burlington Free Press*. While the barges had a much shorter use-life span than the vessels mentioned above, their barges *primary support* function as construction boats were essential to the Burlington Breakwater repair job. The thousands of tons needed for the breakwater could only be carried on these wooden barges and must have contributed to their breakdown. The heavy use and wear the barges experienced is likely a contributing factor to the owner's decision to abandon the barges in the location where they were moored throughout the construction project. Additionally, costs for transportation of the barges back to Massachusetts may have been prohibitive.

The models of each ship within pre-depositional context after *pre-depositional salvage* aids in understanding patterns of salvage after the vessel was discarded, but still within a systemic framework. For each vessel, the models highlight the architectural parts and features that would likely be removed through *primary salvage* processes. Additionally, the functions of these vessels can be distinguished from their remains as "archaeological signatures." These signatures impart signs of site formation processes and patterns related to the use, modification, and discard of the vessels in the ship graveyard. More importantly, it will provide a better understanding of the nature of shipping and transportation in the Burlington, Vermont region. This along with the archaeological context of the ships will be discussed in the next chapter.

CHAPTER SIX: THE ARCHAEOLOGICAL CONTEXT OF THE SHIPS OF THE PINE STREET BARGE CANAL BASIN GRAVEYARD

Introduction

This chapter focuses on the analysis of the archaeological sites (abandoned ships) of the Pine Street Barge Canal Basin Graveyard in their post-depositional context. The data collected from each vessel is arranged on a site by site basis where each vessel has a description of the archaeological context. Each site has a catalog of observed and documented *cultural* and *non-cultural* site formation processes. The locations of the site formation processes are noted on archaeological site maps and referenced in tables. Annotated digital photographs of the observed site formation signatures on each site are included to highlight the processes. A final section includes an analysis of the potential correlation between ship Abandonment and Burlington's maritime commerce, with separate sections considering likely relationships between abandonment and salvage actions by people in Vermont and corresponding economic, population, technological and use trends. Figure 6.1 shows where the vessels were abandoned in the area.

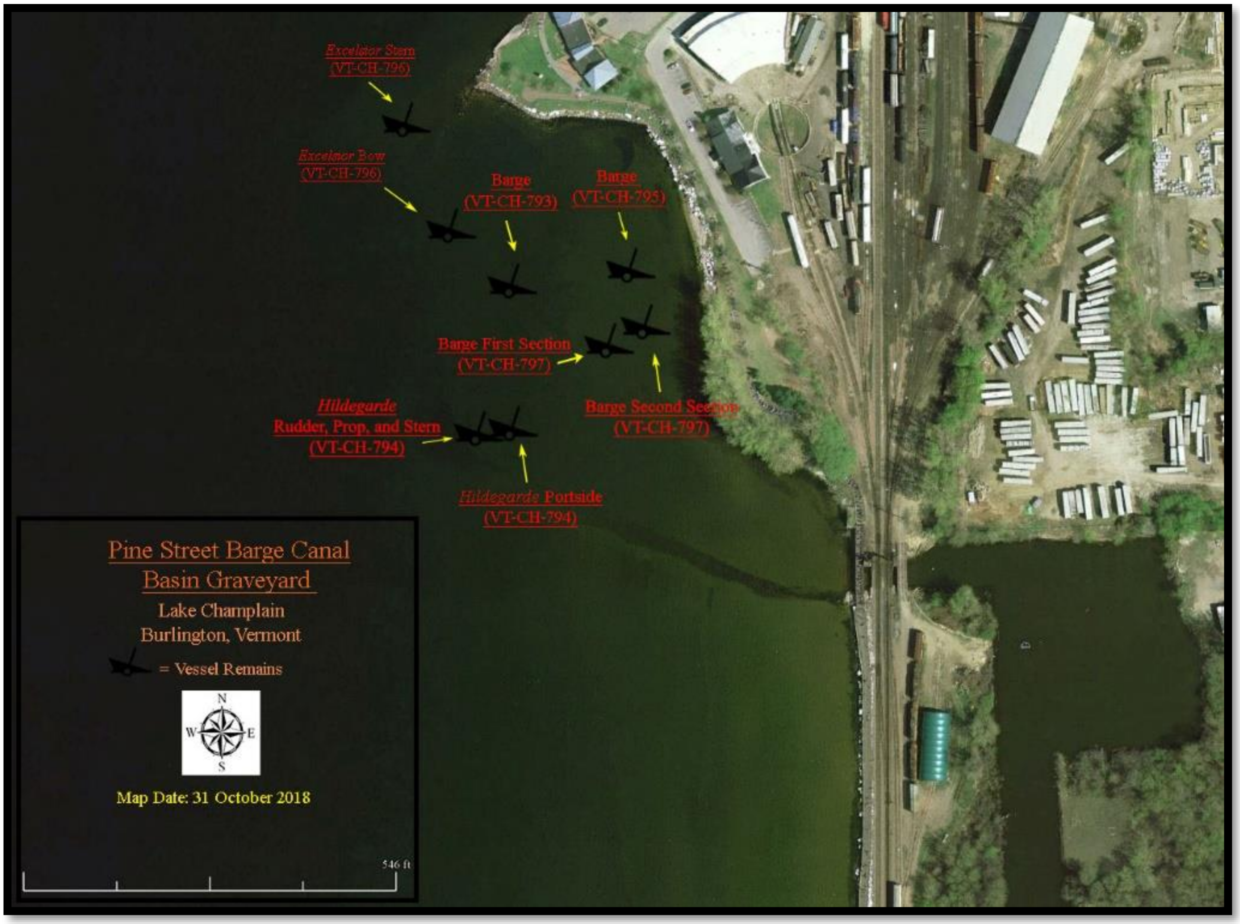


FIGURE 6.1. Field map of the Pine Street Barge Canal Basin Graveyard (Image by author and Google© Maps).

Archaeology of *Excelsior*

Archaeological work completed in July 2018 found much of the vessel remains in a poor state of preservation. Resting parallel alongside the interior of the northern breakwater arm within the basin, the bow and amidships of *Excelsior* from below the turn of the bilge is exposed. Much of the vessel is buried under sediment. Several curved frames are present with both affixed and disarticulated side planks. Other unidentified timbers litter the area with various iron fasteners. Located rearmost of the bow on the starboard side of the vessel is a large, rounded timber along with another similar partially buried timber. Material culture is present in the bow to amidships with a variety of intact glass bottles, rope, and several shoe soles with heels.

The stern remains are located on the outside of the northern breakwater arm, residing upside down adjacent and parallel to the breakwater. The remains are oriented with the stern facing southwest and the amidships facing the northeast. The exposed sternpost, gudgeon, garboard planks, side planking, and keel appear to be in good condition aside from some wear. Some of the ferrous bolts are damaged and the remains of a sacrificial keel are still affixed to the bottom of the keel. A section of the sacrificial keel is missing from the stern to amidships. A significant portion of the hull is buried under sediment with more of the remains extant.

To gain a better understanding of *Excelsior* in its immediate post-abandonment context, a model was made below in Figure 6.2. The model is annotated with features that would remain after the vessel underwent *secondary salvage* processes. It demonstrates the condition of the vessel before it enters the archaeological context. The architectural features include the keel, keelson, centerboard, the centerboard trunk, floor frames, frames, and bottom planking. Other elements include the aft and fore mast steps, stem, apron, stemson, the wing transom, filling transoms, stern post, inner post, sternson, and hull planking.

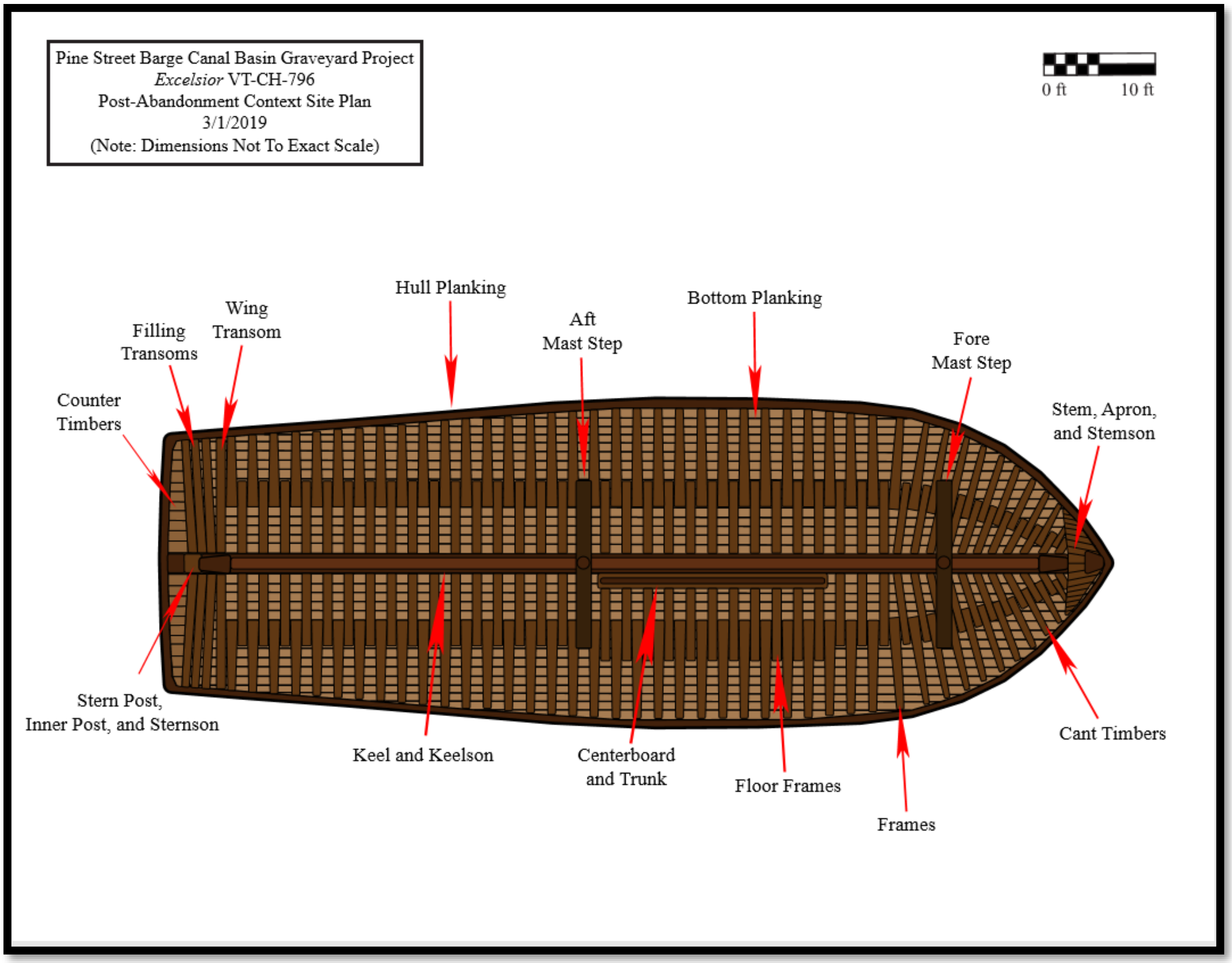


FIGURE 6.2. Model of *Excelsior* Post-Abandonment (Image by Author).

Providing a visual of the vessel in its current archaeological context, Figure 6.3 displays the archaeology site plan of *Excelsior's* bow and amidships section. Based on the site plan made by researchers from the Lake Champlain Maritime Museum, it was augmented by the author using data from fieldwork in July 2018. It depicts locations of site formation signatures discussed below in the next section on cultural and natural formation processes. Figure 6.4 depicts the archaeology site plan of *Excelsior's* stern section. As with the bow and amidships section, it displays the location of site formation signatures observed during fieldwork. The next section reviews the evidence of the archaeological site formation processes noted at *Excelsior*.

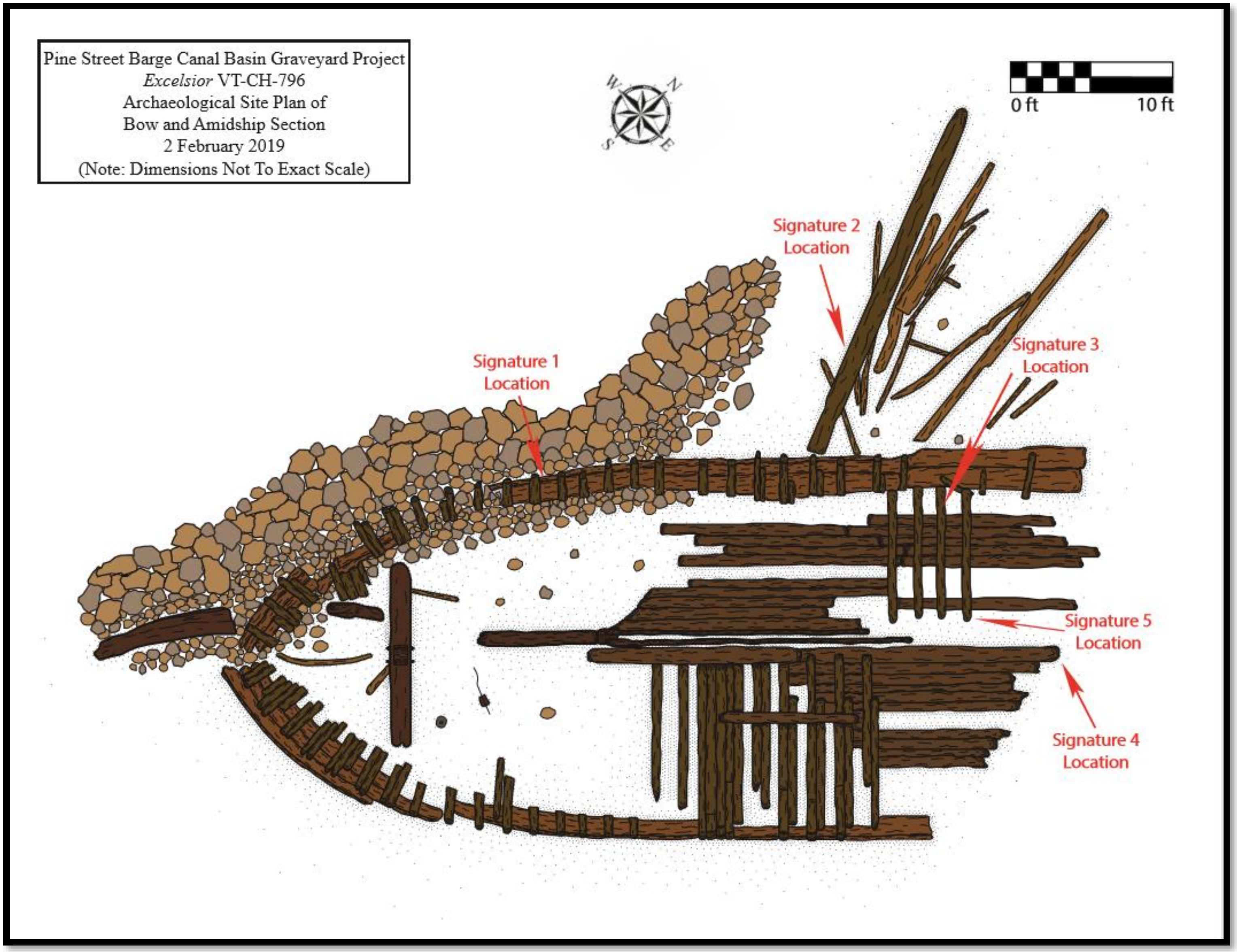


FIGURE 6.3. Archaeology Site Plan of *Excelsior's* Bow and Amidships Section (Image by Author).

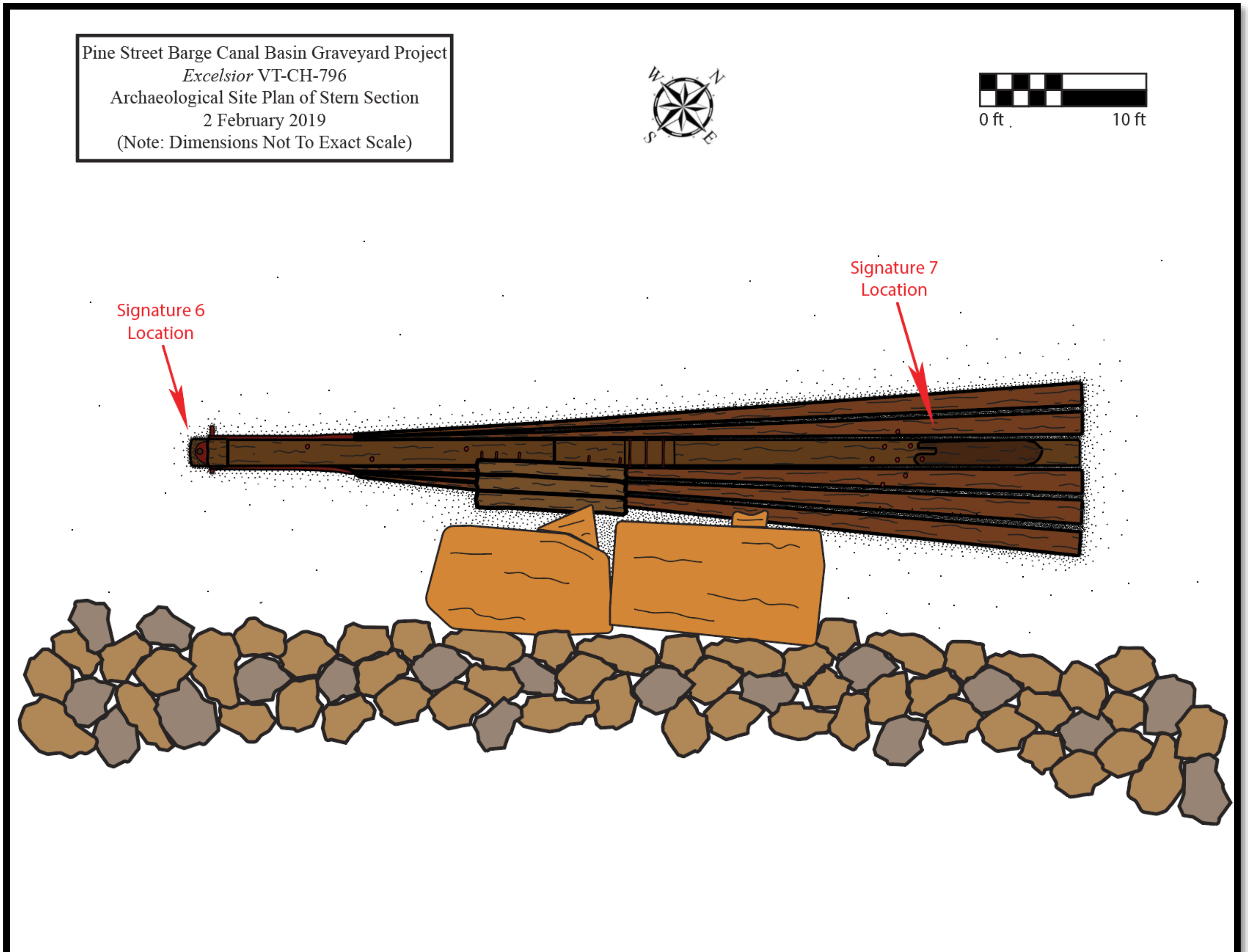


FIGURE 6.4. Archaeology Site Plan of *Excelsior's* Stern Section (Image by Author).

Catalog of Excelsior's *Cultural and Non-Cultural Formation Signatures*

The main site formation process *Excelsior* underwent in the *post-depositional* context is termed discard. Discard is the process where an artifact can longer retain its function and if reuse does not happen, then the artifact is transformed to the archaeological context (Schiffer 1987:47). More specifically, the process of abandonment can ascribe how the vessel is transformed to the archaeological record through *post-depositional salvage* behaviors along with their related signatures (Schiffer 1987:47, 103-105; Richards 2008:145-162). Given that much of the structure of the vessel is missing, *secondary salvage* must have occurred to remove timbers. Evidence of this includes heavily bent bolts, damaged timbers, and separated and missing architectural elements (Richards 2008:155-156). The process is related to *curate behavior*, which was described in the previous chapter (Schiffer 1987:90).

Because most of the architectural elements are absent from *Excelsior* and extant remains are below the turn of the bilge, the vessel has most likely undergone *secondary salvage*. The processes of reducing a vessel down to its smallest size systematically are also referred to as *structural minimization* or *hull reduction* (Richards 2008:147-148). This can only be done by physical breaking the vessel into disarticulated components. Heavily bent ferrous fasteners, cut timbers, absent architectural features, and general damage provide signatures of *secondary salvage* processes. Salvagers would have cut the vessel down to such a degree that it would no longer be in floating condition. The site also appears to have experienced disturbance processes related to obstruction removal and earthmoving processes connected to nearby construction activities (Schiffer 1987:121-122). The disturbance processes of obstruction removal are linked to the removal of spars from 1885 as mentioned in *The Burlington Free Press* (1885:4). As a signature of discard, it is related to *harm minimalization*, where the structure of the abandoned vessel is reduced to its most minimal form. Earthmoving disturbance processes related to the removal of a section of the northern breakwater in the early 1960s may have led to the breakup of *Excelsior's* remains (Kane et al. 2008:89).

Along with the cultural formation processes, non-cultural transformation processes are ongoing at the site. Processes related to *biological agents* of deterioration as evident by the damage caused by zebra mussel colonies (Schiffer 1987:149; Watzin et al. 2001). Another non-cultural transformation process includes *pedoturbation*, where many of the vessel parts are buried in sediment (Schiffer 1987:206). Given the degree of salvage and the amount of mud and soil on the site, it is unclear exactly how much of the ship is buried. There is evidence of *floralturbation* with the growth of milfoil and grasses, which does not appear to affect the archaeological remains. This data and the locations of observed site formation signatures recorded from *Excelsior* is explained below in Table 6.1.

Table 6.1. Site formation Signatures recorded from *Excelsior* (VT-CH-796).

Section of Vessel	Signature Location Number	Type of Site Formation Signatures	Transformation Processes
Starboard, Bow to Amidships	1	Cut Bottom Planking, Floor Frames, and Frames, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary Salvage*, *Pedoturbation*, *Biological Agent*.
Starboard, Bow to Amidships	2	Disarticulated and Torn Masts, Cut Bottom Planking and Frames, Disarticulated Hull Planking, Damage from Zebra Mussels, Burial in Sediment.	*Secondary Salvage*, *Pedoturbation*, *Biological Agent*, *Floralturbation*.
Starboard, Bow to Amidships	3	Damaged Floor Frames, Bent Fasteners, Cut Hull Planking, Damage from Zebra Mussels, Burial in Sediment, Milfoil Growth.	*Secondary Salvage*, *Pedoturbation*, *Biological Agent*, *Floralturbation*.
Amidships	4	Bent Fasteners, Damage from Zebra Mussels, Burial in Sediment, Milfoil Growth.	*Secondary Salvage*, *Pedoturbation*, *Biological Agent*, *Floralturbation*.
Amidships	5	Damaged Floor Frames, Damage from Zebra Mussels, Burial in Sediment, Milfoil Growth.	*Secondary Salvage*, *Pedoturbation*, *Biological Agent*, *Floralturbation*.
Stern to Amidships	6	Missing Rudder and Pintles, Damaged Sacrificial Keel, Redeposition of Remains, Burial in Sediment.	*Secondary Salvage*, Disturbance, *Pedoturbation*.
Stern to Amidships	7	Damaged Sacrificial Keel, Redeposition of Remains, Milfoil Growth, Burial in Sediment.	*Secondary Salvage*, Disturbance, *Biological Agent Pedoturbation*.

The table is divided into four columns with the locations of each signature documented on the archaeological remains. Each column is labeled, with the sections of the vessel listed in the first column. The signature location number constitutes the second column while the third column provides a review of the type of site formation signatures. The fourth column presents information on the individual transformation processes from both cultural and non-cultural transformation processes.

Photographs in Figures 6.5 through 6.11 illustrate representative examples of the site formation signatures marked on the archaeological site plans in Figures 6.2 and 6.3. Figure 6.5 shows the first site formation signature location on the starboard bow to amidships of the vessel remains. Examples of *secondary salvage* are demonstrated by torn and cut floor frames, frames, and damaged bottom planking. Examples of damage from biological agents like zebra mussels are evident by scars and pitting on the wood. Figure 6.6 depicts similar signatures at the second location with two torn and disarticulated masts, with one buried under the starboard hull and the other resting nearly perpendicular on top. Sediment and rocks from the northern breakwater wall bury the remains. Milfoil growth is also present.

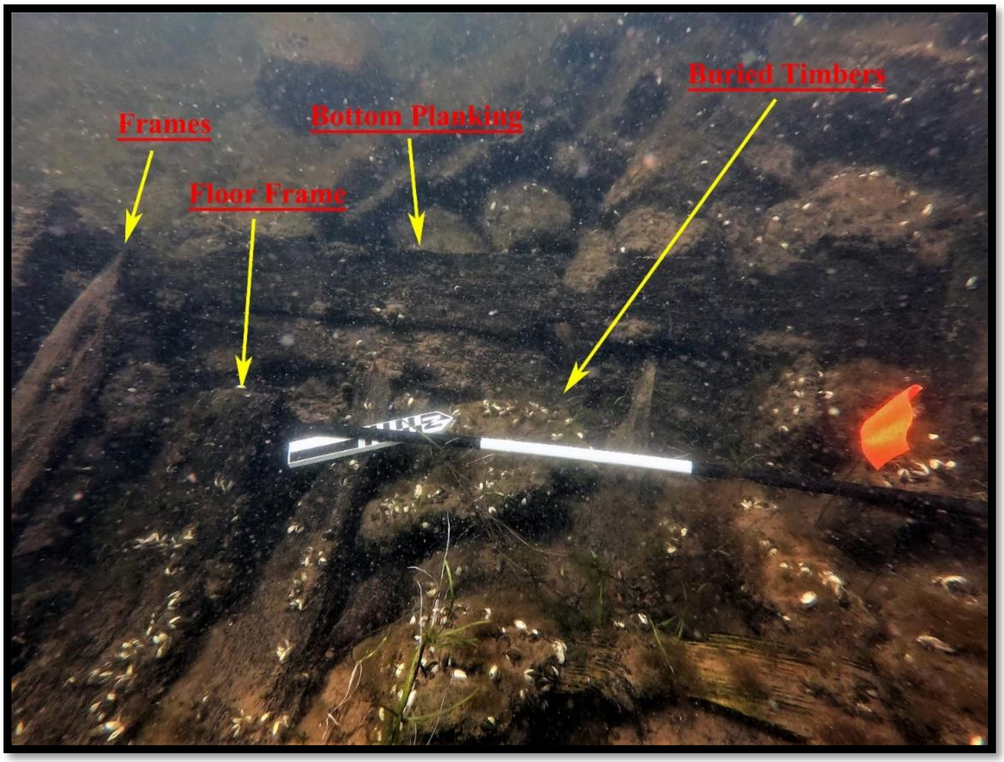


FIGURE 6.5. Site formation signature location 1, photo GOPR2160 (Photo by author, 8 July 2018).

Figure 6.7 shows site formation signature location three amidships near the starboard side of the vessel. The floor frames exhibit damage on the ends near the remains of the hull planking. Ferrous bolts on top of the frames are damaged and contorted in a downward orientation facing north. The hull planking is torn and cut as well with remnants jutting just above the floor frames. Pitting on the ferrous fasteners and scarring on the wooden timbers is evident from zebra mussels. Sediment minimally covers the exposed remnant timbers.

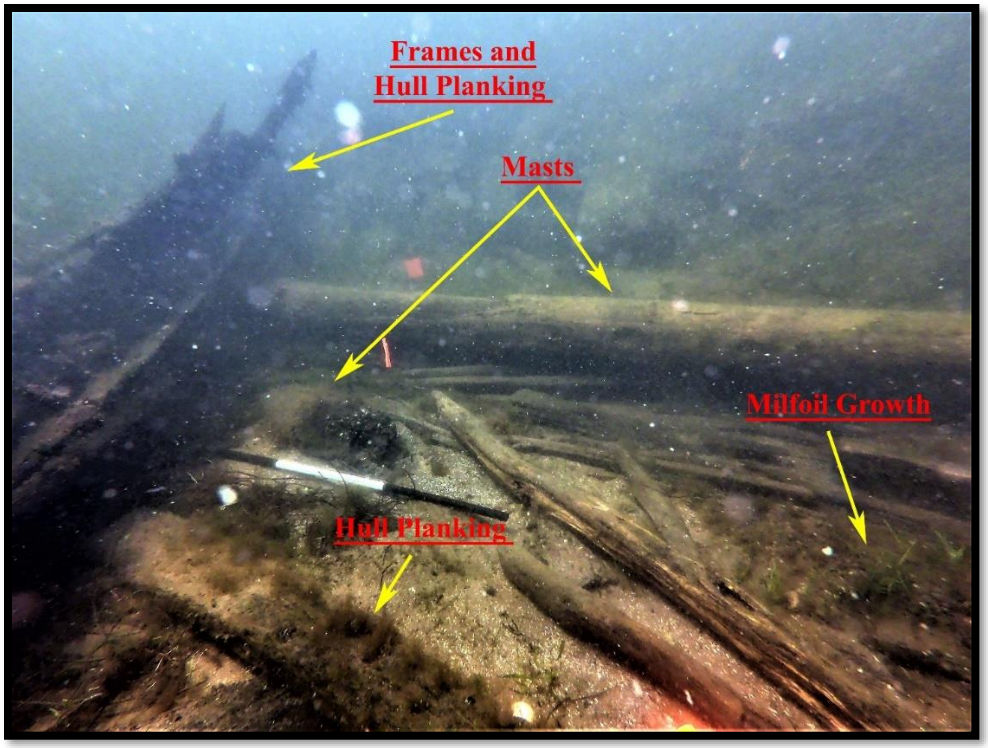


FIGURE 6.6. Site formation signature location 2, photo GOPR2142 (Photo by author, 8 July 2018).

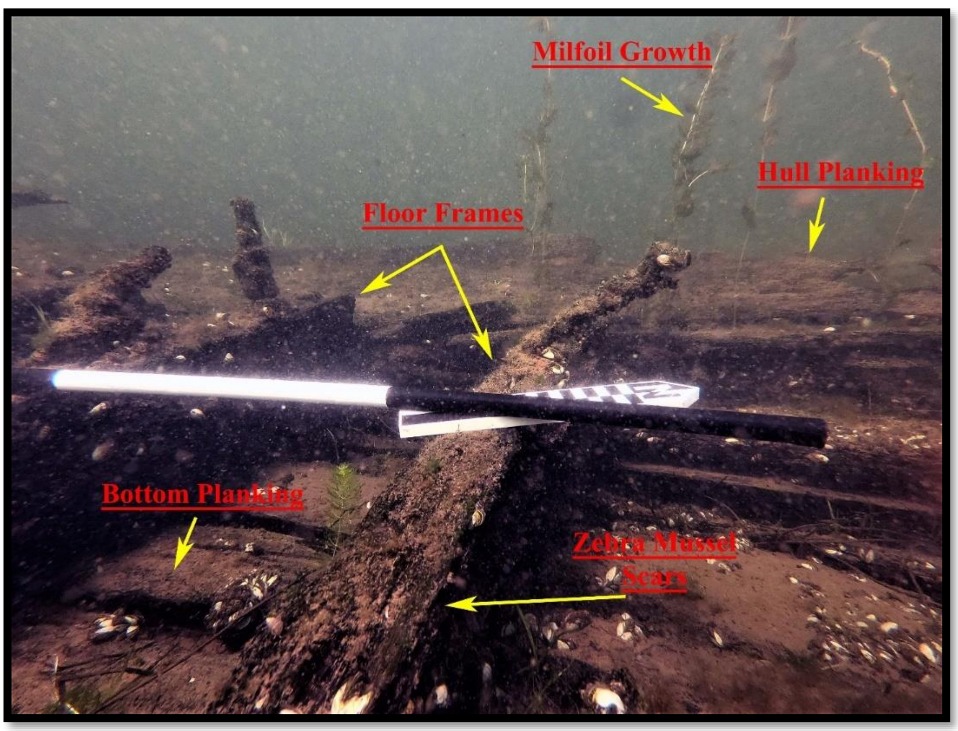


FIGURE 6.7. Site formation signature location 3, photo GOPR2146. (Photo by author, 8 July 2018).

Figure 6.8 depicts site formation signature location four in the center of the vessel amidships aft of the bow. Several bent ferrous bolts are present on top of a floor frame and are twisted in a downward northern orientation. The ferrous fasteners are heavily pitted and damaged from zebra mussel colonies. Much of the remnant timbers are buried in mud and sediment making it difficult to ascertain the presence of other architectural features. Milfoil growth covers much of the area.

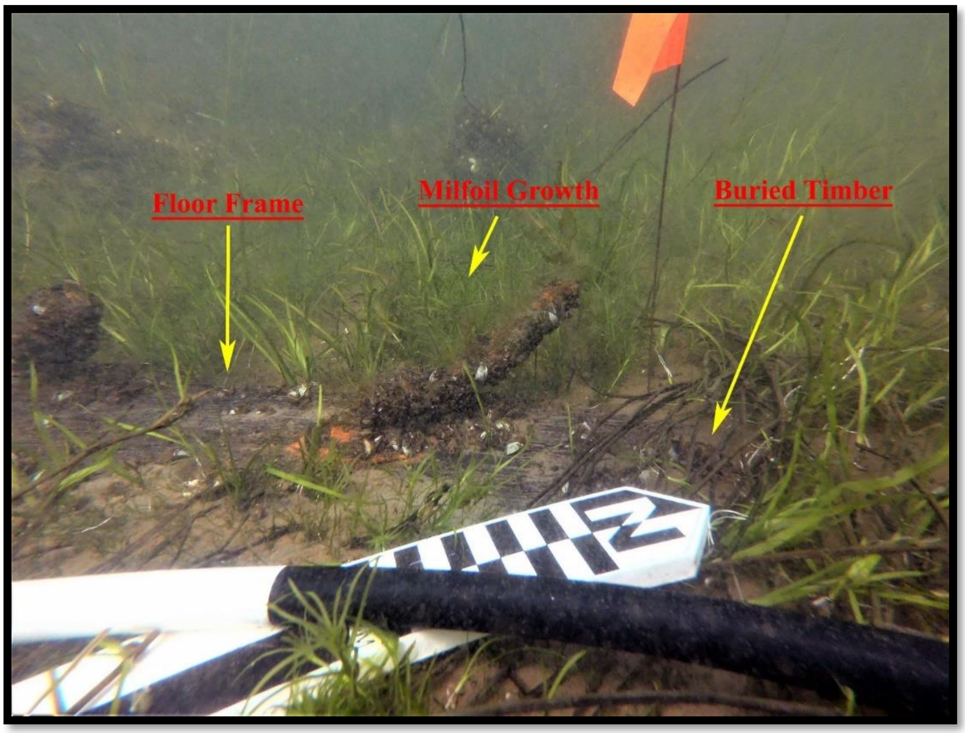


FIGURE 6.8. Site formation signature location 4, photo GOPR2157 (Photo by author, 8 July 2018).

Figure 6.9 portrays site formation signature location five amidships on the starboard side of the vessel. The end of the visible floor frame is damaged, potentially torn from the vessel. Bottom planking is also present, but much of it is buried under mud and sediment. Scars and pitting on the wooden features depict damage from zebra mussels. Milfoil growth in the area is dense. Figure 6.10 shows site formation signature location six located on the end of the stern of the redeposited bisected section of *Excelsior* on the northern half of the breakwater wall.

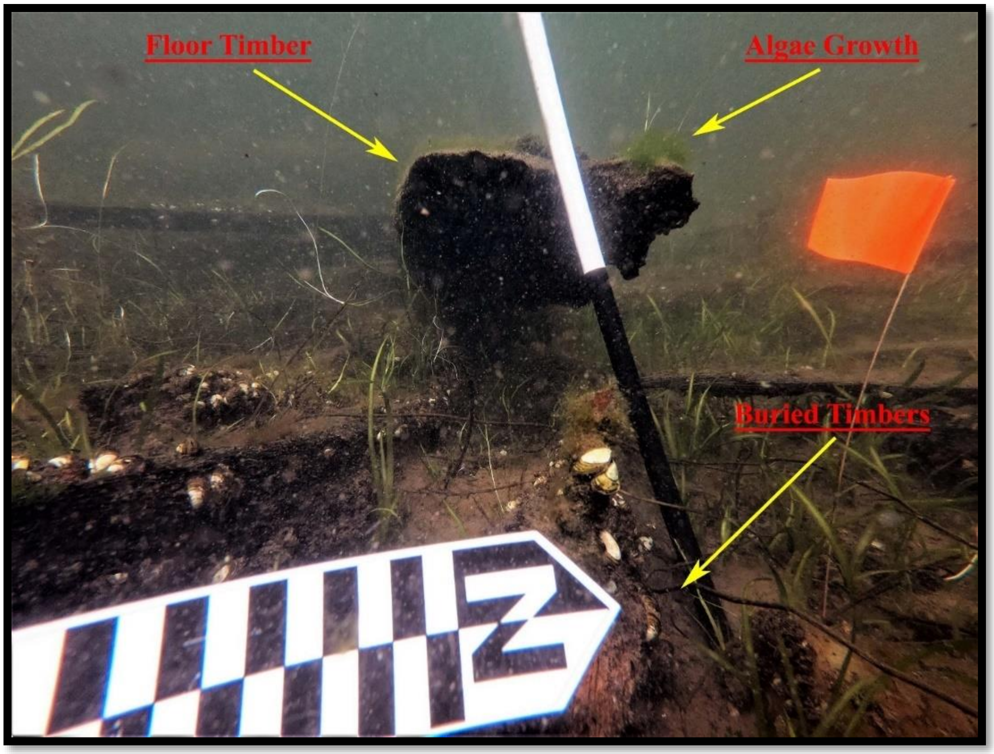


FIGURE 6.9. Site formation signature location 5, photo GOPR2164 (Photo by author, 8 July 2018).

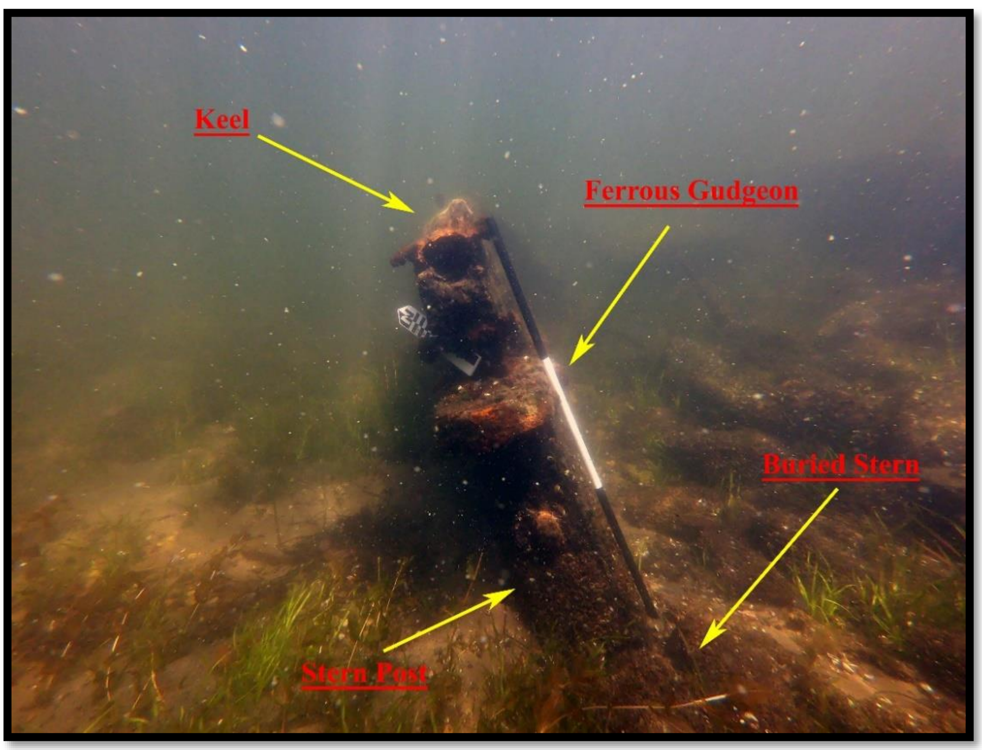


FIGURE 6.10. Site formation signature location 6, photo GOPR4535 (Photo by author, 8 July 2018).

The rudder is not present along with the pintles, or braces used to affix the rudder to the gudgeons. The stern post, ferrous gudgeon, and keel are at a westerly angle and buried with the rest of the extant features.

Figure 6.11 exhibits the last site formation signature location seven located on the end of the stern of the redeposited bisected part of the vessel remains. The rudder is absent along with the pintles. The keel extends forward with the remains of two garboard strakes. The top of the keel depicts damage with split remains of the sacrificial keelson and several broken ferrous bolts. A significant portion of the vessel is buried. It is unknown exactly how much more of the vessels exists.

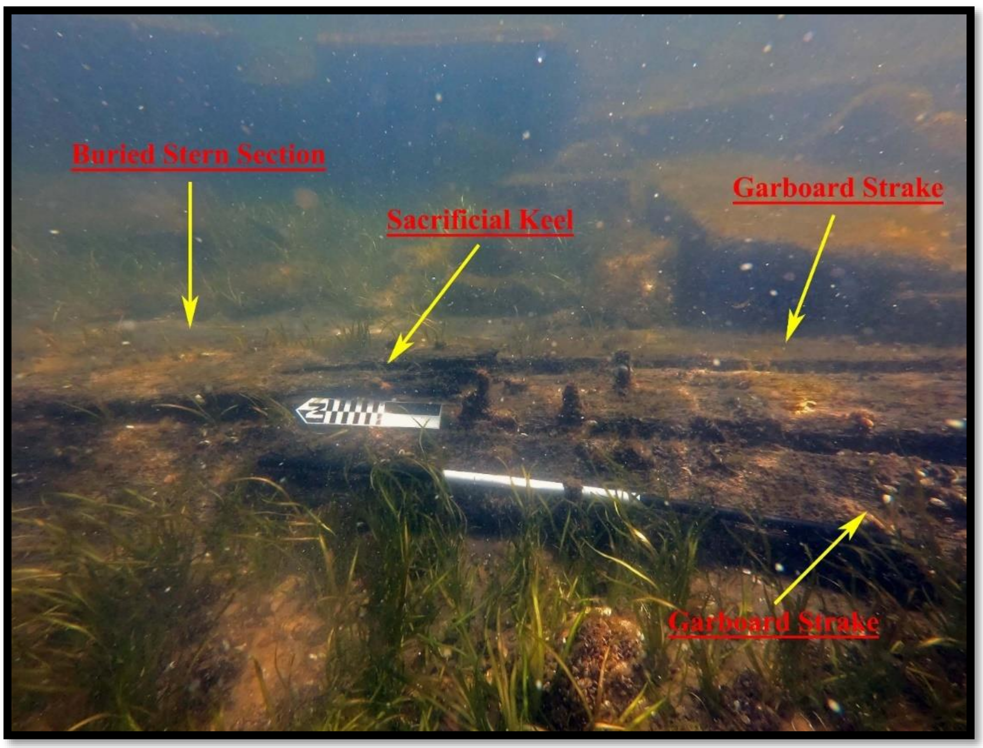


FIGURE 6.11. Site formation signature location 7, photo GOPR4538 (Photo by author, 8 July 2018).

Discerning Patterns from *Excelsior's* Archaeological Remains

In a review of the archaeological remains of *Excelsior*, the architectural features present consist of the material located below the turn of the bilge. Floor frames, frames, stem, and the fore mast step are present in most of the bow to amidships sections of the vessel. Bottom planking along with some hull planking is most evident on the starboard side of the vessel. The remains of ferrous nails and bolts located along the top of the floor frames are present. What appears to be the remains of masts are extant. The disarticulated stern section of *Excelsior* consists of the stern post, the gudgeon for the rudder, garboard strakes, the keel, and some of the sacrificial keel.

The absent architectural features are the top section of the keel, the keelson, centerboard, center board trunk, aft mast step, apron, and stemson. Other parts include the wing transom, filling transoms, inner post, sternson, and ceiling planking. Most of the upper hull planking above the turn of the bilge is gone with other upper works such as the deck beams, deck beam stanchions, hanging knees, shelf, and clamp. Decking, features related to the cabin, wheelhouse, hatch comings, wales, topside planking, top timbers, sheerstrake, planksheer, main rail, and bulwark stanchions and planks are gone.

From the archaeological remains, one pattern discerned is that most of the extant material is related to the very bottom of the vessel. When *Excelsior* underwent *secondary salvage*, the entire ship was dismantled down to the waterline. This would have made it difficult for salvors to access heavier timbers like the floors and frames given that the vessel would no longer be in floating condition. The most distinctive feature of the vessel is the orientation of the two halves, where the bow and upside-down stern section face southwest and are located on both the inside and outside of the northern breakwater wall. This orientation is most likely due to the broken stern section being positioned 180º degrees when the entrance to the inner basin was cleared. The use of a derrick crane to do this is a plausible explanation or another similarly classed equipment with the capability of lifting submerged ship wreckage.

Archaeology of *Hildegarde*

Hildegarde is mentioned in *Phase I Archaeological Survey of Burlington Harbor* contract report from the Lake Champlain Maritime Museum (Kane et al. 2008:92-93). Located at the southern entrance to the Pine Street Barge Canal, the vessel was identified during a Phase I archaeological study of the area in 1991. The remains of *Hildegarde* are closest to the southern breakwater arm. The remains of a ferrous propeller are mentioned as well. No other known archaeological work was done on this vessel except for historical research conducted by Arthur Cohn in 1984.

Archaeological work done in July 2018 found much of the vessel remains in poor condition. Marked in Figure 6.1, it is located on the north side of the southern breakwater arm where the breakwater slants at a northern angle. The remains of *Hildegarde* are oriented with the stern section facing west and the portside remains face east. The unknown timber assemblage is just off the breakwater foundation wall, lying parallel to the portside remains in a west and east orientation. All extant remains are in a severe state of decay. Much more of the vessel may be buried underneath the sediment.

To gain a better understanding of *Hildegarde* in its immediate post-abandonment context, a representative model of the vessel is depicted in Figure 6.12. The model is annotated with features remaining after the vessel underwent *secondary salvage* processes. The architectural features include the keel, keelson, sister and rider keelsons, floor frames, frames, and bottom planking. Other elements include the stem, apron, stemson, bow cant timbers, the propeller post, stern tube, and stuffing box, the stuffing box bulkhead, propeller, propeller hub, screw aperture, stern post, stern frames, and hull planking.

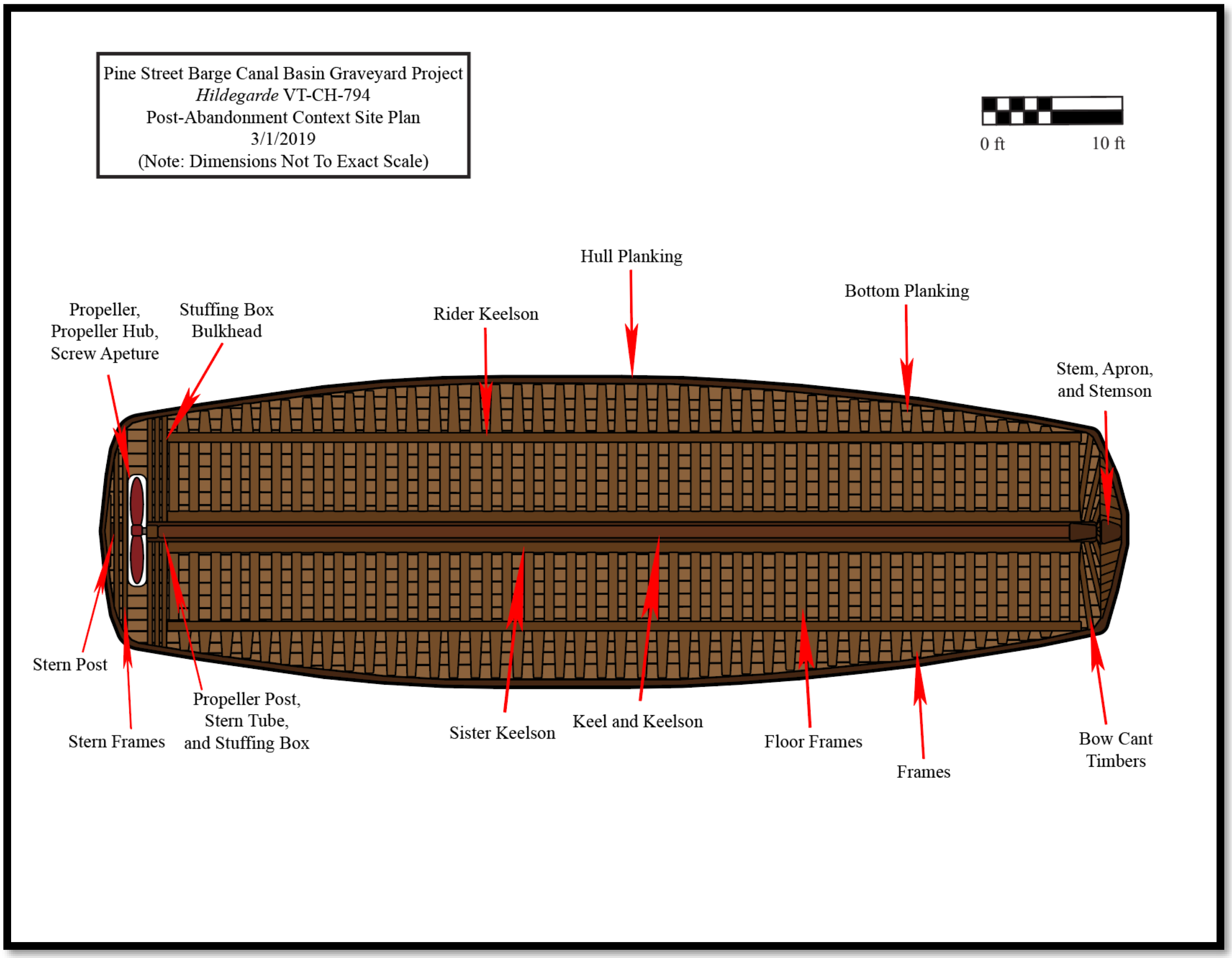


FIGURE 6.12. Model of *Hildegarde* immediate Post-Abandonment (Image by Author).

Figure 6.13 shows the present-day archaeological site plan of *Hildegarde* with site formation signature locations. The remains of the iron rudder post assemblage, a large ferrous propeller, the stuffing box for the propeller shaft, the sternpost, and a steel pipe are also present. The extant assemblage also lies at an angle southwest over 10 feet (3.04 meters) away from the portside remains. Additionally, a very large intact wooden element with ferrous framing elements lies south of the portside remains near the southern breakwater pier foundations.

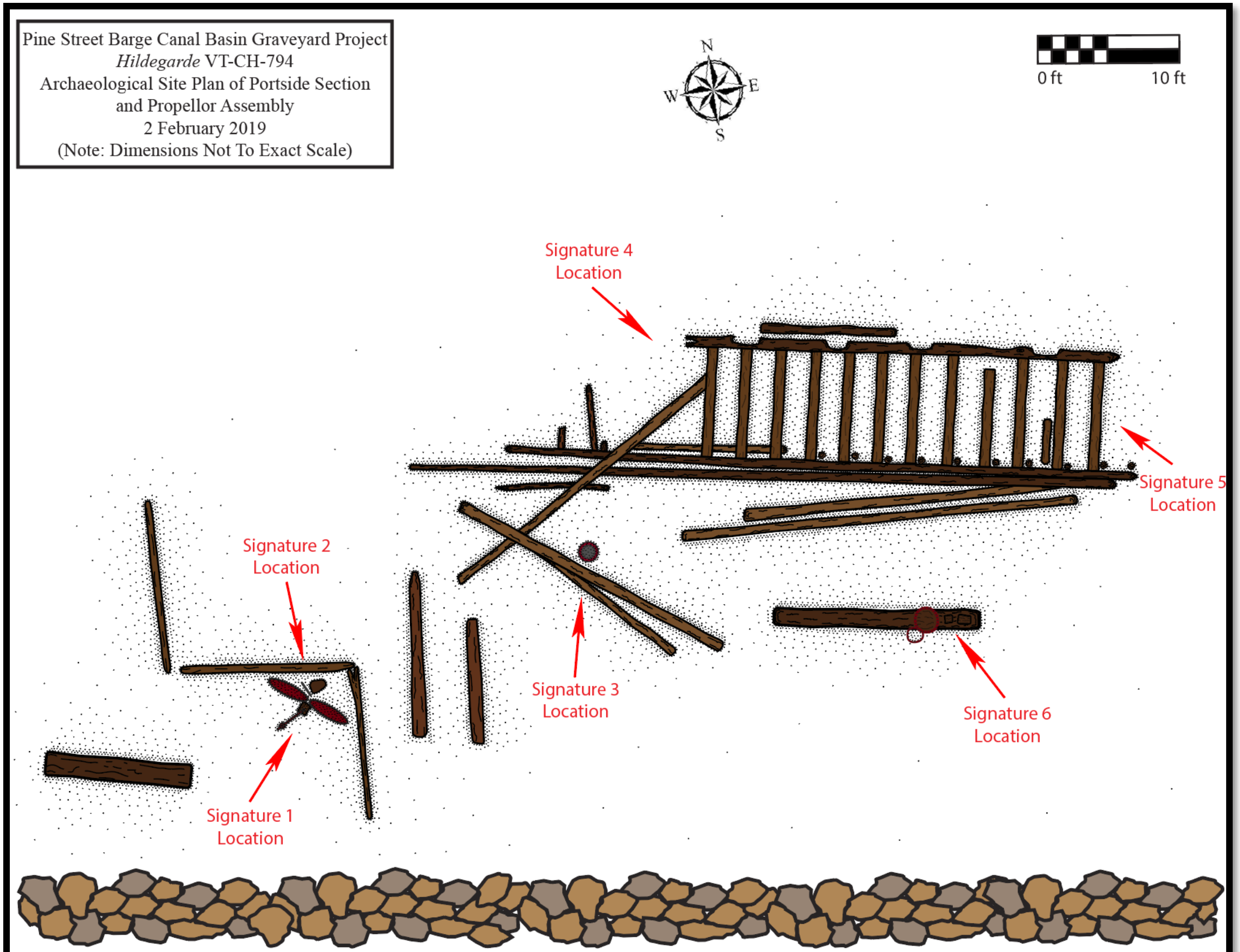


FIGURE 6.13. Archaeology Site Plan of *Hildegarde* (Image by Author).

A very large contorted ferrous ring-shaped part lies just on top of the remains with the bottom section of the entire wooden structure buried. It is unclear if this is associated with *Hildegarde*.

Catalog of *Hildegarde's* Cultural and Non-Cultural Formation Signatures

Because most of the architectural elements are missing on *Hildegarde* and the extant remains are below the turn of the bilge, the vessel appears to have undergone extensive *secondary salvage*. *Structural minimization* processes reduced much of the vessel down to its bottom-most parts. Since much of the vessel does not remain, it is likely that all accessible material was removed before the vessel lost its ability to float by itself. However, it should be stated that given the significant removal of material, it makes it harder to find evidence of *pre-depositional* salvage signatures on the present-day hull remains.

Any machinery associated with steam engine components is not present. It is likely that this material was removed while the vessel went through the *primary salvage* process. However, there is still a ferrous circular tube present in the starboard side of the vessel. Additionally, the ferrous propeller, rudder, stern post, and what appears to be a stuffing box for the propeller shaft are present. Given the location of the vessel remains at a depth of about 10 ft (3.04 m) and the remaining material was below the waterline of the vessel, it was probably too difficult for salvagers to access it.

Non-cultural site transformation processes continue to affect the site. The processes related to *biological agents* of deterioration are evident by the damage caused by zebra mussels. *Pedoturbation* processes of sedimentation buried most of the remnant structural features. Given the amount of mud and soil on the site, it is unclear exactly how much of the ship is buried. There is evidence of *floralturbation* with the growth of milfoil and grasses, which does not appear to affect the archaeological remains except to cover and obscure them. This data and the locations of observed site formation signatures recorded from *Hildegarde* is explained below in Table 6.2.

Table 6.2. Site formation signatures recorded from *Hildegarde* (VT-CH-794).

Section of Vessel	Signature Location Number	Type of Site Formation Signatures	Transformation Process
Stern	1	Broken Up Rudder, Propeller, and Propeller Post, Damage from Zebra Mussels, Buried Timbers in Sediment, Algae and Milfoil Growth.	*Secondary salvage*, Disturbance, *Pedoturbation*, *Biological Agent*, *Floralturbation.*
Stern	2	Cut Propeller Post, Damage from Zebra Mussels, Burial in Sediment, Algae and Milfoil Growth.	*Secondary salvage*, Disturbance, *Pedoturbation*, *Biological Agent*, *Floralturbation*.
Stern, Amidships	3	Unknown Ferrous Tube, Disarticulated Hull Planking, Damage from Zebra Mussels, Burial in Sediment, Algae and Milfoil Growth.	*Secondary salvage*, *Pedoturbation*, *Biological Agent*, *Floralturbation*.
Stern, Portside	4	Damaged Rider Keelson, Floor Frames, Unknown Timbers, Disarticulated Hull Planking, Damage from Zebra Mussels, Burial in Sediment, Algae and Milfoil Growth.	*Secondary salvage*, *Pedoturbation*, *Biological Agent*, *Floralturbation*.
Bow, Portside	5	Damaged Rider Keelson, Floor Frames, Unknown Timbers, Disarticulated Hull Planking, Damage from Zebra Mussels, Burial in Sediment, Algae and Milfoil Growth.	*Secondary salvage*, *Pedoturbation*, *Biological Agent*, *Floralturbation.*
Amidships	6	Damaged Unknown Timbers, Heavily Bent Ferrous Rings, Damage from Zebra Mussels, Burial in Sediment, Algae and Milfoil Growth.	*Secondary salvage*, *Pedoturbation*, *Biological Agent*, *Floralturbation.*

The first site formation signature location is portrayed in Figure 6.14, near the stern. The remains of the ferrous rudder post assemblage, a large ferrous propeller, the propeller post, the stuffing box for the propeller shaft, and a ferrous pipe are present. *Secondary salvage* processes are evident by the breakdown and separation of the stern elements. The extant assemblage lies at an angle southwest and over 10 feet (3.04 meters) away from the portside remains, suggesting disturbance processes related to salvage broke up the stern section. Examples of damage from *biological agents* such as zebra mussels are evident by scars and pitting on the wood and ferrous features. Significant algae and milfoil growth cover much of the area. *Pedoturbation* processes buried much of the remains in sediment and mud.

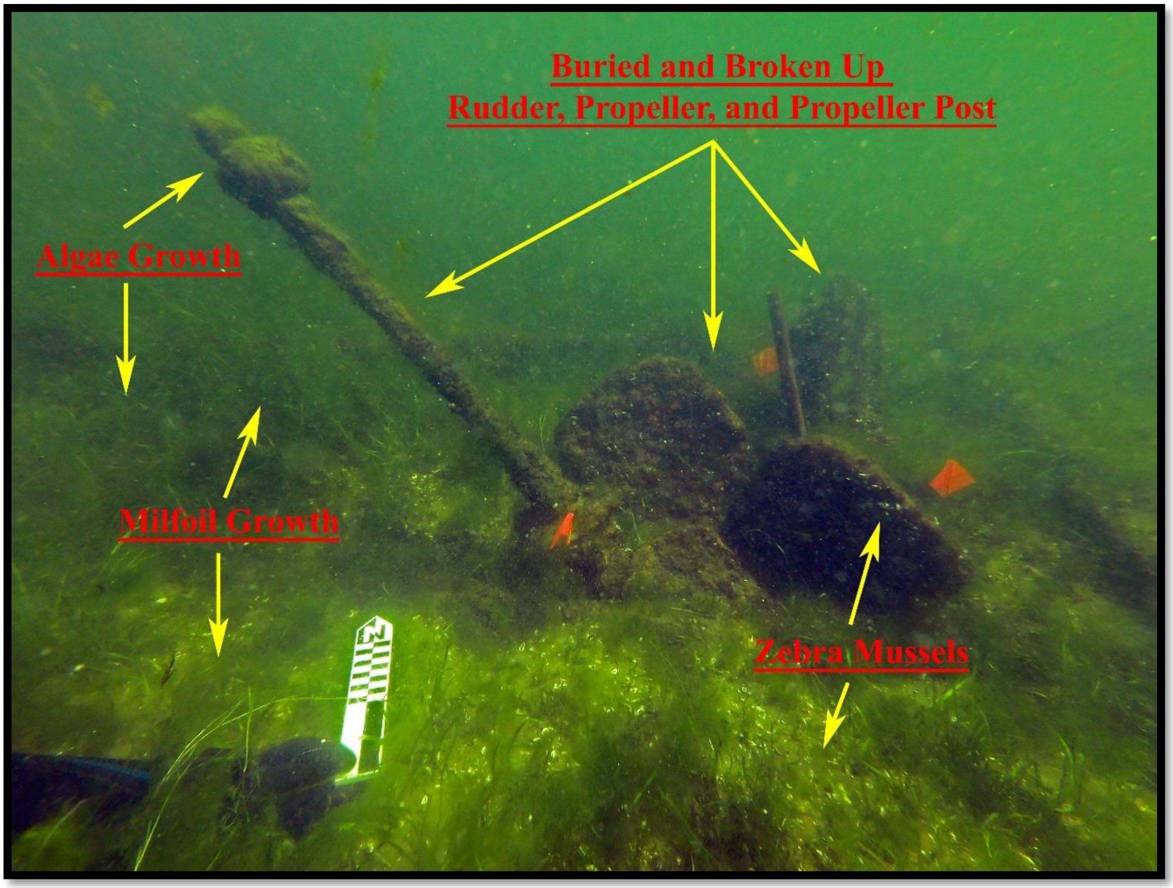


FIGURE 6.14. Site formation signature location 1, photo GOPR5469 (Photo by author, 18 July 2018).

Figure 6.15 shows the second site formation location and primarily illustrates the rudder post remains in Figure 6.14. The top section of the sternpost remains is heavily jagged and cut, with general deterioration and wear. Much of the bottom portion of the rudder post is buried along with the other associated remains. Evidence of natural transformation processes relating to *biological agents* of deterioration is evident pitting caused by zebra mussels. Much of the remains are buried in sediment, potentially covering other architectural features. Algae and milfoil growth are dense.

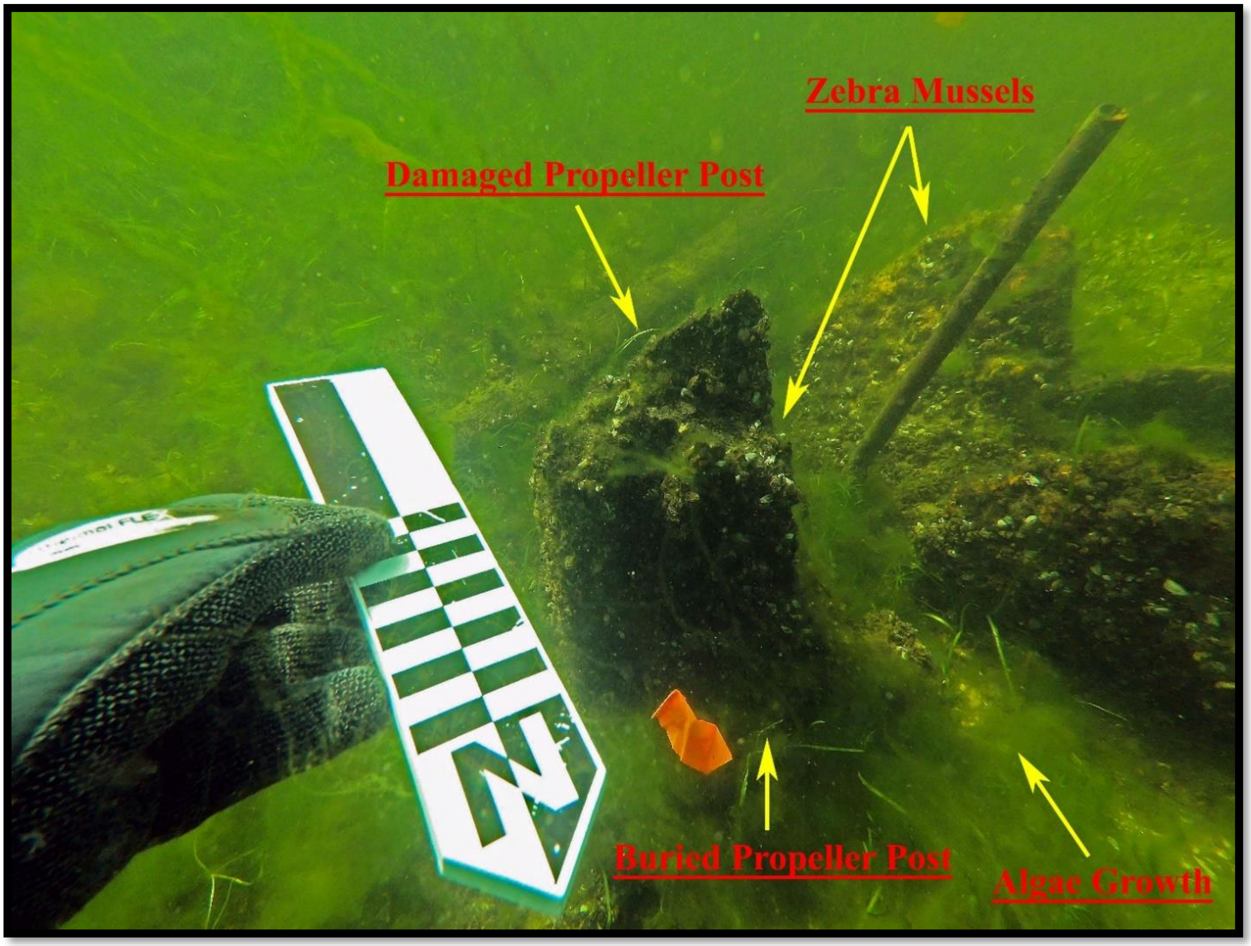


FIGURE 6.15. Site formation signature location 2, photo GOPR5479 (Photo by author, 18 July 2018).

Figure 6.16 displays site formation location three amidships of the stern. Disarticulated hull planking is scattered around the area with some timbers heaped on top of others. A large, ferrous tube was found sticking out of the sediment in an upright position in the rear portion of the disarticulated portside remains. It is unclear what the feature is, but it may be related to equipment for a steam engine. Several broken wooden timbers are scattered on the western and eastern side of the pipe. Pitting from zebra mussels is on the tube while the wooden timbers are heavily scarred.

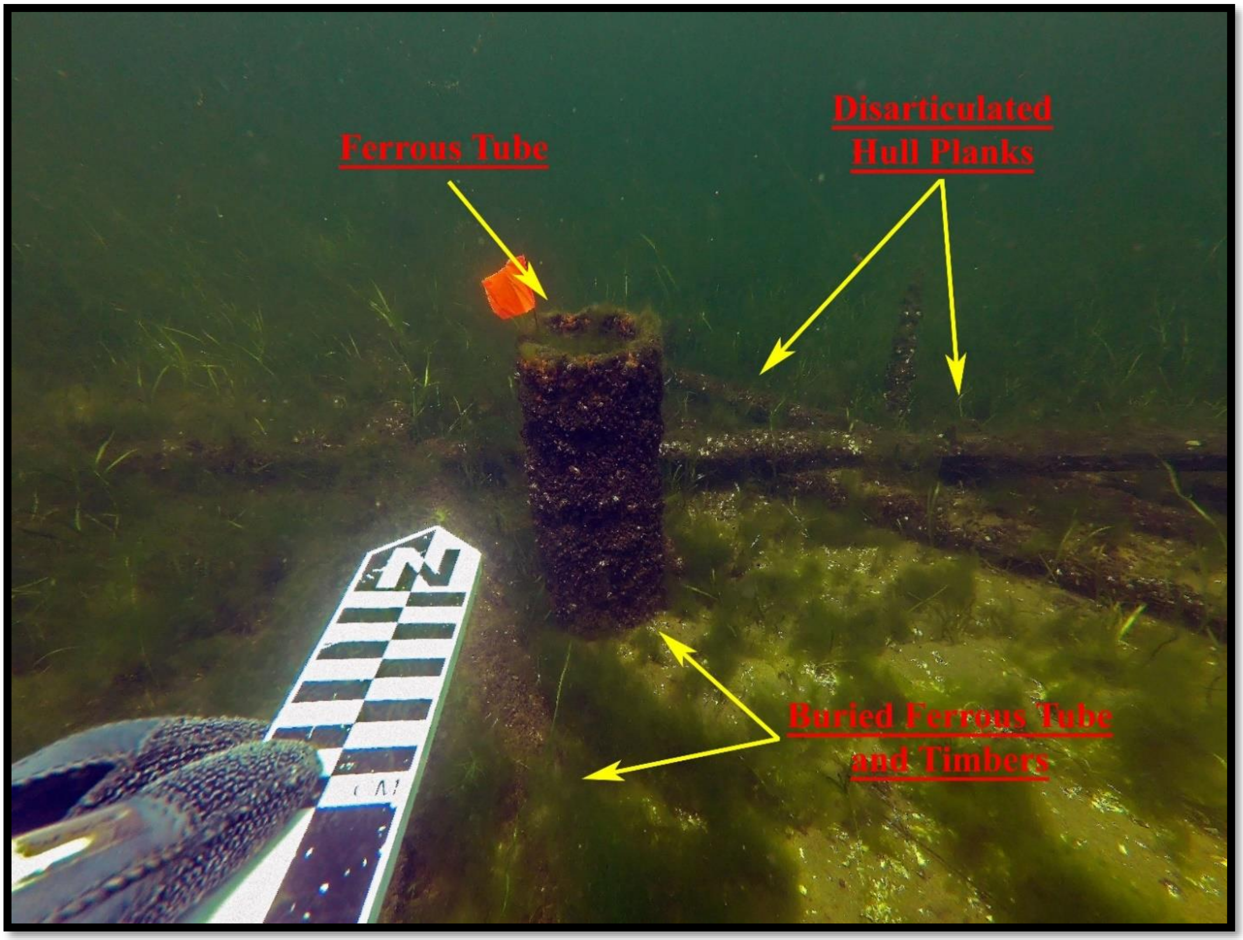


FIGURE 6.16. Site formation signature location 3, photo GOPR5499 (Photo by author, 18 July 2018).

Site formation signature location four is depicted in Figure 6.17. It portrays the portside and stern section with the remains of a rider keelson, floor frames, and hull planking. Amidships are heavier unknown timbers, possibly engine bedding timbers. Much of the bottom frames are still affixed to this timber assemblage and partially buried. Some damaged ferrous fasteners are still attached to various timbers Much of the surfaces of the wooden timbers are scoured and ripped with pitting from zebra mussels. The starboard side is either buried or non-existent.

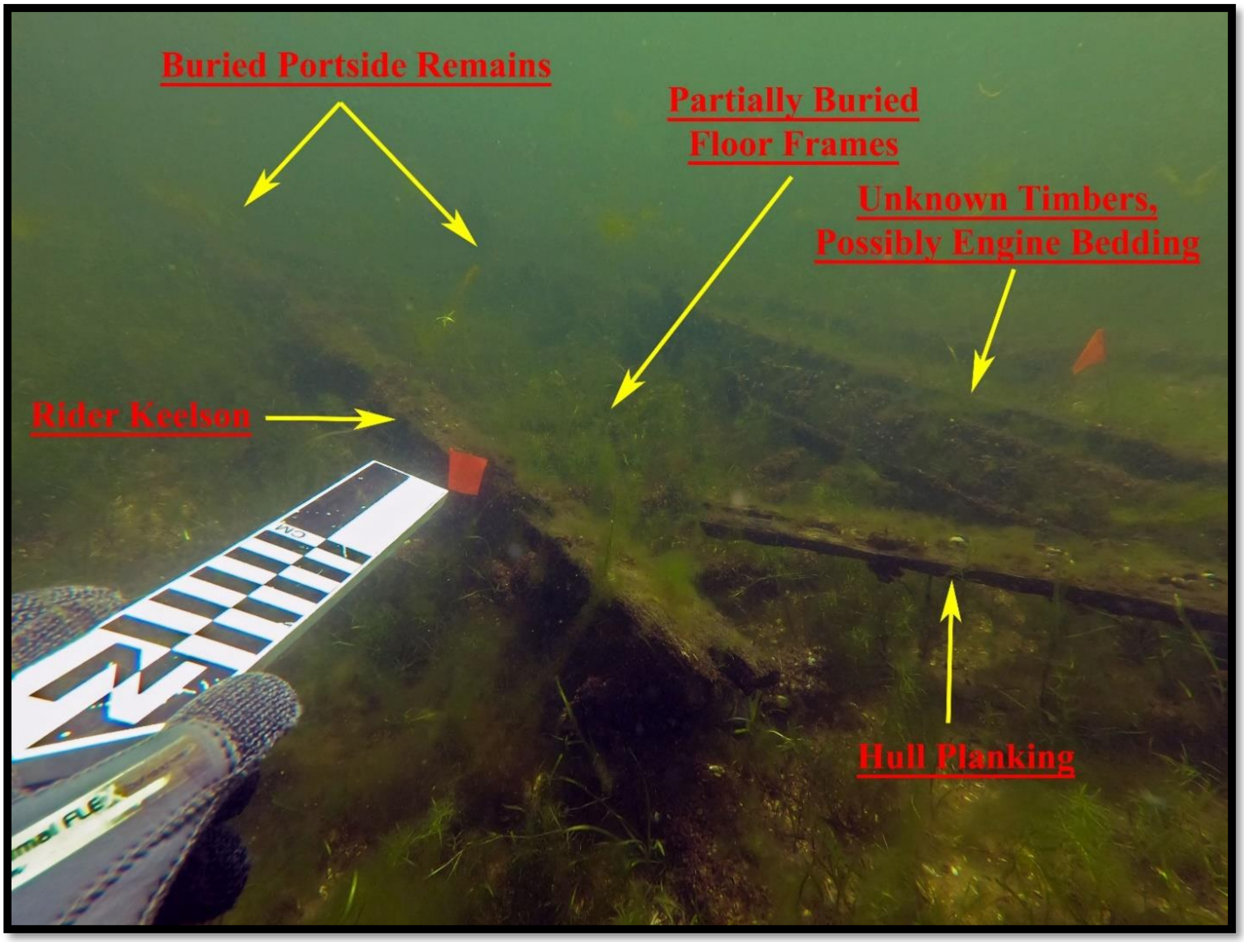


FIGURE 6.17. Site formation signature location 4, photo GOPR5503 (Photo by author, 18 July 2018).

Site formation signature location five is shown in Figure 6.18. Located on the port side toward the bow, it depicts another view of the remains discussed for Figure 6.17. A rider keelson, floor frames, hull planking, and unknown timbers are visible. Three other unknown timbers in the foreground abut the heavy unknown timber amidships. They may be the remains of deck stanchions, but it is difficult to confirm. A minimal amount of bent and damaged ferrous fasteners is present. Much of the surfaces of the wooden timbers are damaged and possible cut. Heavy concentrations of zebra mussels cover all the wooden elements while other parts are buried in sediment.

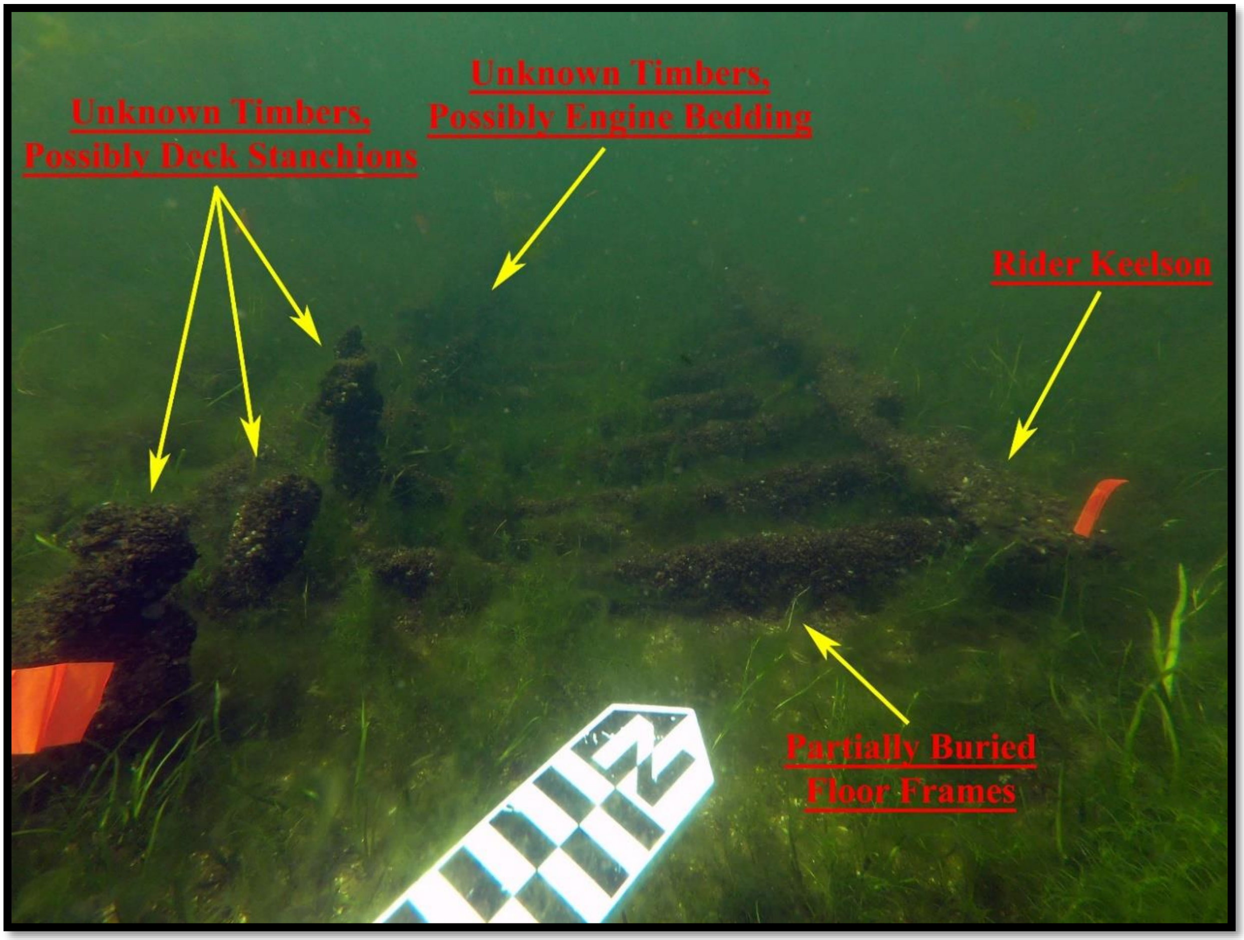


FIGURE 6.18. Site formation signature location 5, photo GOPR5512 (Photo by author, 18 July 2018).

The sixth site formation signature location is depicted in Figure 6.19. A very large intact wooden feature with ferrous parts lies south of the portside remains near the southern breakwater foundations. A large contorted ring-shaped ferrous part lies just on top of the remains with the bottom section of the structure buried. It is unclear if this is associated with *Hildegarde*. Physical forces related to salvage are evident by the damaged timber and bent ferrous ring. Natural transformation processes relating to *biological agents* of deterioration are evident by the zebra mussels, algae growth, and milfoil. An unknown amount of this feature is buried in sediment and debris.

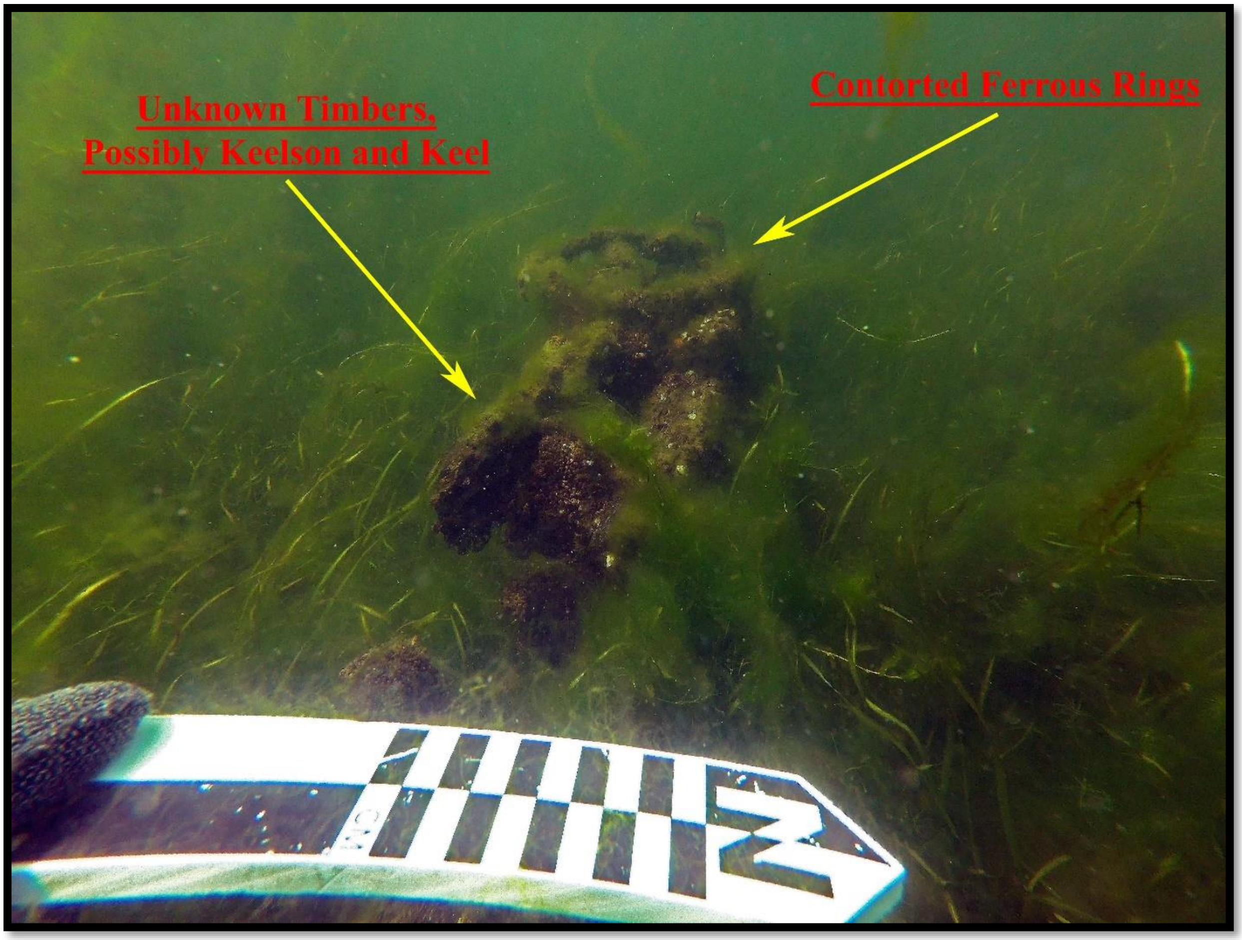


FIGURE 6.19. Site formation signature location 6, photo GOPR5526 (Photo by author, 18 July 2018).

Discerning Patterns from *Hildegarde's* Archaeological Remains

In a review of the archaeological remains of *Hildegarde*, architectural features present consist of the material located below the turn of the bilge. A ferrous rudder post, a large ferrous propeller, the propeller post, and the stuffing box for the propeller shaft are present near the stern section of the vessel. Other extant features on the port side of the vessel consist of floor frames, a rider keelson, possible engine bedding timbers, possible deck stanchions, and disarticulated hull planking. The ferrous tube may be associated with steam engine remains, but it is heavily buried. What is more interesting is the larger timber assemblage and contorted ferrous rings. While the feature appears to be a composite of several parts, sediment, milfoil, and algae make it difficult to identify.

The absent architectural features are the keel, the keelson, sister keelsons, starboard floor frames, frames, starboard rider keelson, bow cant timbers, stem, apron, and stemson. Other parts include the stern post, stern frames, screw aperture, stuffing box bulkhead, stern tube, and ceiling planking. Most of the upper hull planking above the turn of the bilge is gone with associated upper works such as the deck beams, deck beam stanchions, hanging knees, shelf, and clamp. Decking, features related to the wheelhouse, hatch comings, wales, topside planking, top timbers, sheerstrake, planksheer, main rail, and bulwark stanchions and planks are non-existent.

A pattern observed on *Hildegarde* is that most of the extant material is associated with the very bottom parts of the vessel. *Secondary salvage* processes cut the entire ship down to the waterline, making salvage of the larger timbers and material below the waterline problematic. However, the absence features like the starboard floors and support framing are suspect. A distinctive feature of the vessel is the remains of the propeller and the unknown ferrous tube. Given that both parts are substantial pieces of metal, it would be sensible for salvors to recover them from the vessel remains to be sold for scrap. Another distinctive feature is the orientation of the stern remains in relation to the extant portside structures. It is possible that given the greater depth of the water and the greater distance from shore than *Excelsior*, salvage was probably more difficult.

Archaeology of the Turner & Breivogel Barges

Previous archaeological work conducted on the three Turner & Breivogel barges is mentioned in *Phase I Archaeological Survey of Burlington Harbor* contract report from the Lake Champlain

Maritime Museum (Kane et al. 2008:89-92). The vessels are minimally documented, yet the survey reports that the three vessels are similar in construction and likely built at the same boatyard. Researchers mentioned that due to the shallow depth of the water, the three wooden construction barges were severely affected by ice and storms. The initial investigation found the remains consisted of a jumbled debris field of disarticulated sides, ends, decks, bottoms of hulls and miscellaneous deck hardware.

Figure 6.20 is a representative model of what each of the three barges would have looked like in their immediate post-abandonment context. The model is annotated with features that would remain after the vessel underwent *secondary salvage* processes.

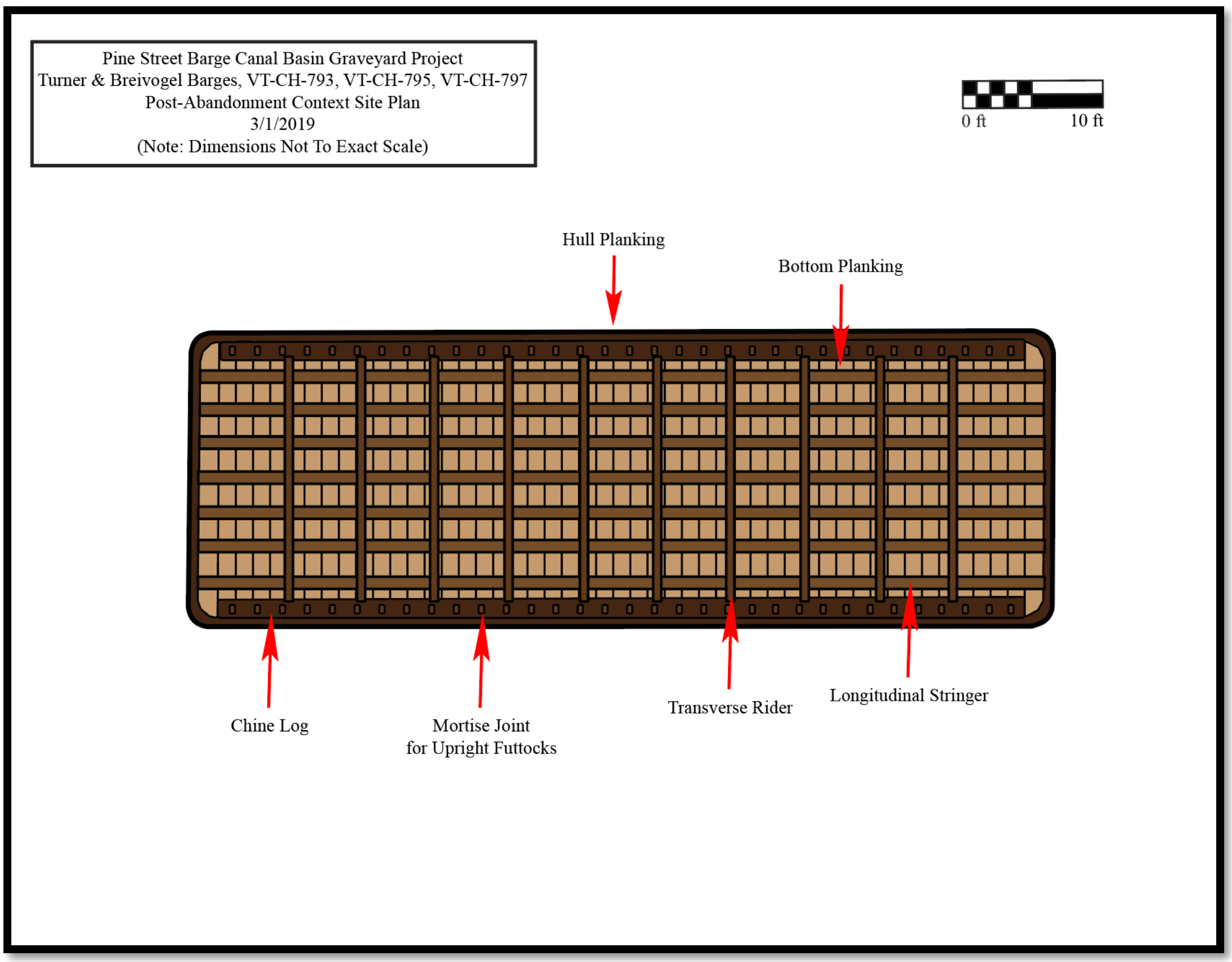


FIGURE 6.20. Model of Turner & Breivogel Barges Post-Abandonment (Image by Author).

The architectural features include the chine logs and mortise joints for the upright futtock or frames. Additionally, longitudinal stringers, transverse riders, bottom planking, and hull planking are highlighted. The model illustrates the structural features on the barges before they entered the archaeological context.

Fieldwork from July 2018 found all the barges in a poor state of preservation. The first Turner & Breivogel barge VT-CH-793 was surveyed and not much of the vessel remains. However, a substantial number of 7 longitudinal stringers and 4 riders are intact. Most of the bottom planking is extant and buried beneath the sediment. It is unclear which ends of the barge are the bow and stern. However, both ends are raked, flat on the bottom, and collapsed along with what appears to be side planking affixed on the western side. The barge lies parallel to the interior of the northern breakwater south of the remains of *Excelsior*. The archaeological site plans for Turner & Breivogel barges are represented in figure 6.21, 6.22, and 6.23.

Catalog of Cultural and Non-Cultural Formation Signatures on the Turner and Brievogel Barge VT-CH-793

Based on the observed patterns and differences, all three of the Turner & Breivogel barges underwent *secondary salvage*. *Structural minimization* is evident on all the vessel remains and each barge appears to have the bottom-most components present on each site. This included bottom planking, chine logs, longitudinal stringers, and transverse riders. There are remnant upright frames, hull planking, decking, ferrous bollards, ferrous fasteners, and other unknown timbers. Since upper structural parts like bollard and decking are present at the site, differentiating *pre-depositional* and *post-depositional* salvage processes is challenging.

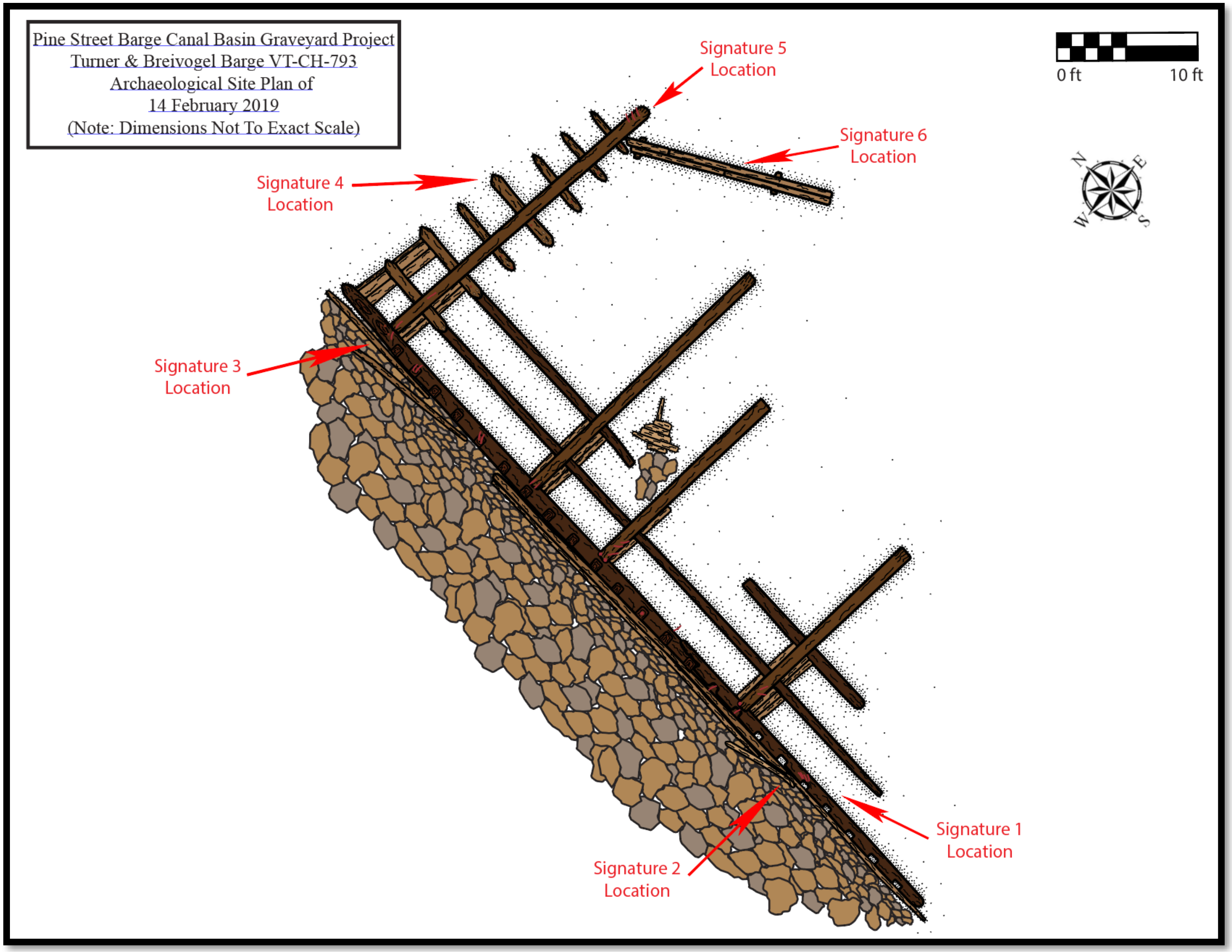


FIGURE 6.21. Archaeology Site Plan of Turner & Breivogel Barge VT-CH-793 (Image by Author).

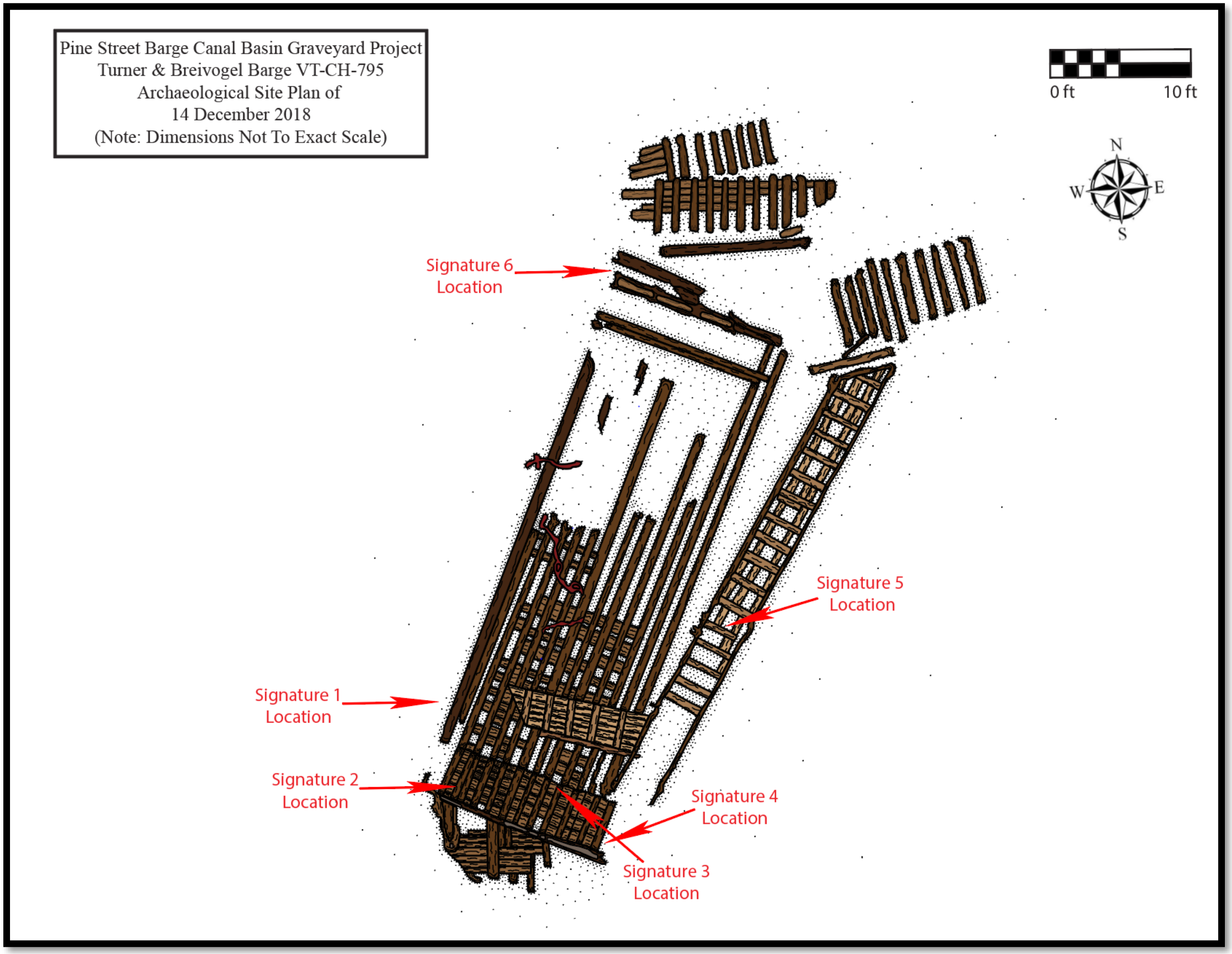


FIGURE 6.22. Archaeology Site Plan of Turner & Breivogel Barge VT-CH-795 (Image by Author).

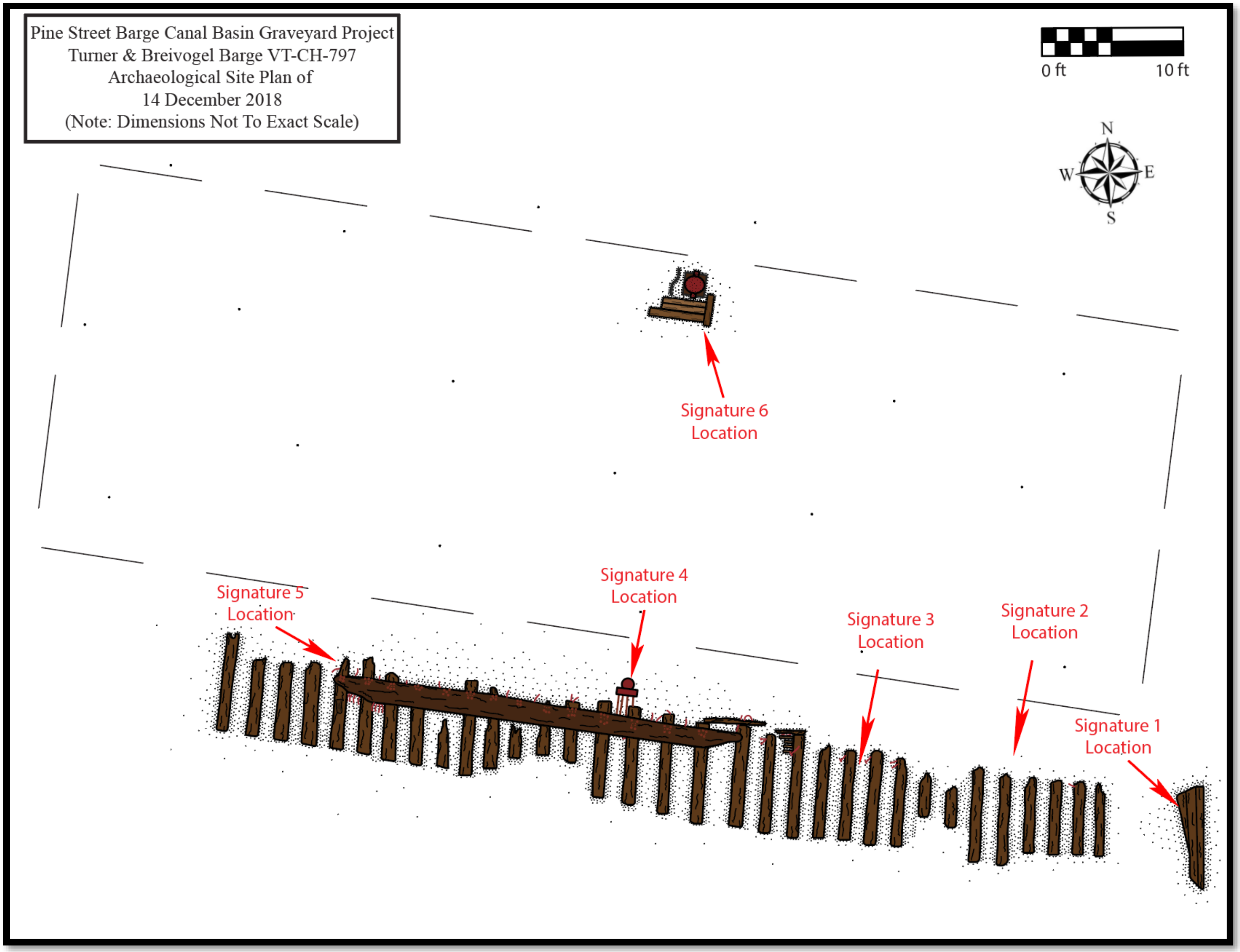


FIGURE 6.23. Archaeology Site Plan of Turner & Breivogel Barge VT-CH-797 (Image by Author).

It should also be noted that the vessels may have been left to breakdown without any *secondary salvage* processes.

Non-cultural transformation processes affect the site. The processes related to *biological agents* of deterioration as evident by the damage from zebra mussels. *Pedoturbation* processes of sedimentation buried most of the remnant structural features. *Floralturbation* is present with the growth of milfoil and grasses, which does not appear to affect the archaeological remains except to cover and obscure them. This data and the locations of observed site formation signatures recorded from is explained below in Table 6.3.

Table 6.3. Site formation signatures recorded from Turner & Breivogel Barge (VT-CH-793).

Section of Vessel	Signature Location Number	Type of Site Formation Signatures	Transformation Process
North on Southern Section	1	Disarticulated Hull Planking, Damaged Chine Log, Stringer, Bottom Planking, Bent Ferrous Bolts, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary salvage*, Biological Agent, *Pedoturbation.*
West on Southern Section	2	Disarticulated Hull Planking, Damaged Chine Log, Bent Ferrous Bolts, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary salvage*, *Biological Agent*, *Pedoturbation*.
East on Northern Section	3	Disarticulated Hull Planking, Damaged Chine Log, Rider, and Stringer, Bent Ferrous Bolts, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary salvage*, *Biological Agent*, *Pedoturbation*.
East on Northern Section	4	Damaged Stringer, Damage from Zebra Mussels, Buried Timbers in Sediment, Milfoil Growth.	*Secondary salvage*, *Biological Agent*, *Pedoturbation*, *Floralturbation*.
West on Northern Section	5	Disarticulated Hull Planking, Damaged Rider, and Stringer, Bent Ferrous Bolts, Damage from Zebra Mussels, Buried Timbers in Sediment, Milfoil Growth.	*Secondary salvage*, *Biological Agent*, *Pedoturbation*, *Floralturbation*.
West on Northern Section	6	Disarticulated Hull Planking, Damage from Zebra Mussels, Buried Timbers in Sediment, Milfoil and Algae Growth.	*Secondary salvage*, *Biological Agent*, *Pedoturbation*, *Floralturbation*.

The first site formation signature location is portrayed in Figure 6.24. Located on the northern section of the remains, the chine log is present along with a stringer, bottom planking, and disarticulated hull planking.

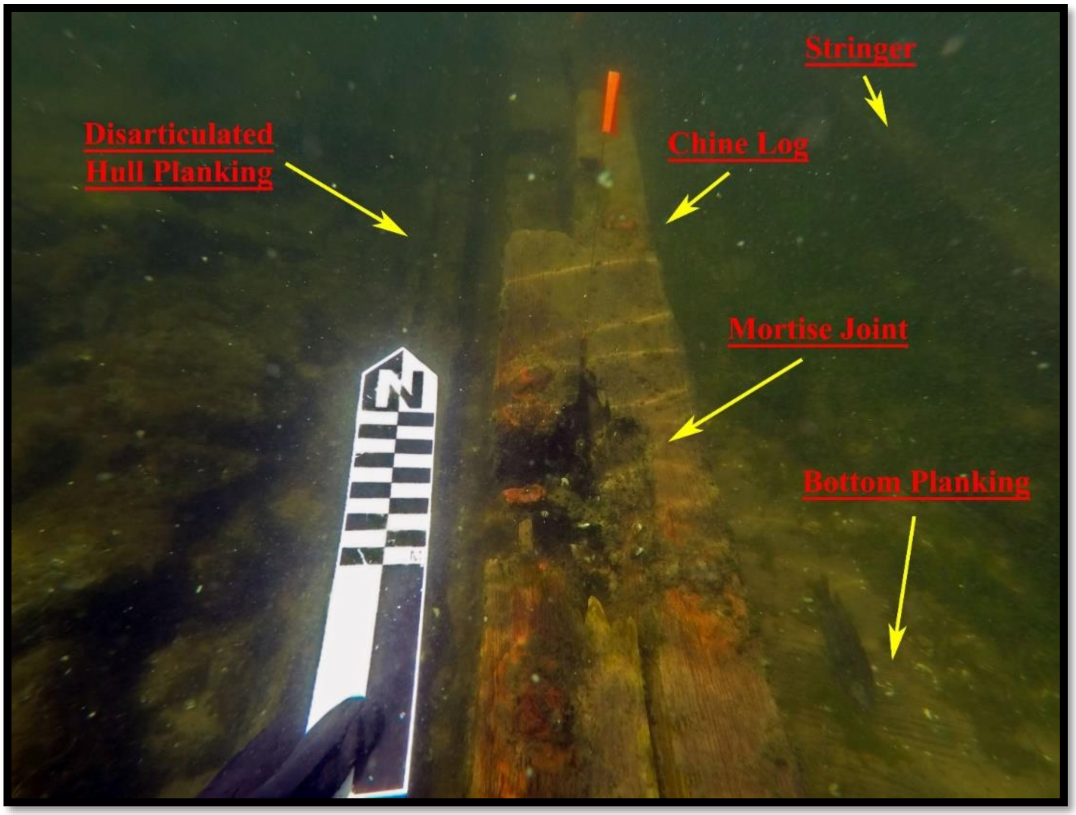


FIGURE 6.24. Site formation signature location 1, photo GOPR1115 (Photo by author, 13 July 2018).

Figure 6.25 depicts the second site formation signature location in the same area, but with more detail of damage to the chine log scarf joint and mortise. The cut-down hull planking and damaged chine log indicate *secondary salvage*. Examples of damage from *biological agents* like zebra mussels are evident by scars and pitting on the wood and ferrous features. *Pedoturbation* processes buried the timber remains in sediment and mud.

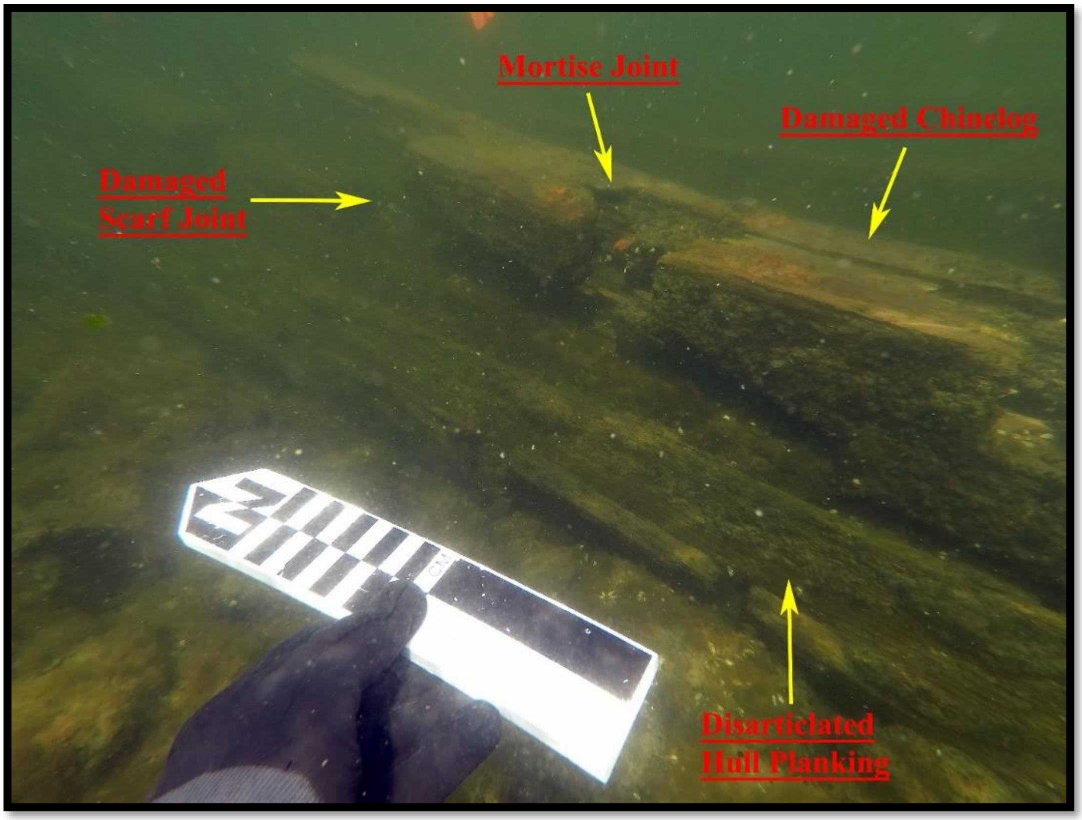


FIGURE 6.25. Site formation signature location 2, photo GOPR1118 (Photo by author, 13 July 2018).

Figure 6.26 shows the third site formation location on the northern section of the vessel remains. The hull planking is heavily cut up while the rider shows damage on the end of the timber. Bent and contorted ferrous bolts are on top of the chine log while the stringers protrude at an angle out of the sediment. Pitting from zebra mussels is minimal. Figure 6.27 depicts site formation signature location four on the northern section. The stringers show signs of damage on the ends and are partially buried underneath sediment and milfoil growth. Zebra mussel colonies in the area are negligible and the timbers appear to be minimally damaged.

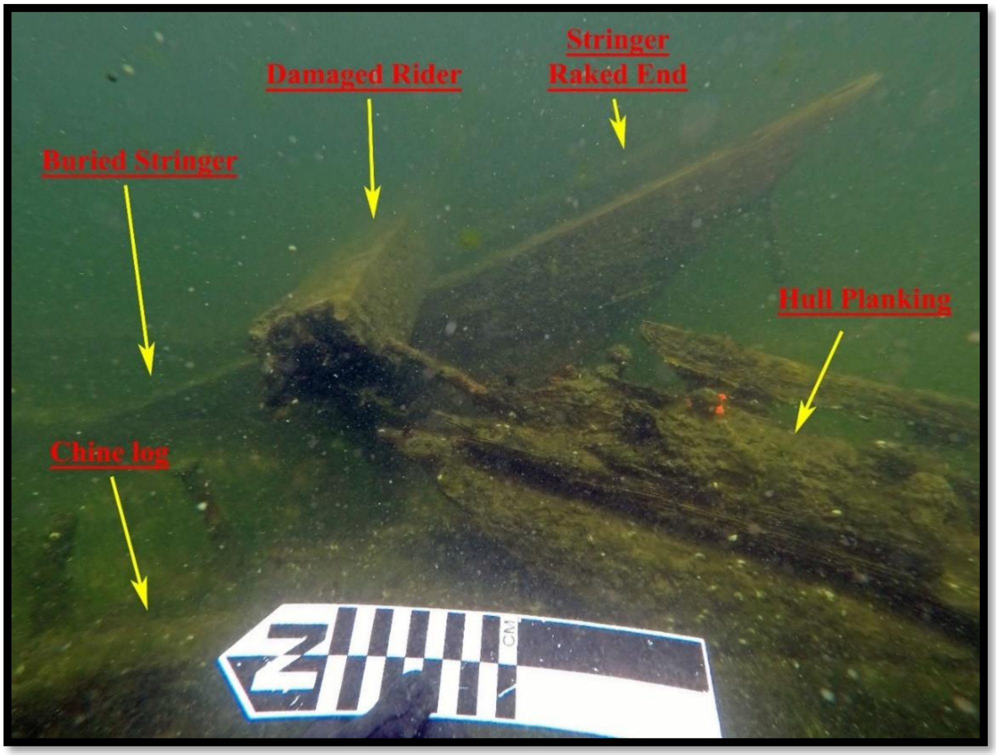


FIGURE 6.26. Site formation signature location 3, photo GOPR1146 (Photo by author, 13 July 2018).

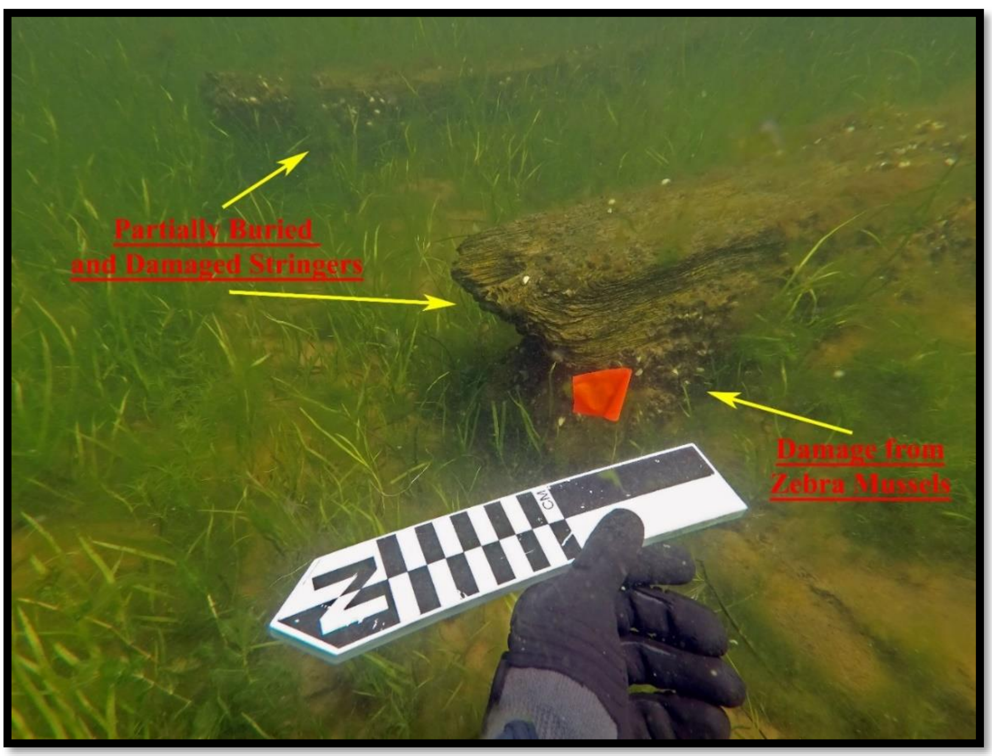


FIGURE 6.27. Site formation signature location 4, photo GOPR1154 (Photo by author, 13 July 2018).

Site formation signature location five is portrayed in Figure 6.28. Located on the northern section of the barge remains opposite signature location three, it shows the damaged end of the rider along with several large bent ferrous bolts. The stringers protrude at an angle out of the sediment with milfoil growth. A section of hull planking resides to the left on the bottom and partially under a stringer. Slight damage from zebra mussels pitting is on the timber surfaces. Figure 6.29 shows site formation signature location six, an extension of the hull planking fragment in Figure 6.28. The planking is partially buried in sediment and is ripped along the edges. Zebra mussels cover the planking along with algae.

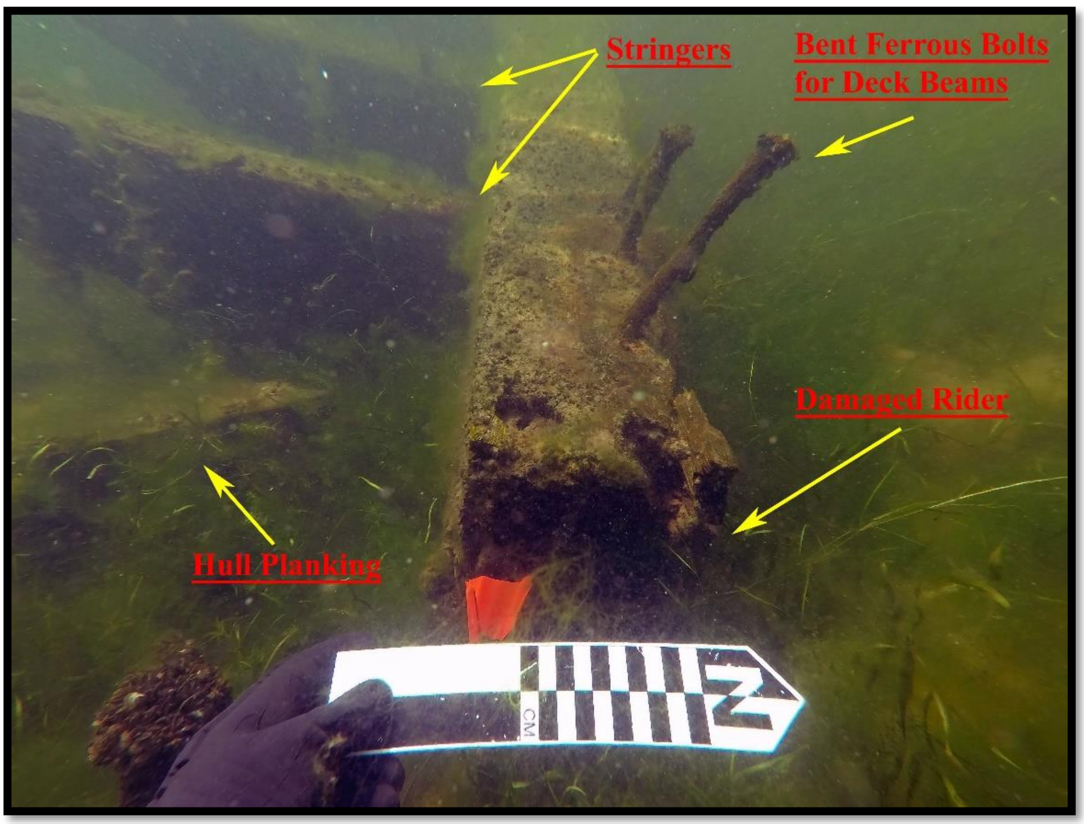


FIGURE 6.28. Site formation signature location 5, photo GOPR1162 (Photo by author, 13 July 2018).

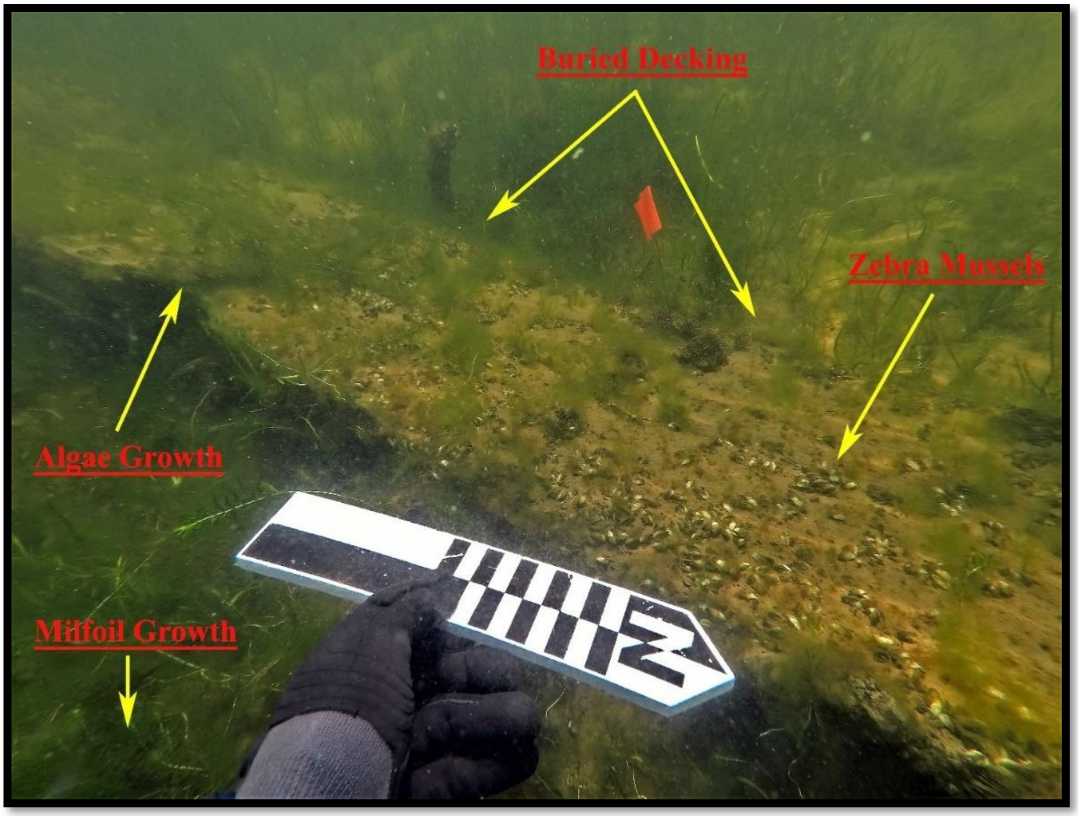


FIGURE 6.29. Site formation signature location 6, photo GOPR1164 (Photo by author, 13 July 2018).

Catalog of Cultural and Non-Cultural Formation Signatures on the Turner and Brievogel Barge VT-CH-795

The remains of barge VT-CH-795 are oriented into two heavily disarticulated sections with one heaped jumble of material southwest of the remains of barge VT-CH-797 and the second section northeast and nearly parallel to the shore of Burlington. The condition of the remains made it difficult to identify most of the timbers. The first section is composed of assorted ferrous fasteners, possible stringers, some chine log remains, planking, and other unidentified timbers. The second section has a possible chine log, bottom planking, possibly a stringer, assorted ferrous fasteners, and a ferrous tie rod. The archaeology site plan of barge VT-CH-795 is above in Figure 6.22 while Table 6.4 shows the site formation signature locations.

Table 6.4. Site formation signatures recorded from Turner & Breivogel Barge (VT-CH-795).

Section of Vessel	Signature Location Number	Type of Site Formation Signature	Transformation Process
West on Western Section	1	Damaged Ferrous Plates, Damaged Unkown Timber, Bent Ferrous Bolts, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary Salvage, Biological Agent, Pedoturbation.*
West on Northern Section	2	Damaged Stringer, Bottom Planking, Bent Ferrous Bolts, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary Salvage, Biological Agent, Pedoturbation.*
West on Eastern Section	3	Damaged and Disarticulated Timbers, Detached Ferrous Strap, Bent Ferrous Bolts, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary Salvage, Biological Agent, Pedoturbation.*
West on Eastern Section	4	Damaged Stringer, Bottom Planking, Bent Ferrous Bolts, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary Salvage, Biological Agent, Pedoturbation.*
West on Eastern Section	5	Disarticulated and Damaged Bottom Planking, Bent Ferrous Tie Rod, Damaged Stringer, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary Salvage, Biological Agent, Pedoturbation.*
East on Northern Section	6	Disarticulated Stringer, Damaged Unknown Timber, Bent Ferrous Bolts, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary Salvage, Biological Agent, Pedoturbation.*

The first site formation signature location is portrayed in Figure 6.30. Located on the western section of the remains is what appears to be a chine log along with two rectangular ferrous plates. Heavily contorted ferrous bolts are also present. While marks of damage are indicative of *secondary salvage* processes, it is unclear if this barge underwent salvage. Damage from *biological agents* like zebra mussels is evident by scars and pitting on the wood and ferrous features. Much of the timber remains are buried in sediment and sand via *pedoturbation* processes.

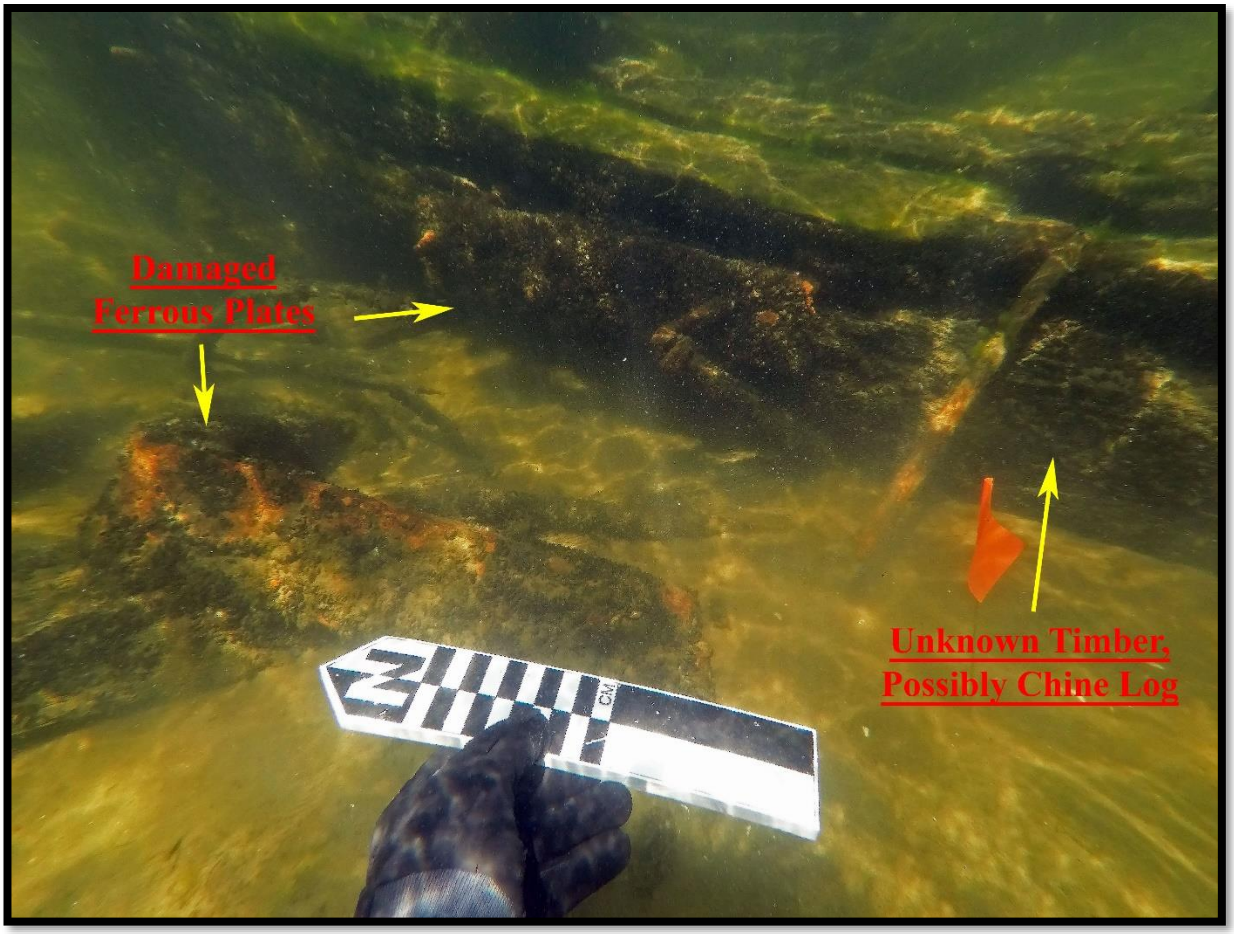


FIGURE 6.30. Site formation signature location 1, photo GOPR1029 (Photo by author, 11 July 2018).

Figure 6.31 displays the second site formation signature location on the western side of the remains. A broken-up stringer and angled bottom planking are exposed with a series of bent and damaged ferrous bolts. Much of the remnant timbers are buried in sand and sediment. Figure 6.32 shows the third location in the eastern section of the vessel. Much of the wooden timbers are ripped up and strewn about the area making it difficult to identify them. A long, bent ferrous rod is present with a detached iron rounded strap. Zebra mussels primarily cover the ferrous parts and some of the wooden timbers.

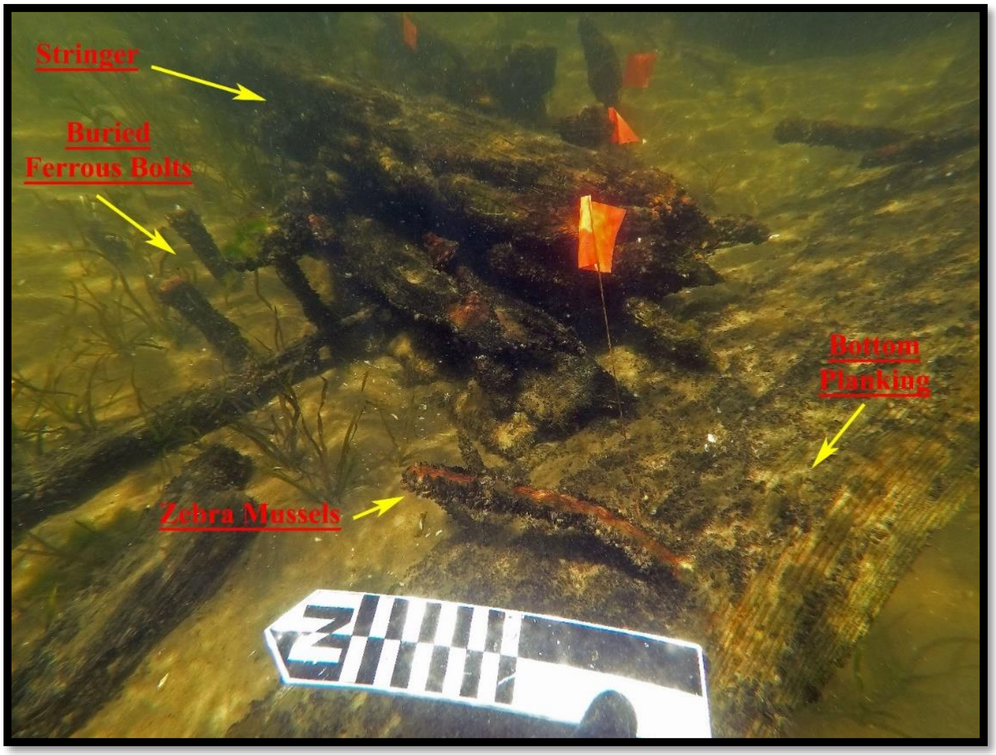


FIGURE 6.31. Site formation signature location 2, photo GOPR1046 (Photo by author, 11 July 2018).

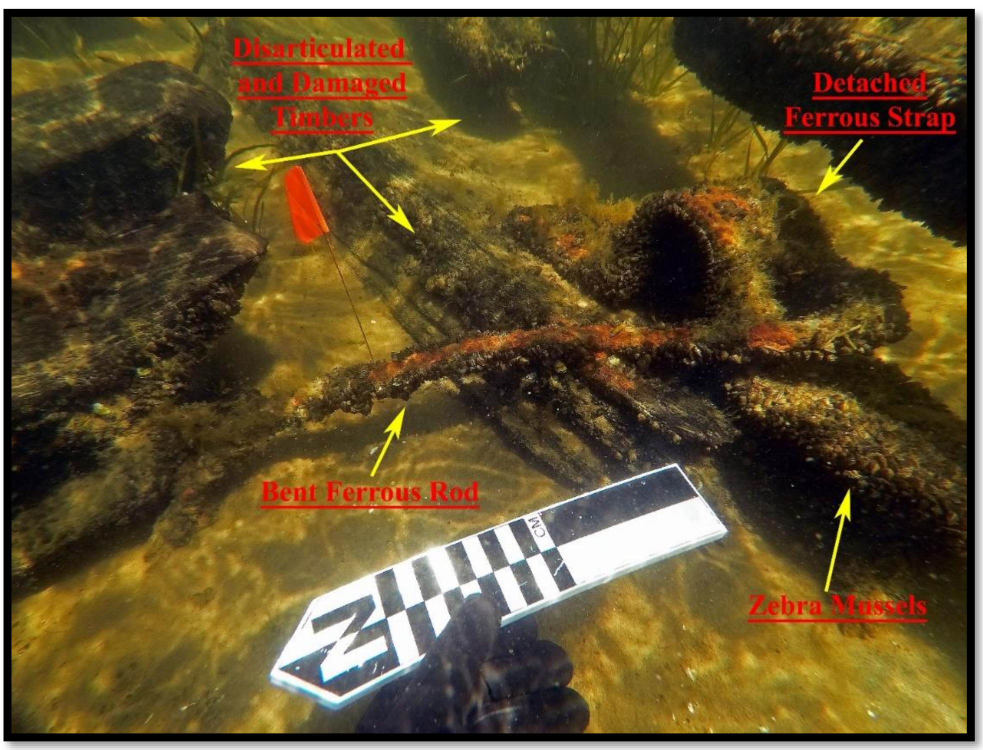


FIGURE 6.32. Site formation signature location 3, photo GOPR1019 (Photo by author, 11 July 2018).

The fourth site formation signature location is represented in Figure 6.33. Located on the eastern section of the remains and parallel to signature location two are the bottom planking, stringer, and several bent ferrous bolts. Damage from *biological agents* like zebra mussels is evident by scars and pitting on the wood and ferrous features. Much of the timber remains are buried in sediment and sand via *pedoturbation* processes.

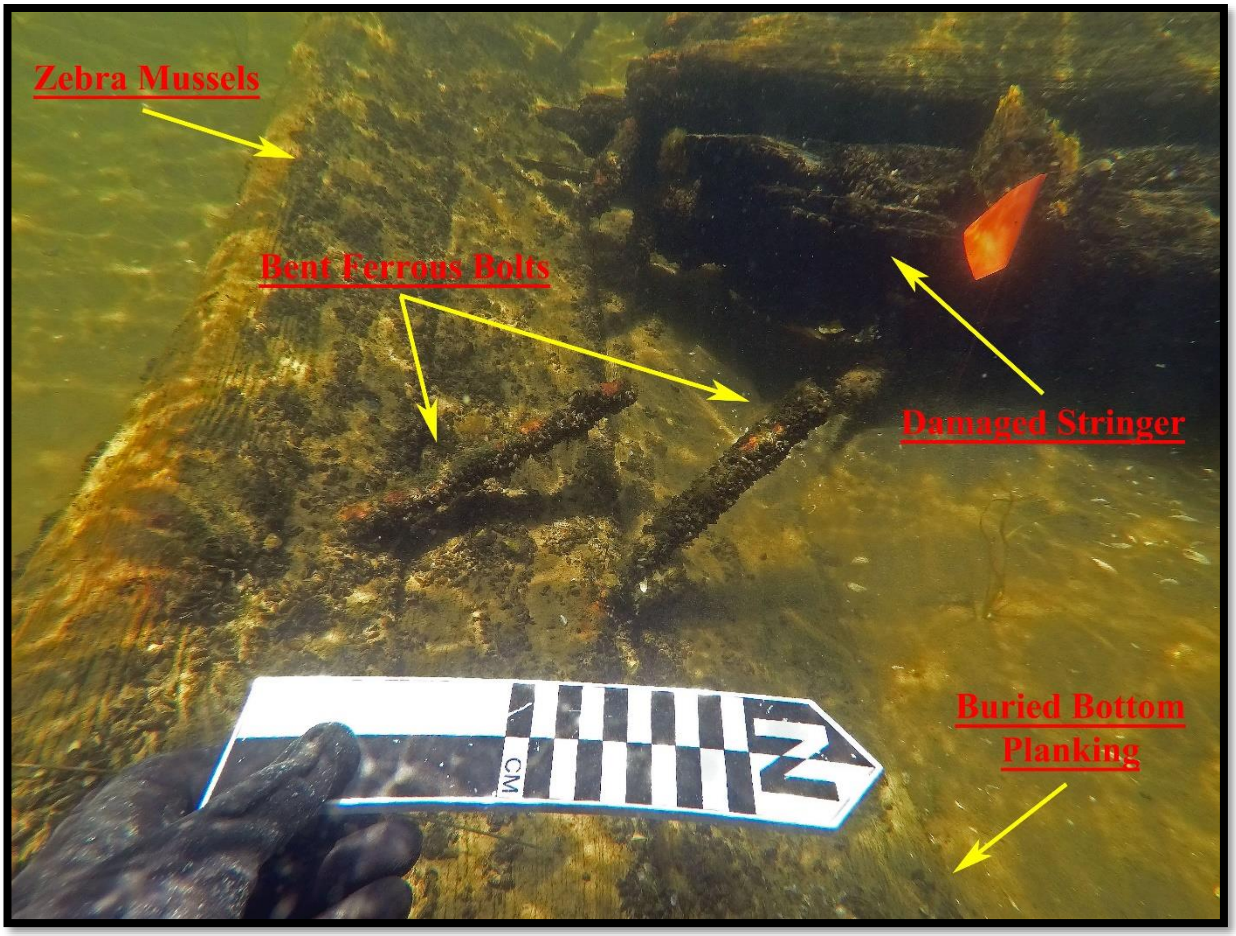


FIGURE 6.33. Site formation signature 4, photo GOPR1051 (Photo by author, 11 July 2018).

Figure 6.34 depicts the fifth site formation signature location on the eastern section of the barge remains. A long, twisted ferrous tie-rod connected to disarticulated and damaged timbers resides in between a stringer and the remains of bottom planking. Sediment covers most of the bottom planking and other timbers.

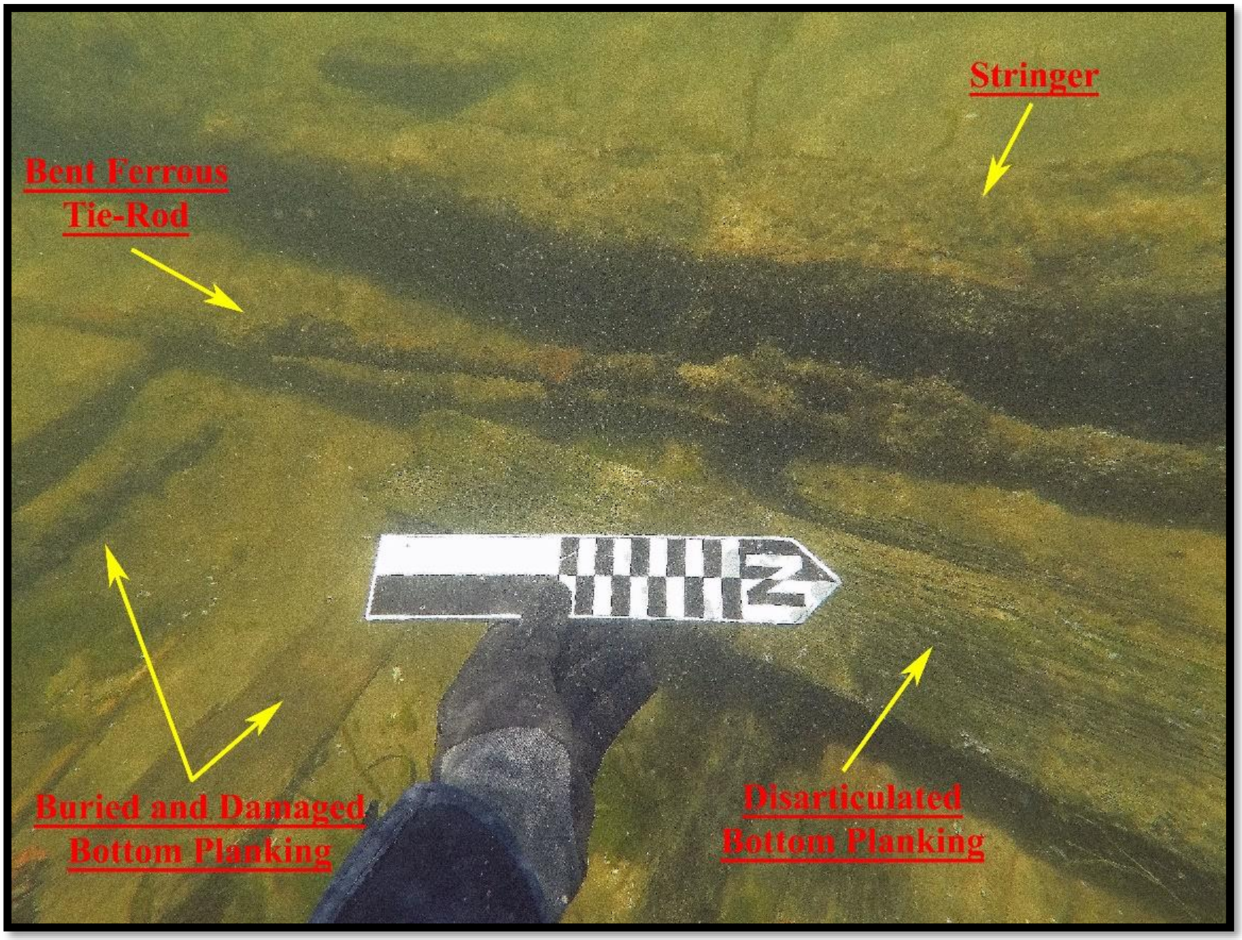


FIGURE 6.34. Site formation signature location 5, photo GOPR1082 (Photo by author, 11 July 2018).

The final site formation signature location is displayed in Figure 6.35. Located on the northern section of the vessel, a disarticulated stringer, possibly a chine log fragment, several unknown timbers, and warped ferrous bolts are heaped in a pile. Damage from zebra mussels is negligible.

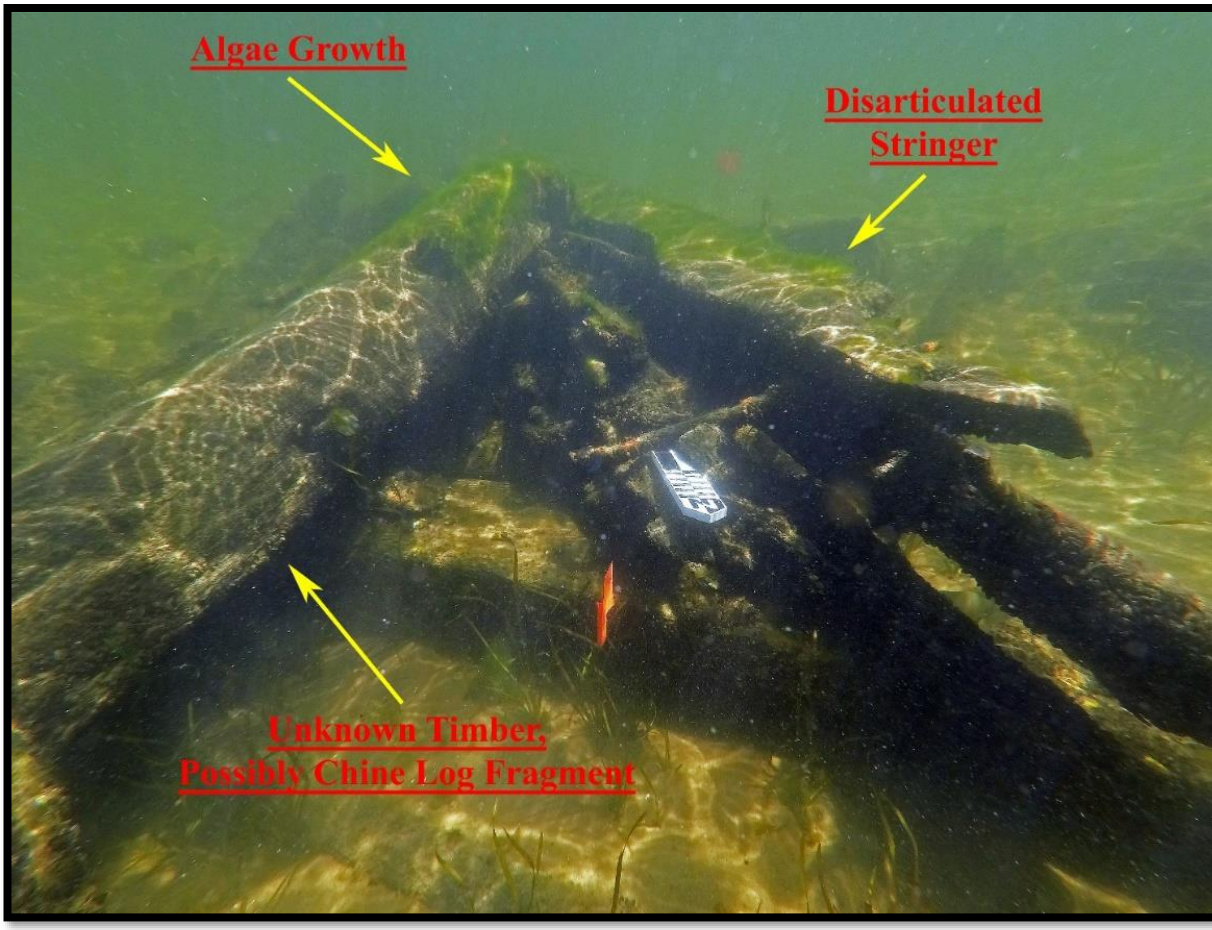


FIGURE 6.35. Site formation signature location 6, photo GOPR1037 (Photo by author, 11 July 2018).

Catalog of Cultural and Non-Cultural Formation Signatures on the Turner and Brievogel Barge VT-CH-797

The remains of barge VT-CH-797 are oriented in a west to east orientation and are closest to the shore near the Burlington Bike Path. Not much of the vessel remains, but a substantial number of futtocks are present with two ferrous bollards. Side planking affixed to the futtocks are extant with most of the planking buried. Due to the condition and the scant remains, it was difficult to identify other heavier timbers. The remains of a ferrous bollard still affixed to decking with a heavy steel wire twisted cable are evident. It is likely part of a larger section of detached decking buried beneath the sediment. The archaeology site plan of barge VT-CH-797 is above in Figure 6.23 while Table 6.5 depicts the site formation signature locations.

Table 6.5. Site formation signatures recorded from Turner & Breivogel Barge (VT-CH-797).

Section of Vessel	Signature Location Number	Type of Site Formation Signature	Transformation Process
East on Western Section	1	Damaged Unkown Timber, Bent Ferrous Bolts, Charring From Fire, Bottom Planking, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary Salvage*, *Biological Agent*, *Pedoturbation*.
West on Western Section	2	Damaged Futtocks, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary Salvage*, *Biological Agent*, *Pedoturbation*.
South on Western Section	3	Damaged Futtocks, Bent Ferrous Bolts, Side Planking, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary Salvage*, *Biological Agent*, *Pedoturbation*.
East on Western Section	4	Disarticulated Iron Bollard, Bent Ferrous Bolts, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary Salvage*, *Biological Agent*, *Pedoturbation*.
East on Western Section	5	Damaged Unknown Timbers, Futtocks, Bent and Damaged Ferrous Bolts, Damage from Zebra Mussels, Buried Timbers in Sediment.	*Secondary Salvage*, *Biological Agent*, *Pedoturbation*.
North on Northern Section	6	Decking and Ferrous Bollard, Braided Steel Cable, Presence of Zebra Mussels, Buried Timbers in Sediment.	*Secondary Salvage*, *Biological Agent*, *Pedoturbation*.

Figure 6.36 exhibits site formation signature location one at the very far end of the vessel remains. It is unclear what the larger timber is, but it may be a rider or stringer. Charring on the exposed remains with more on the buried planking is evident. This is most likely the barge that caught fire on 8 June 1964 as it was tied off at Perkins Pier (*The Burlington Free Press* 1964c:22). Ferrous bolts affixed to the unknown timber are bent over at a downward angle. Signature location two depicted in Figure 6.37 west of location one shows a series of futtocks aligned east to west. The ends are torn and ripped with the bottoms of each futtock buried in varying degrees of sediment and sand. Scars and pitting from zebra mussels are present on the surface of the timbers.

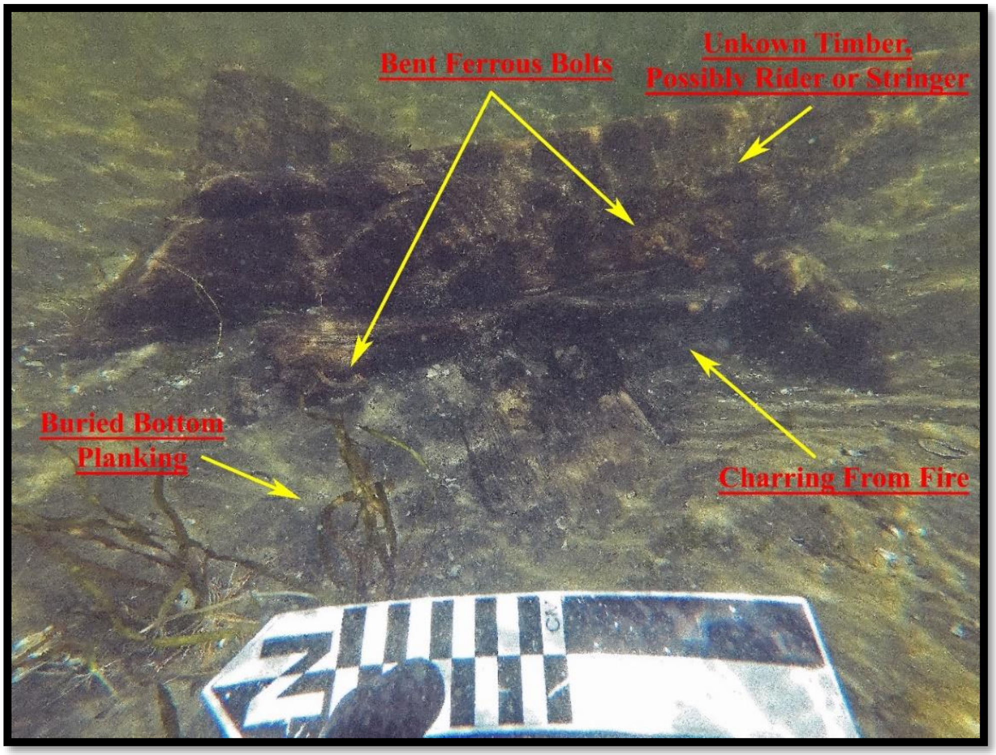


FIGURE 6.36. Site formation signature location 1, photo GOPR5465 (Photo by author, 11 July 2018).

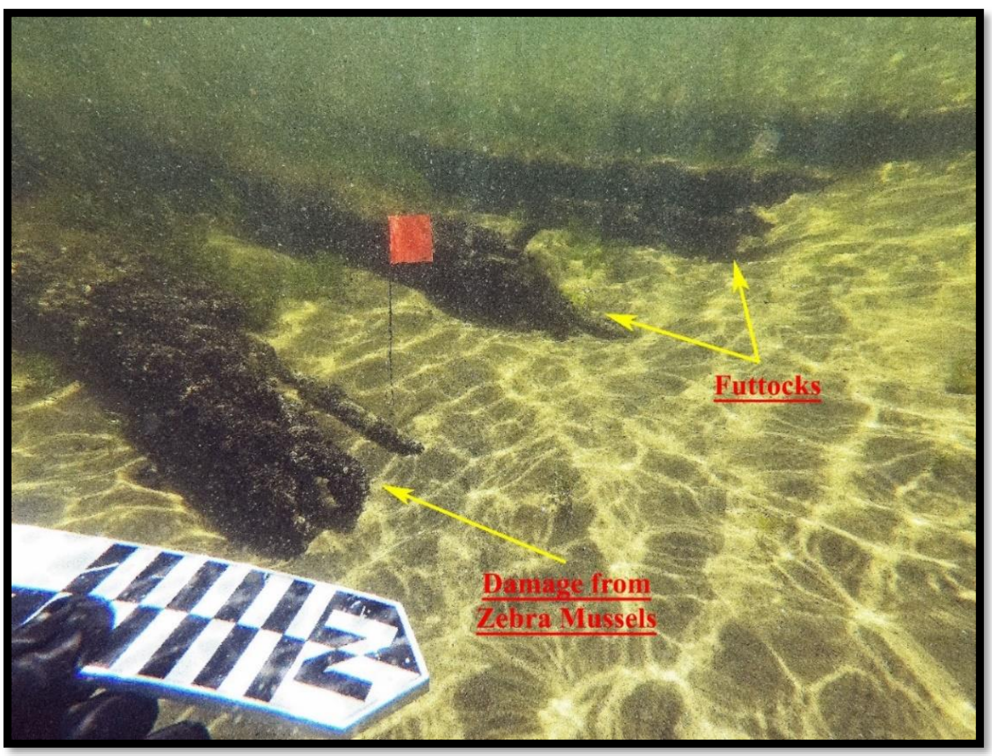


FIGURE 6.37. Site formation signature location 2, photo GOPR5447 (Photo by author, 11 July 2018).

Figure 6.38 shows site formation signature location three further west from the second location. It illustrates the damage to the futtocks with the remains of a threaded bent ferrous bolt and the hole from a missing fastener. The futtocks and affixed side planking are buried in varying amounts of sand and sediment. Further west is site formation signature four as shown in Figure 6.39. Affixed to the rent and ripped remains of a top log is a small ferrous bollard. The ferrous bolts still attached to the bollard base and top timber are bent and damaged. Pitting from zebra mussels is present along with a small amount of algae growth.

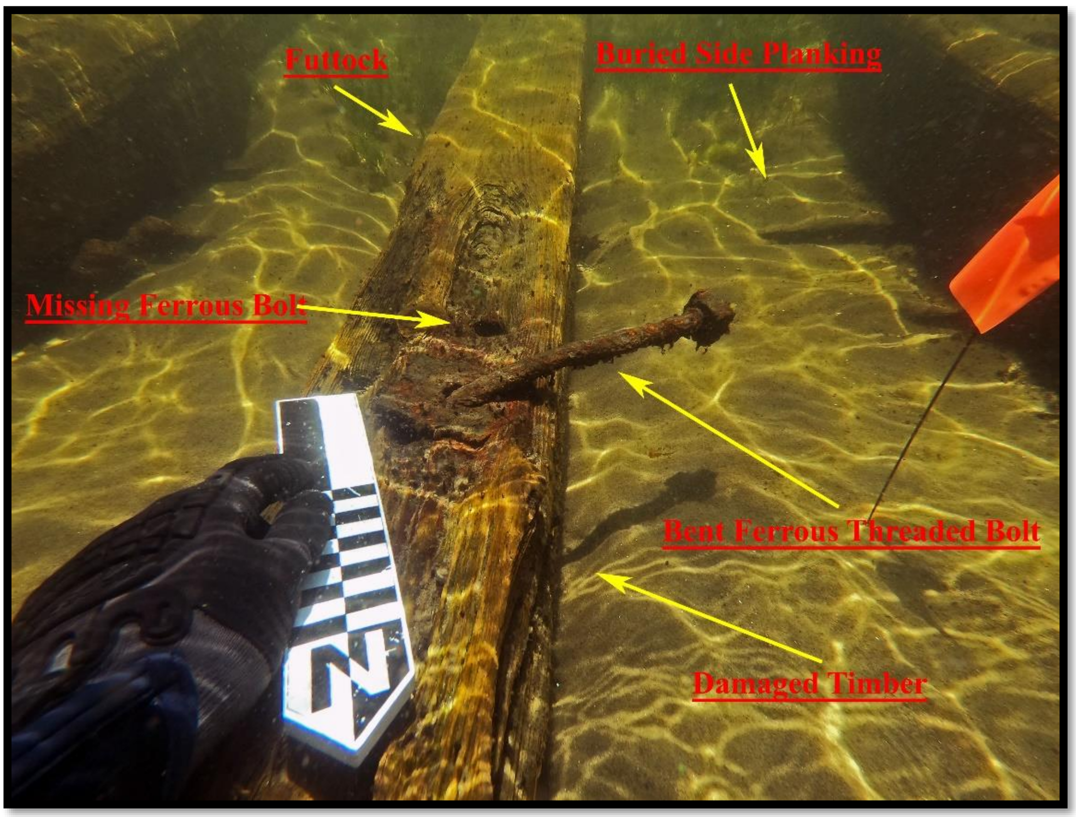


FIGURE 6.38. Site formation signature location 3, photo GOPR5397 (Photo by author, 11 July 2018).

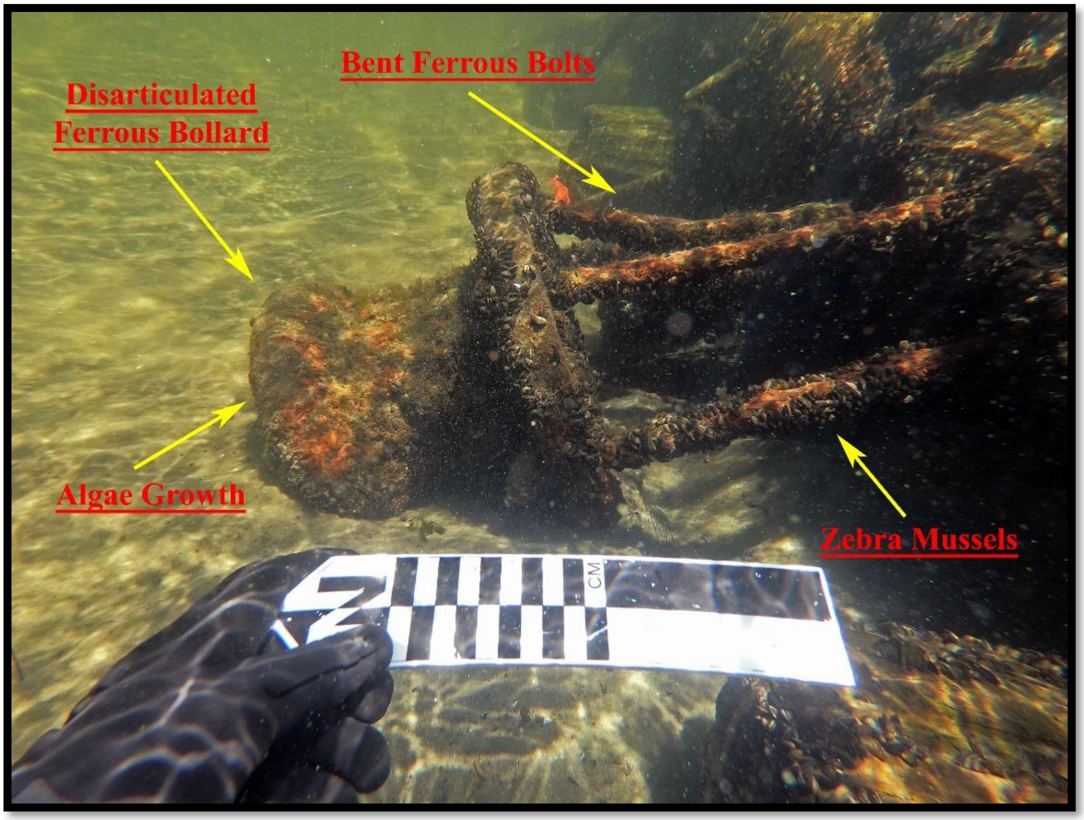


FIGURE 6.39. Site formation signature location 4, photo GOPR5424 (Photo by author, 11 July 2018).

Figure 6.40 displays site formation signature location five at the farthest western section of the barge remains. The last few futtocks affixed to what is believed to be the top log are heavily cut down and damaged. The top log is also broken up and has a heavy gash down the middle of it with a missing portion of the timber. A series of contorted ferrous bolts from the right-hand side of the top log is present. The final site formation signature is shown in Figure 41 with a large ferrous bollard affixed to the base and wooden decking along with a braided ferrous cable. It is suspected that much more decking is buried underneath the sand.

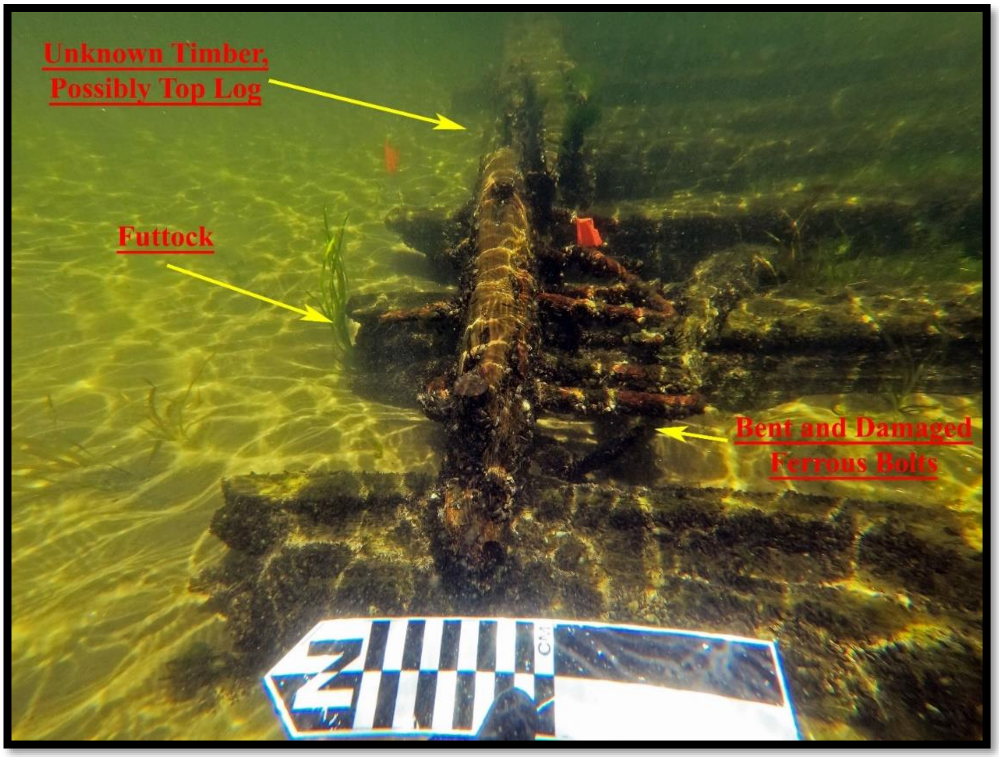


FIGURE 6.40. Site formation signature location 5, photo GOPR5442 (Photo by author, 11 July 2018).

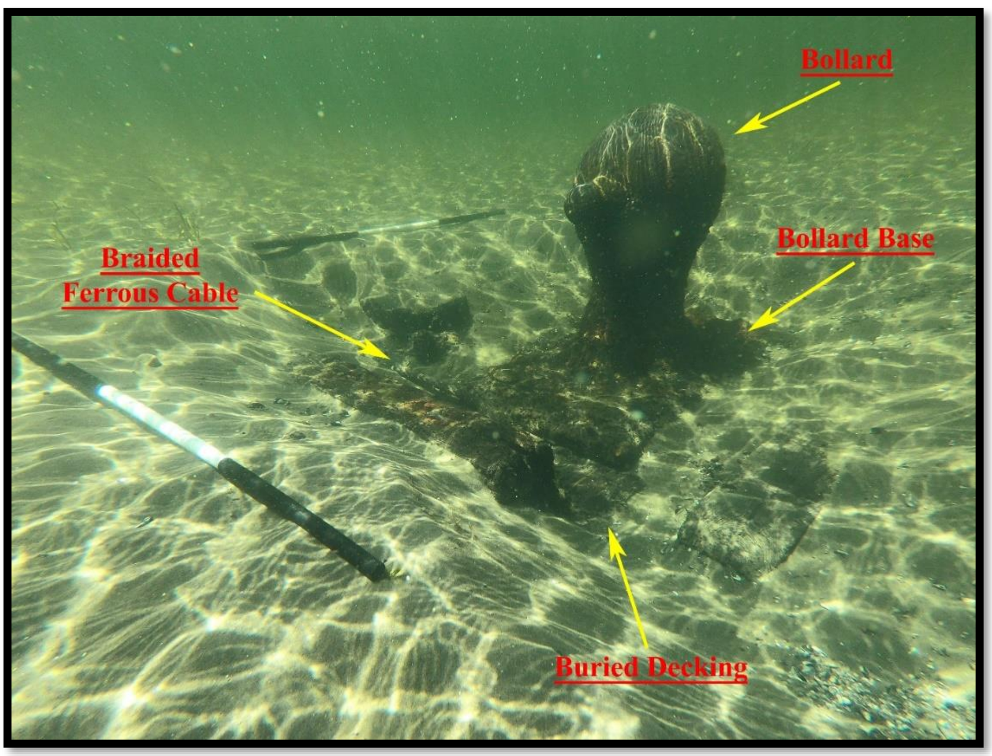


FIGURE 6.41. Site formation signature location 6, photo GOPR15087 (Photo by author, 11 July 2018).

Discerning Patterns from the Archaeological Remains of the Turner & Brievogel Barges

Out of all three barge remains, the presence of bottom planking, chine logs, longitudinal stringers, transverse riders, futtocks, a top timber, several unknown timbers, various ferrous fasteners, bollards, decking, and side planking are noted. Absent material varies on each barge, but consists primarily of upper hull planking, deck planking, deck beams, deck rails, corner iron, corner rakes, and bumper logs. Given the proximity of the barge remains to each other and their location in relatively shallow water, it would have made salvage of material from the barges relatively easy. As much of the super structures of the barges were removed, the bottom-most parts located below the waterline remained.

However, it is odd that the portion of decking and bollard from VT-CH-797 is present at the site. The water depth was about 2 feet (0.06 meters), so such an easily accessible part of the barge would have likely been salvaged. The other two barges had no evidence of deck elements as they reside in much deeper water at a depth of 6 ft (1.82m). Additionally, barges VT-CH-793 and VT-CH-795 have bottom planking, stingers, riders, chine logs, and ferrous fasteners present while VT-CH-797 only has futtocks, hull planking, a possible, top timber, and an unknown portion of decking. While the barges did undergo salvage processes, it is possible that not all the vessels were fully broken down through *secondary salvage*.

An Analysis of Potential Correlation between Ship Abandonment and Burlington's Maritime Commerce

As acts of watercraft abandonment and salvage occur within the context of technological and economic change, there is the potential that deliberate ship discard events may correlate to broader historical trends in economic changes, especially trends along Burlington's waterfront.

So too, the introduction of newer technologies, such as the sailing canal boat, trains and rail networks, and petroleum-based engines are events with potential impacts to Vermont's broader maritime trade networks. The time period between 1866 and 1970 was used to reflect the abandonment dates of all five vessels. Given the paucity of historical economic data in Vermont, the *Annual Reports of the Chief of Engineers, United States Army* provides economic data for the port of Burlington, Vermont from 1866 to 1971. Most of the statistical information regards the monetary values of commodities like lumber, coal, and petroleum (*Annual Report of the Chief of Engineers* 1866:180, 1868:298, 1869:186, 1870:216, 1873:406, 1885:2307, 1876:353, 1878:422, 1879:396, 1880:557, 1882:1959, 1883:1959, 1884:2157-2158, 1885:2308, 1886:1904, 1887:2409, 1888:2099-2100, 1889:2449. 1890:2881, 1891:2934, 1892:2611, 1893:3196-3197, 1894:2496-2497, 1895:3238, 1896:3168, 1897:3298, 1898:1045, 1899:1290, 1900:1483-1484,1901:1054, 1902:862, 1903:749-750, 1904:866, 1905:833, 1906:893, 1907:926, 1908:968, 1909:1001, 1910:1119, 1911:1270, 1912:1484, 1913:1650, 1914:1704-1705, 1915:2126, 1916:1976, 1917:2093, 1918:2147, 1919:2272, 1920:33, 1921:328, 1922:246-247, 1923:286-287, 1924:289-290, 1925:248-249, 1926:265-266, 1927:276, 1928:234-235, 1929:226, 1930:227, 1931:228, 1932:229, 1933:209, 1934:214, 1935:229, 1936:239, 1937:248, 1938:252, 1939:281, 1940:271. 1941:281, 1943:244, 1944:255, 1945:263, 1946:279, 1947:267, 1948:292, 1949:292, 1950:278, 1951:278, 1952:302, 1953:301, 1954:67, 1955:70, 1956:88, 1957:73, 1958:82, 1959:80, 1960:76, 1961:68, 1962:65, 1963:94, 1974:87, 1965:89, 1966:97, 1967:83, 1969:87, 1970:103, 1971:86). The report from the Army Corps of Engineers are not completely listed each year and some reports include statistics that other reports do not. Commercial statistics is not listed for 1926, and no report was listed for 1942 or 1967 (*Annual report of the*

Chief of Engineers 1927:276, 1968:108). In addition, population statistics are provided for the city of Burlington and Chittenden county from 1791 to 2010.

Information on technological development and use correlates from 1780 to 1990 is included to aid in connecting historical research, the archaeology, and analysis of the abandoned vessels. Technological correlates like the replacement of traditional commercial sailing craft with the newer classes of sailing canal boats provide evidence of changes in transportation in the Lake Champlain region. Rail transportation and eventually roads also led to the disuse and eventual abandonment of sailing and steam vessels. As trains and automobiles were more reliable and had fixed routes allowing nearly year-round service, it made sailing and steam vessels obsolete. More efficient petroleum-based engines also contributed to the end of these vessels. Use, age, deterioration, and economic reasons given additional plausible explanations for the abandonment of the ships in the graveyard.

A Consideration of Population and Economic Correlates

Figure 6.42 shows information gathered from the Vermont census records of the population of Burlington and Chittenden county from 1781 to 2010. The abandonment dates of the vessels are highlighted in heavy dark vertical lines. Correlations between the population of Burlington and Chittenden county to the abandonment of the vessels do not appear to show any plausible relations. The graph depicts a slow, but gradual upward trend in overall population growth for the region. While there was a drop in the 1860s (most likely due to the American Civil War and need for soldiers) till 1900, population levels appear to steadily grow throughout the entire 20th century.

The author speculates that the increase changes in population levels of Burlington and Chittenden County are related to the increased consumption in imports and exports of the selected products of lumber, coal, and petroleum discussed below. For example, as population levels increased in the second half of the 19th century, the tonnages of both lumber and coal products increased as well. In the early part of the 20th century, population levels grew slowly and steadily while lumber and coal products started to decrease. The author believes these correlates to the rise of petroleum shipping in the region in the early part of the 20th century and into the second half as tonnages of this product increased along with population levels.

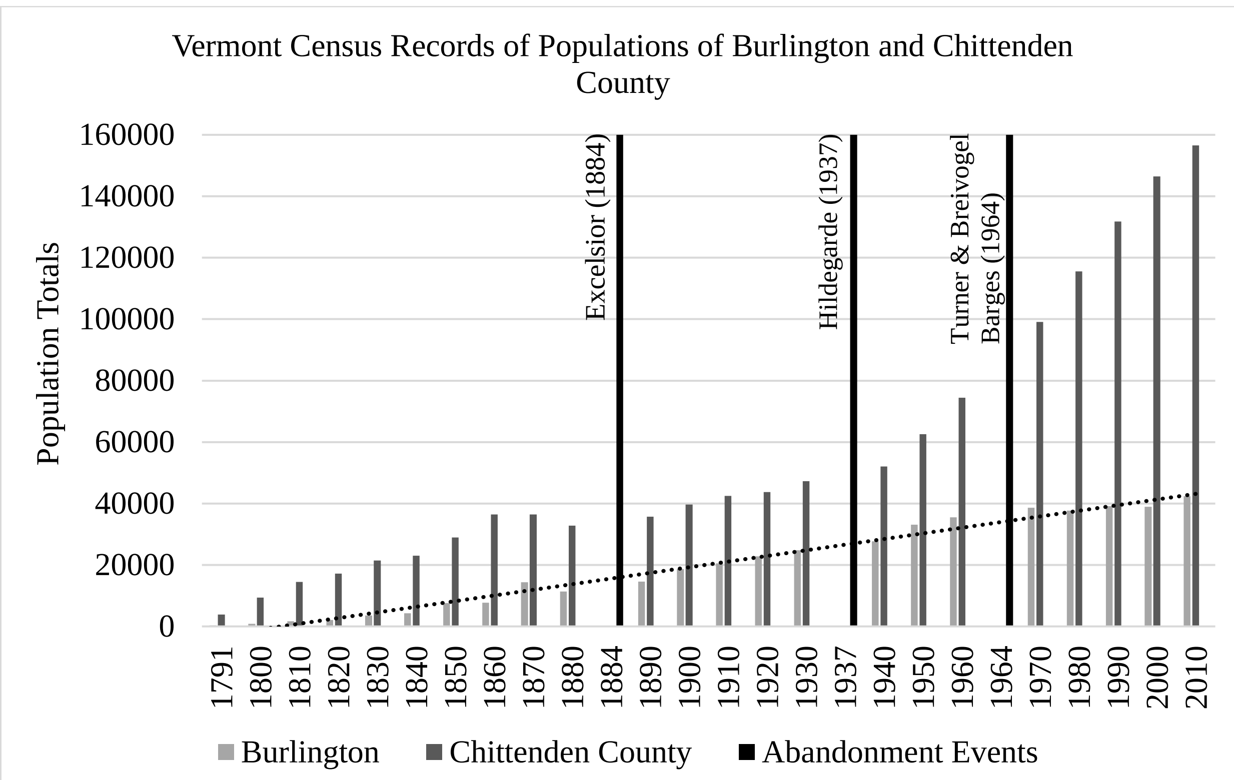


FIGURE 6.42. Vermont Census Records of Populations of Burlington and Chittenden County (Vermont Historical Society 2019).

Figure 6.43 below represent a collection of data on the amount of lumber coming into the port of Burlington from 1866 to 1930. The dates of abandonment for the vessels in the graveyard are also included. Based on the statistics researched in the *Annual Report of the Chief of*

Engineers, the heaviest amount of timber trade is through Canada in the late 19th century as lumber was coming into the lake through the Chambly Canal. Though not listed for each year, higher values of lumber in feet and then tons are listed in the graph from 1866 to 1883. Timber products from this time period were converted from board feet to tons using the formula 0.0023172750963701 multiplied by the amount in board feet. After 1884, timber trade starts to decline as fewer amounts of products came through the port of Burlington.

Coincidentally, *Excelsior* was abandoned in the same year. While the vessel is not a canal boat and would have been relegated to coastal commerce solely on the lake, the time period does represent an era of decline in timber product import. After 1931, no data on the timber trade is listed in the *Annual Report of the Chief of Engineers*. This makes it problematic in interpreting potential correlates linking the abandonment of *Hildegarde* and the Turner & Breivogel barges. However, given that *Hildegarde* was a car ferry converted to a tugboat for hauling stone barges in the early 20th century, a correlation between the timber industry and abandonment may not be plausible. Correlations for the Turner & Breivogel barges is also probably unlikely as the barges only in the rehabilitation of the Burlington breakwater from 1960 to 1964.

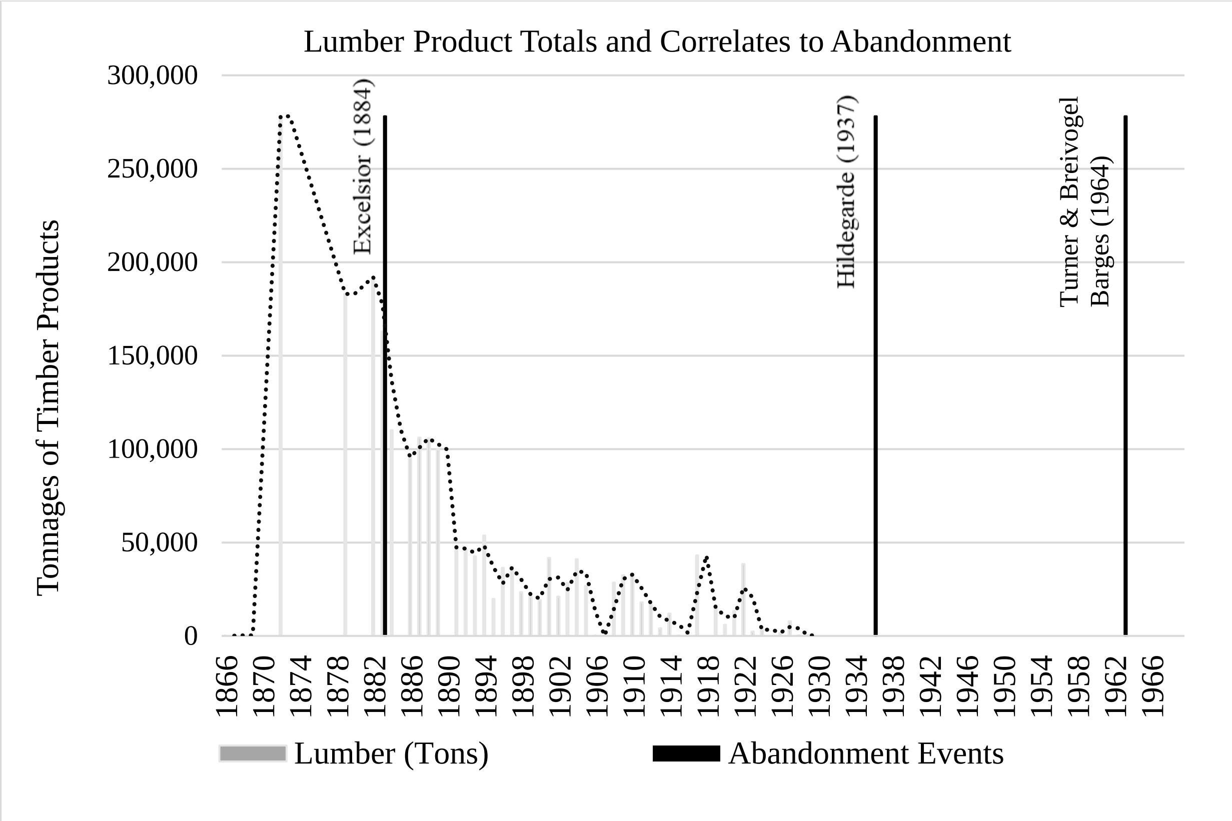


FIGURE 6.43. Data on Lumber Totals and Correlates to Abandonment from 1866 to 1970 (*United States Army Corps of Engineers Annuals Report of 1866 to 1931*).

Figure 6.44. provides data on the amount of coal in tons arriving in the port of Burlington and correlates to abandonment from 1869 to 1920. Much like the listing for timber products above, the *Annual Report of the Chief of Engineers* does not list tonnages of coal every year. In 1869, the total tonnage of coal was 22,050 tons with the highest peak in trade listed in 1892 with 115,000 tons. The rest of the time period shows fluctuations in tonnages with 250 tons in the last registered year of 1920.

It is unclear if the abandonment of *Excelsior* is correlational to the coal trade in the port of Burlington. If *Excelsior* was not abandoned in 1884, it would be possible for it to prosper in hauling coal throughout the 19th century based on the higher tonnages registered in the 1880s. Yet, most of the coal was arriving through the Champlain Canal on canal boats. It would seem unlikely for a coastal vessel confined to the lake to haul coal from canal boats as they portaged through the canal. Additionally, non-sailing canal boats typically had steamships tugging them into the port of Burlington.

The author believes it is also uncertain if the decline in the coal trade possible has any relational correlates to the abandonment of *Hildegarde* and the Turner & Breivogel barges. Given that *Hildegarde* was a steam vessel, it would have relied on sources of coal to fuel the ship's boiler to produce steam for the engine. While the decline of the trade is evident from the graph well before 1900, it is plausible that the continuing decrease in coal coming into the port of Burlington may have led to the abandonment of *Hildegarde*. It is unlikely that any correlation exists between the coal trade and the abandonment of the Turner & Breivogel barges in 1964. Bolstering this argument is the short life span of the vessels and their function as construction support barges in the Burlington harbor breakwater project, a role unrelated to the commercial coal industry.

Figure 6.45. depicts statistics on petroleum products in tons arriving in the port of Burlington and correlates to abandonment from 1918 to 1970. As gas companies established storage tanks on the Burlington waterfront in the early 20th century, imports of petroleum-based products gradually rose through the latter half of the century until oil companies began vacating the waterfront. In 1918, the number of petroleum products arriving in port was 5,382 tons. While some dates do not list the tonnage of products with fluctuations well into the 1940s, much of the higher numbers trended upward. The highest tonnage listed for this graph was 553,832 tons in 1970.

The possibility of correlations existing between the abandonment of *Excelsior* and the petroleum trade in the port of Burlington is unlikely.

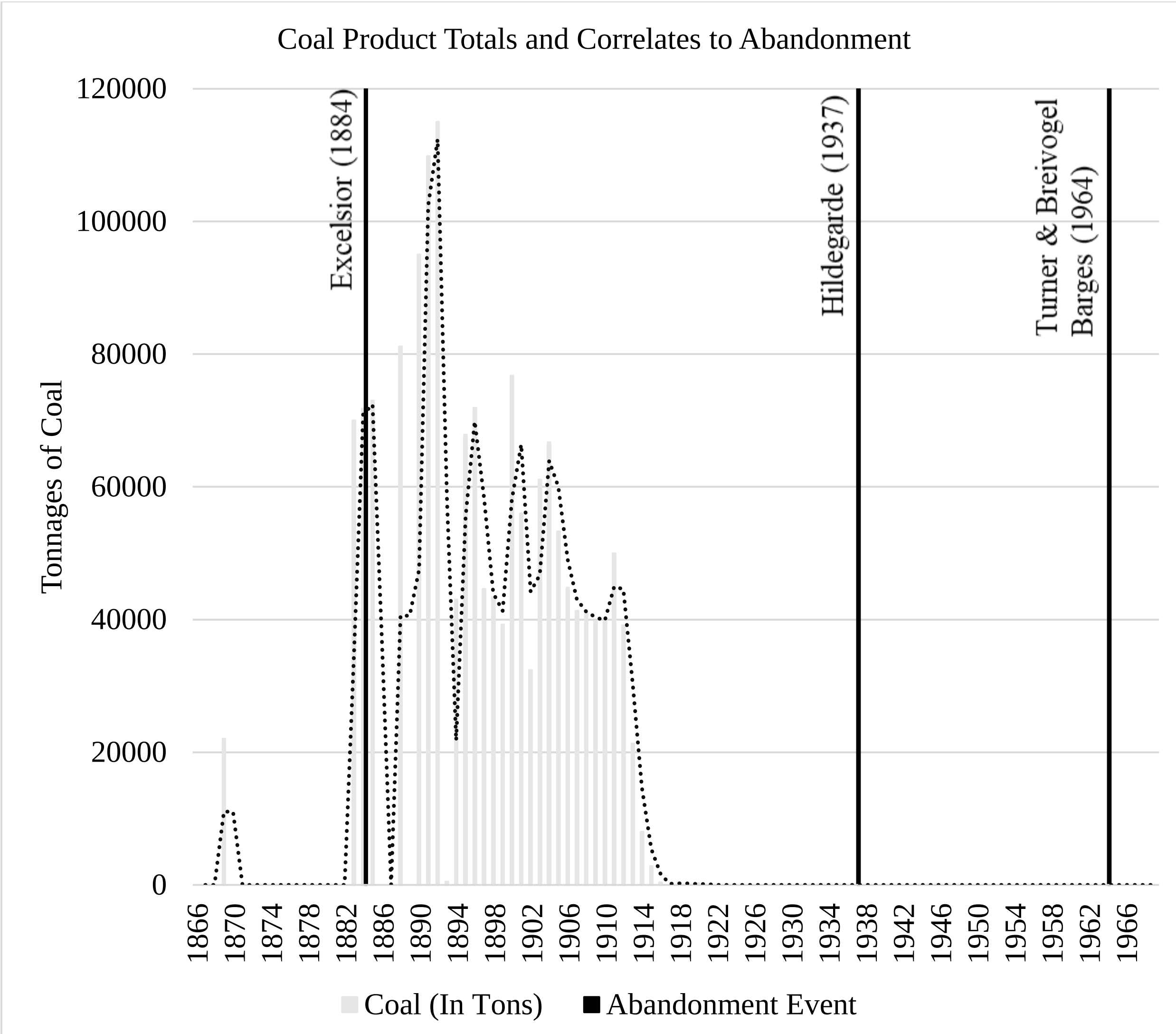


FIGURE 6.44. Data on Coal Totals and Correlates to Abandonment from 1866 to 1970 (*United States Army Corps of Engineers Annuals Report of 1866 to 1970*).

Since *Excelsior* was abandoned in 1884, it places the discard of the vessel 34 years before the first shipments of petroleum products arrived in Burlington. It is ambiguous if the rise in petroleum commercial trade possibly has any relational correlates to the abandonment of *Hildegarde* or the Turner & Breivogel barges. As a tugboat, *Hildegarde* would have been able to push barges hauling oil through the Champlain Barge Canal. Yet, the historical record makes no mention of the steamboat being involved in the oil business. The barges could have been sold off to local companies to be used in hauling petroleum products, but given their wooden construction and heavy use, the barges may have been un-fit to use safely in future commercial endeavors.

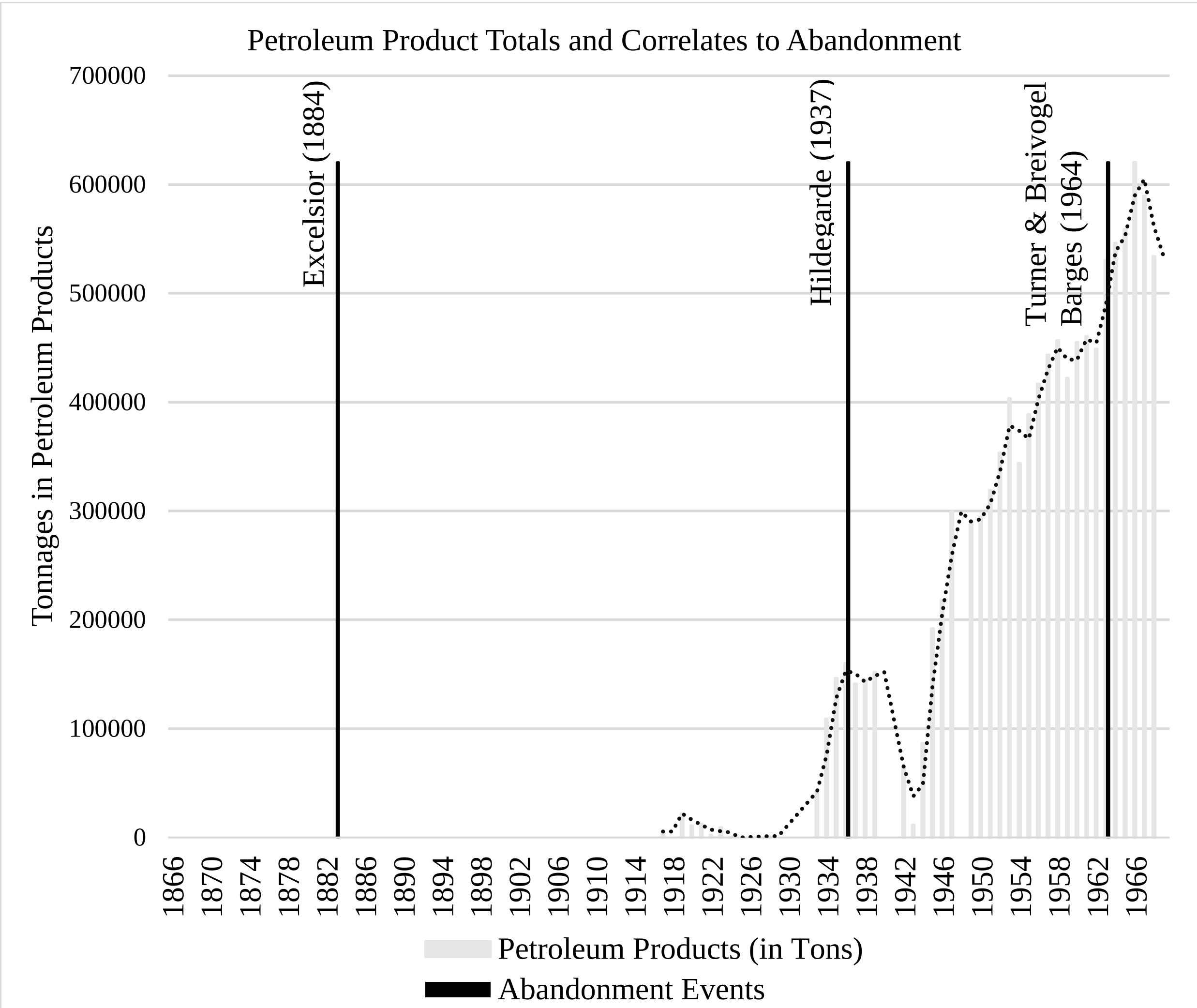


FIGURE 6.45. Data on Petroleum Product Correlates to Abandonment from 1866 to 1970 (*United States Army Corps of Engineers Annuals Report of 1866 to 1970*).

A Consideration of Technological and Use Correlates

Figure 6.46 depicts technological development and use correlates to aid in interpreting trends related to ship abandonment in Burlington, Vermont. A time period of 1780 to 1990 was used to highlight the multitude of historic events related to technological development occurring both in the city of Burlington along with broader relational events in the Lake Champlain region. While the potential economic correlations listed above do not provide very plausible evidence for the abandonment of the vessel in the Pine Street Barge Canal Basin Ship Graveyard, the technological development and use correlates provide better links to ship discard. The year of construction (use date for the Turner & Breivogel barges given that the built date is not known) and the year of abandonment and salvage of the vessels is incorporated into the timeline of events and technological developments.

Technological evolutions in ship designs along with the opening of the Champlain Canal provide credible correlations for the abandonment of *Excelsior* in the Pine Street Barge Canal Basin. As seen in the figure below, from approximately 1780 to 1823 traditional commercial sailing craft were used in the port of Burlington. As commercial activities slowly took place along the waterfront of the city, some of the first steamboats such as *Vermont* started service. When the Champlain Canal was officially opened in 1823 followed by the Chambly Canal in 1843, it ushered in a new era of canal waterborne transport. It also led to an era of commercial development in the early half of the 19th century where the harbor was augmented with the Burlington breakwater starting construction in 1836 (Hemenway 1867:669-670; Adams 1894:381).

Traditional lake schooners like *Excelsior* could not fit into the lock systems and were only used to ferry cargo from the open lake to smaller canal boats before they entered the canal. As the Champlain canal expanded over the course of the 19th century and became more economically viable, so too did canal boats. Shipbuilders in the area made canal boats with shallow drafts, centerboards, and sails to operate in the open lake. By simply retracting the centerboard, un-stepping the masts, and stowing the sails, canal boats could easily fit into the locks of the canal (Hemenway 1867:683-684; Cohn 2003). With this new technology, it put older traditional lake schooners in direct competition with canal boats. Additionally, the development of railroads and infrastructure in the Champlain Valley and Burlington added further pressure to commercial sailing endeavors. With the arrival of Central Vermont Railroad in the late 1840s and the expansion of other rail companies, rail traffic allowed for year-round service to local towns and beyond (*The Daily Free Press* 1848:2; MacGill 1917:179-187).

As an obsolete vessel with a use life of thirty-four years, *Excelsior* was no longer able to fulfill its function as a heavy freight hauler. While it enjoyed a lengthy career on the lake, it could not compete against the newer sailing canal boats. The exponential increase in rail line through Vermont and into neighboring areas also detracted from the vessel's ability to be financially stable. As the Central Vermont Railroad extended its rail service to areas along the Burlington waterfront including the Pine Street Barge Canal area, it led to a decrease in use for commercial maritime purposes. The confines of the derelict basin must have appeared to be a good location for the abandonment of *Excelsior*.

Rail transportation networks continued to develop along the waterfront of Burlington in the 1860s while steam service also gained traction and use. Vermont rail service points ran all along the Burlington waterfront and occupied most of the land used for waterborne commerce (Cohn 2003). Much of the commercial productivity of the Burlington waterfront extended well into the 1880s. With the completion of the Burlington Breakwater in 1890, the port of Burlington has reached a zenith in canal, steamship, and railroad prosperity. At the same time, newer technologies such as the gasoline engine and earlier petroleum fuel-based engines where fitted onboard vessels. With these developments, the 20th century was a mark for the decline of the canal and steamboat use, leading to an era of recreation on Lake Champlain.

Vessels that ran on petroleum-based fuels made both sail and steam vessels obsolete. Use of these fuels replaced the need for coal-fired steam engines. This provides a plausible correlation for the abandonment of *Hildegarde*. A more credible and stronger correlation is the effects of the Great Depression during the 1930s. The economic downturn in the United States during the Great Depression was catastrophic and did not recover until the 1940s (PBS 2019). Mentioned in Chapter 2, research into the history of *Hildegarde* revealed that the vessel was abandoned in the 1930s due to economic hardship experienced by its owner Clarence Morgan (Kane et al. 2004:93). Given that the owner could no longer afford to keep the vessel, it presents a highly plausible correlation for abandonment.

However, it presents an interesting case of steam-powered vessels in use during an era where petroleum-powered ships replaced older vessels with coal-fired steam engines. Given that the last owners operated *Hildegarde* until its final abandonment in 1937, the author speculates that perhaps Morgan could not sell the vessel due to the demand for petroleum-powered vessels at the time. The decline of steam-engines in marine vessels is further supported by evidence provided in the downward trend on Coal Totals and Correlates to Abandonment from 1866 to 1970 shown in FIGURE 6.44. In addition, the rise in petroleum products as indicated in FIGURE 6.45 for the Data on Petroleum Product Correlates to Abandonment from 1866 to 1970 provides more evidence for the decline of steam engines (*United States Army Corps of Engineers Annuals Report of 1866 to 1970*).

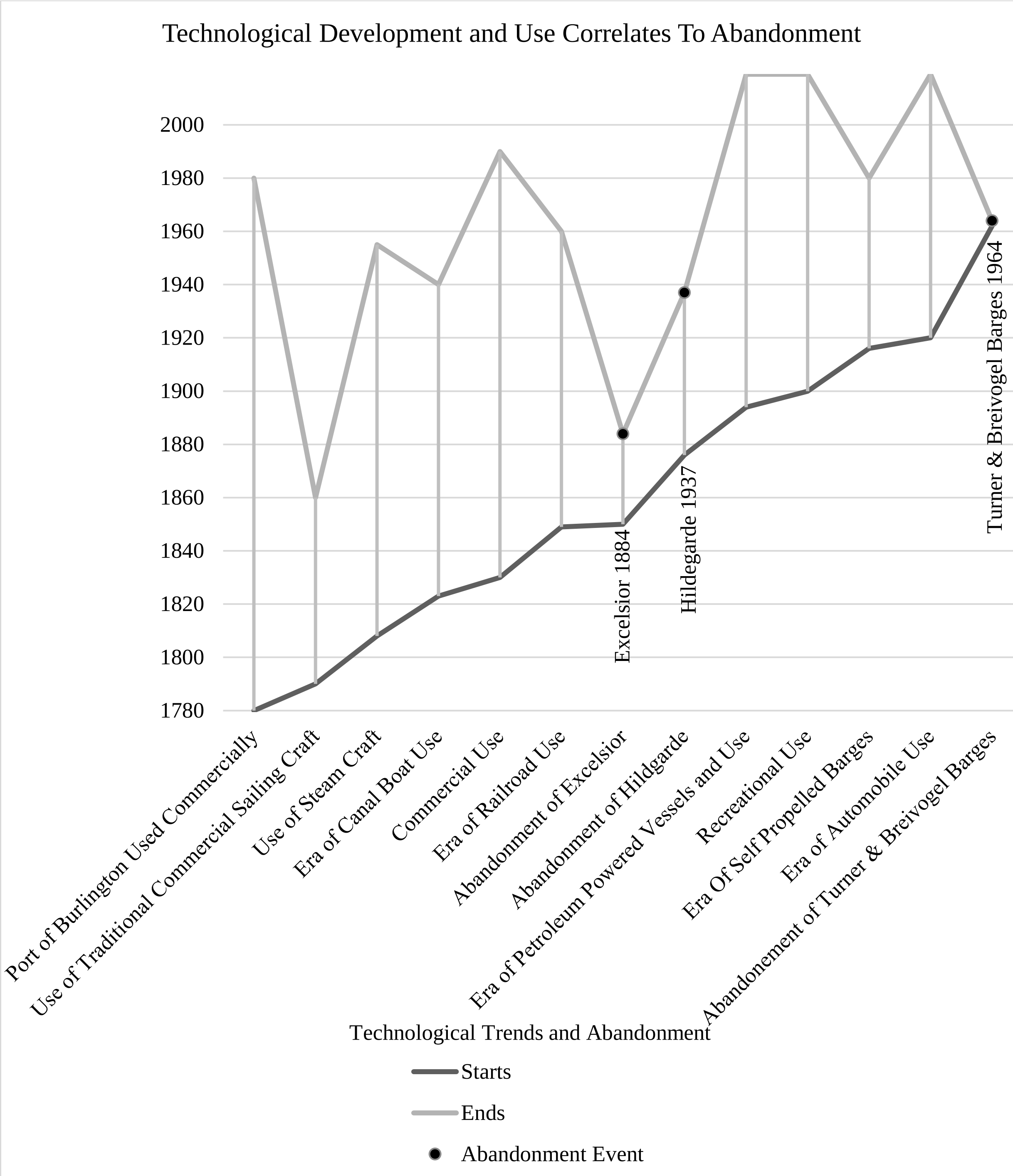


FIGURE 6.46. Technological Development and Use Correlates from 1780 to 1990 (Image by the author based on historical events researched by the author (Zadock 1842; *The Daily Free Press* 1848:2; Hemenway 1867; Rann 1886; Burlington Board of Trade 1889; Auld 1893; Adams 1894; Allen 1905; *The Burlington Daily News* 1914:10; MacGill 1917; Crockett 1921:186-190; *The Burlington Free Press* 1929:6; The Champlain Transportation Company 1930; Wilgus 1945:89; *The Burlington Daily News* 1953:1; City of Burlington, Vermont 1970; *The Burlington Free* Press 1970a:9, 1970b:9, 1984a:1a, 1984b:9a, 1987:1a; McFee 1998:181-184; Cohn 2003; City of Burlington, Vermont 2018).

By 1906, the last steamboat, *Ticonderoga*, was built and used in the region. Steam vessel service continued to operate but the use of steam technology was already beginning to decline. Canal boat use also declined further wherein 1914, a newer and much larger Champlain Barge Canal system was opened and allowed larger self-propelled barges to operate. Relying on tugs boat service and wind power, older canal boats could not compete. By the 1940s, the use of traditional canal boats ended followed by the end of steam use in 1953 with the retirement of *Ticonderoga*, the last steamboat on Lake Champlain (*The Burlington Daily News* 1914:10; *The Burlington Free Press* 1953:1).

The development of infrastructure for automobiles in the 20th century is another plausible correlation for the disuse and abandonment of steam-powered vessels like *Hildegarde*. While the Central Vermont Railroad provided more reliable service than both sailing and steam vessels, eventually automobiles and roads began to dominate transportation networks in Vermont. The opening of the Champlain Bridge in 1929 connecting the state of New York and Vermont made it possible for travel on Lake Champlain to be avoided altogether. Commercial sailing canal vessels and even the larger steamboats of the Champlain Transportation Company began to struggle. Gasoline and diesel engine equipped ships and ferries were more efficient and cost-effective than older steam-driven vessels. These factors furthered the decline in steamboat use (*The Burlington Free Press* 1929:6; Cohn 2003).

With the use of steamboats for commercial activity in the mid-1950s and the use of modern petroleum-based engines gaining popularity, a distinct shift in technology is evident. Usage changes, as well as the use of Burlington waterfront as a mercantile port, transitioned to recreational use for the public benefit. By the 1970s, the remaining industrial spaces along the waterfront began to be removed. By 1987, the Public Trust Doctrine mandated that the waterfront be converted to the use of the public. While some industrial spaces like the Burlington ferry terminal and the Vermont Rail yard still exist, the technological change led to a decline of the commercial use as much of the waterfront was transformed to public use (*The Burlington Free Press* 1987:1a).

Use, age, and deterioration are additional factors contributing to the decision to abandon *Hildegarde*. *Hildegarde* had a long life of sixty-one years and underwent several changes for new uses. The amount of time, energy, and investment in the ship are indicative of the owner's desires to keep the vessel viable. Transitioning between various uses and functions requires a lot of modification and augmentation. Given the age of the vessel, the various changes it went through, and obsolescence against newer technology, abandonment was the final option for the vessel. Located in the confines of the disused Pine Street Barge Canal entrance and the broader area mostly used by the Central Vermont Railroad, it was an ideal location to abandon the vessel.

The Turner & Breivogel barges represent box scows made for a single purpose, which was to haul hundreds of tons of stone for the Burlington Breakwater rehabilitation project. The overall architectural design of scow barges did not change much over the course of the 20th century as the Turner & Breivogel barges are basic examples of scows. Made primarily of wood, they would not have lasted longer than barges with metal hulls, which tended to be sturdier and had longer use-lives. As the vessels were heavily used for construction purposes, their abandonment in the confines of the Pine Street Barge Canal Basin was probably a decision made by the owners for scuttling purposes.

As the basin was re-opened intentionally so that the barges could be moored there, it also became their final resting place. In personal communication with the son of one of the owners of Turner & Breivogel, Don Breivogel recounted something his father said when he was still alive.

According to Don, the cost of bringing back the barges to Falmouth Massachusetts was too much for the construction company (Don Breivogel 11 July 2017, pers. comm.). The company owners decided to abandon the vessels in the Pine Street Barge Canal Basin. Bolstering this is information from an interview with Captain Merritt Carpenter, who said the barges were abandoned in the confines of the basin after completion of the rehabilitation project (Kane et al. 2008:92). As the area was already used to abandon *Excelsior*, the deposition of the barges in the area made sense as a place to deposit the barges.

Conclusion

The post-depositional context of the vessels in the Pine Street Barge Canal Basin Graveyard reveals patterns associated with cultural formation processes of *secondary salvage* as the extant archaeological remains consist of features below the waterline. Non-cultural formation processes from *biological agents*, *pedoturbation*, and *floralturbation* also impact each site through damage and obfuscation of ship parts. Post abandonment models of each ship articulate architectural features present before site formation processes affect and reduce the vessel to their archaeological context. Archaeological site plans with data collected on representative signatures of cultural and natural transformative processes help to interpret the physical manifestations of formation processes.

Based on the results of fieldwork, patterns observed on all vessels indicate bottom portions of the hulls as extant material remains while most of the upper structural elements are absent. *Secondary salvage* processes cut the vessels down to such an extent that salvage of larger timbers and material below the waterline was likely to be difficult. This would apply to vessels in deeper water like *Excelsior*, *Hildegarde*, and barge VT-CH-793. However, vessels like

Hildegarde and barge VT-CH-797 still have valuable material left on them as evident by the propeller on *Hildegarde* and the bollards on the barge. More suspect is the deck remains on the barge, evidence suggesting that *secondary salvage* processes might have not occurred.

Historic economic data of lumber, coal, and petroleum products from the *Annual Report of the Chief of Engineers* and population levels in Vermont provide some plausible correlational links to abandonment decisions based on the economic climate. However, given the gaps in available information based on trade goods, it is difficult to identify potential correlates. On the other hand, examples like the decrease of coal tonnages in the early 20th century and the abandonment of *Hildegarde* in 1937 represents a possible correlate as the vessel would have relied on coal as a fuel source. More in-depth research on Vermont historic economic trends would augment the future analysis of economic correlations to ship abandonment.

The introduction of newer technologies, such as the sailing canal boat, rail networks, and gasoline and diesel engines relate to changes in shipping and transportation in Burlington, Vermont. Given that the use-lives of the vessels effectively ended once they reached obsolescence, they could no longer serve their intended function. Since most of the surrounding maritime infrastructure was falling into disuse or under the ownership of the Central Vermont Railroad, the Pine Street Barge Canal Basin was a perfect area to abandon ships.

Technological correlates such as the introduction of sailing canal boats, trains and rail networks, along with the use of gas and diesel engines for automobiles and ships provide correlates between changes in shipping and transportation in the Lake Champlain region and vessel abandonment. The Champlain Canal and evolution of sail rigged canal boats replaced traditional lake schooners. Rail transportation and later roads led to the disuse and eventual abandonment of commercial sailing and steam vessels as they could not compete. More specifically age, use, and deterioration provide additional plausible explanations for the abandonment of the ships in the graveyard.

Since the Pine Street Barge Canal and Basin fell into disuse in the late 19th century and well into the 20th century, maritime operations in the area declined. Given that the Vermont Central Railroad owned and occupied much of the area, it further stifled maritime use of the Pine Street area along the Burlington waterfront. As a derelict harbor, the choice to abandon and salvage ships in the area is plausible. After the middle of the 20th century, much of the waterfront began transitioning from heavy industrial use to a recreational landscape. Though much of the businesses, infrastructure, wharves, and rail lines are gone, a substantial amount of historic buildings and archaeological sites remain. Other derelict vessels are also present throughout the Burlington waterfront and other areas of Lake Champlain, which gives credence to the potential for future research in the region on ship graveyard studies.

CHAPTER 7: CONCLUSION

Introduction

The vessels within the Pine Street Barge Canal Basin Ship Graveyard is a collection of ships that represents a segment of time where the port of Burlington, Vermont thrived as a commercial center. From the late 18th century when the city was founded after the American Revolutionary War, Burlington steadily grew as Lake Champlain provided a navigable water route through the entire region. As newer technologies of sailing canal boats, steam engines, trains, and eventually automobile developed, a distinct change in the industry and economics of the port of Burlington occurred. As the city piqued commercially by the start of the 20th century, much of the older marine vessels and infrastructure fell into disuse. With the newer technological developments, vessels like the collection of ship remains in the graveyard became obsolete and were discarded. As abandoned ships within the confines of the waterfront, they are significant sources for research and analysis of the history of Burlington.

Correlational links from the historical record and the archaeological remains of the vessels in the Pine Street Barge Canal Basin Graveyard presents a system to evaluate abandoned ships and their relation to social, economic, and technological trends. As a progression of events that pertain to the decline in maritime industries of the Burlington waterfront, research, and subsequent analysis focused on human decisions that are represented in the archaeological remains. Circumstances responsible for influencing behaviors was reviewed through the historic record to deduce the reasons for abandonment.

Research for this thesis is based on Schiffer's concepts from the theory of site formation processes. Chapter 3 outlines the theoretical concept of site formation processes and their application to ship abandonment and graveyards. Processes from both *systemic* and *archaeological* contexts provided the means to understand how events and processes produce archaeological sites and the decisions that affect and influence them. Modified theoretical concepts of abandonment attributed to Richards' work further enhances the paradigm of *cultural* and *non-cultural transformation processes* and provides an explanation of their effects on the archaeological record.

The methodology used for this thesis as discussed in Chapter 4, relied on three phases of historical research, archaeological research, and fieldwork planning. The historical research was crucial to establishing the histories of each vessel and to place them within their systemic context. The archaeological research aided in establishing a baseline of previous research for the development of fieldwork planning. An analytical framework for the collected data organized all the information found through historical and archaeological research.

Chapter 5 outlines the histories of the ships within the Pine Street Barge Canal Basin Graveyard and their use-lives within the systemic context. In addition, *pre-depositional* models of the vessels in their intact form highlights the *cultural transformation processes* of salvage and the effect on each vessel. The archaeology of the vessels in Chapter 6 further illustrates the effects of site formation processes on the ship's *post-depositional* context. Documented locations of the site formation processes on the archaeological site maps and reference tables provide evidence and inferences on observed patterns of *cultural* and *non-cultural transformation processes*. The correlational data found in the historic and archaeological record generated links between abandonment and broader changes in social, economic, and technological trends pertaining to the maritime industries of the Burlington waterfront. However, links based on the economic data appeared to be unclear and warrant for further research.

Conclusions Drawn from the Pine Street Barge Canal Basin Ship Graveyard

Conclusions drawn from historical and archaeological research that answer the research questions posed for this thesis are discussed below. For the primary question querying what the abandonment of the five vessels in the Pine Street Barge Canal Basin Ship Graveyard can tell us about changes to the nature of shipping and transportation in the Burlington, Vermont area, the answer is complex. Research shows that the vessels within the basin are essentially remnant products associated with commercial activities that rose and declined from the late 18th century into the 20th century. Historically, shipping and transportation on Lake Champlain relied on sailing vessels like sloops and schooners. Locally manufactured ships like *Excelsior* served as the primary hauler of bulk cargo along the coast of the lake. Given the time of service from 1850 to 1884, it was operating in conjunction with sailing canal boats, steamships, and the railroad.

While *Excelsior* was a capable cargo vessel as indicated by the limited newspaper accounts, its service to the lake was limited in the face of newer technologies like the sail equipped canal boat and steam equipped ships. Canal boats had the advantage of being able to lock through the Champlain Canal system and operate under sail with a drop keel for added stability in deep lake waters. Geographically, service of canal boats was also much more extensive as both the Champlain and Chambly Canals connected Lake Champlain to a larger inter-regional area. As indicated by the statistics from *Annual Reports of the Chief of Engineers*, goods like coal and timber products rose in total tonnages from the 1860s to the turn of the century.

As steamships rose in use during the 19th century, they provided service to both passengers and as tugs for un-powered canal boats. Sailing schooners like *Excelsior* had a limited cargo capacity of about 100 tons, a steam-powered ship could tow over several hundred tons and collect revenue from passenger service. Rail service also imposed competition upon traditional sailing vessels. Trains operating on railroads not only had the advantage of hauling more cargo tonnages with passengers, but also operated nearly year-round on fixed schedules. *Excelsior* enjoyed a long career (as will be discussed in answer to the secondary questions), but in a changing commercial waterfront, it could not adapt. By the time *Excelsior* was abandoned in 1884, much of the waterfront of Burlington was developed with the infrastructure used to service canal vessels, steamships, and trains – a mark of the rise in economic prosperity.

As another remnant and aging vessel operating in the changing commercial waterfront of Burlington is *Hildegarde*. *Hildegarde* has the interesting position of being a ship that it did not operate on the lake originally, but was a racing yacht built in 1876 in Islip, New York. When it first appeared in Lake Champlain in the 1920s, it was converted from a sloop yacht to a steam-equipped ferry. It was converted again to a tugboat, a behavioral sign showing that the owners of the ship spend considerable time, effort, and money to keep it economically viable. Indeed, it would have as automobiles were heavily in use with ferry service points located all along the lake. Operation as a tugboat for hauling bulk cargo like stone is another example of its economic viability.

However, *Hildegarde* was in operation at a time when commerce through the canals was starting to decline. Economic statistics from the *Annual Reports of the Chief of Engineers* depict a marked drop in total product tonnages for timber and coal toward the end of the 19th century and into the 20th century. Additionally, petroleum products gained momentum as one of the main groups of commercial goods arriving at the port of Burlington in the early 20th century. Many of the newer vessels made to haul oil products were self-propelled and did not rely on service from tugboats like *Hildegarde*.

Aside from being a heavily invested in the vessel, *Hildegarde* was also an older vessel still outfitted with steam technology. Petroleum-based marine engines were gaining in popularity and use by the time *Hildegarde* was nearing the end of its use-life. Steamboat use in general was already declining on the lake with only a few of the larger steamships owned by the Champlain Transportation Company still in use for passenger and ferry service. By the middle of the 20th century, the use of steamships came to an end in the region. As another outdated and technologically obsolete vessel, *Hildegarde* was abandoned in 1937.

The latter half of the 20th century, much of the waterfront of Burlington declined in commercial activity. However, oil and petroleum products still arrived in port with historic data showing increased tonnages from the late 1940s to 1970. The Pine Street Barge Canal areas were already in disuse except for the yards and tracks owned by Vermont Railroad. By the late 1950s, the Burlington Breakwater fell into disrepair and some sections sustained damage from ice and storms. As a historic and important piece of infrastructure used to protect the harbor of Burlington, the city undertook steps to repair it. The Army Corps of Engineers selected the contractor Turner & Breivogel to conduct repairs on the breakwater using the scow barges that are present in the Pine Street Barge Canal Basin Graveyard.

Unlike *Excelsior* and *Hildegarde*, the three scow barges used by Turner & Breivogel were not old vessels. They only had a use-life span of nearly five years, which is roughly the same amount of time it took to rehabilitate the breakwater. The barges do represent a concerted effort to maintain the Burlington breakwater on part of the community and government. The time and money spent on contracting Turner & Breivogel to do the repair work indicate an investment in the degrading port infrastructure. As purpose-built wooden barges, their use in hauling thousands of tons of stone and other construction material must have taken a toll on the structural integrity of the barges, leading to the owner's decision to abandon them.

Secondary research questions posed by this thesis focus more on the vessels in addition to the theme of abandonment and the potential of the vessels being a navigation hazard. The first question is why were these vessels abandoned and what can they tell us about the use-life of each vessel? Based on historical and archaeological research combined with applicable principles of site formation theory, it was found that the primary reason for the abandonment of these vessels is that each vessel reached the end of its use-life and became obsolete. Each vessel had a specific use-life while it the systemic and *pre-depositional* context and retained value as they underwent *lateral cycling* and *primary salvage* once discarded. Each vessel continued to retain value in their *post-depositional,* or archaeological context, as they underwent *secondary salvage* processes before they were abandoned.

As remarked on above in the discussion on the answer to the primary thesis question, *Excelsior* enjoyed a long career of 34 years as a traditional lake sailing schooner in its systemic context. From 1850 till its abandonment in 1884, the process of *lateral cycling* affected the vessel as it went through three different owners and masters based on historic information from the records of enrollment. *Excelsior* is also representative of an earlier vintage of schooners that developed from the Hudson River tradition of centerboard equipped, the shallow draft vessel used predominantly in the 19th century. As the ship reached the end of its use-life at a stage of obsolescence, it was discarded, and *primary salvage* processes cut the vessel down. In its *post-depositional,* the vessel still had value for salvage and underwent *secondary salvage* before abandonment.

Hildegarde had an even longer use-life span of 61 years in its systemic context and more of a varied career in terms of its *primary mercantile* function. Using primary sources to find the owners of the vessel combined with the process of *lateral cycling*, *Hildegarde* had five different owners from 1876 to 1937 when it was abandoned. During its lifespan, the vessel also underwent modifications and conversions from its *primary mercantile* function as a racing sloop yacht to a gas engine, then steam equipped car ferry for its *secondary mercantile* function. It can be argued that *Hildegarde* had a final *tertiary mercantile* function when it was used as tugboat by Herbert Pashby in the 1930s. Given its long lifespan, the vessel reached a point of uselessness and *primary salvage* and *secondary salvage* processes reduced the ship to a non-floating condition, where it was finally abandoned.

Conversely, the Turner & Breivogel barges had much shorter use-lives in their *pre-depositional* context as they served as construction barges in their *primary support* function from about 1962 to 1964. While the barges were not formally registered based on research, an extensive amount of documentation was found through newspapers. *The Burlington Free Press* depicted nearly the entire routine of work the barges engaged in during the rehabilitation of the Burlington Breakwater. Carrying cranes, stone, and other related construction material, the Turner & Breivogel barges were vital to the building project. Given the fact that some of these vessels sunk during the construction project, it is evident that the general wearing of the barges occurred. With the owners making the decision to leave the barges in the basin where they moored during the project due to cost prohibitions and worn condition, the barges were broken down through *primary salvage* and abandoned.

The last two questions are related to a degree as they concern queries related to their locations and potential to cause hazards to navigation, shipping, and transportation. Accordingly, why were they abandoned within the confines of the inner breakwater adjacent to the Pine Street Barge Canal and the Northern sections of the Waterfront District? Also, did the presence of the schooner *Excelsior* (VT-CH-796), Construction Barge 1 (VT-CH-795), Construction Barge 2 (VT-CH-793), Construction Barge 3 (VT-CH-797) and *Hildegarde* (VT-CH-794) present navigational hazards for maritime shipping and transportation? Based on the historical research into the dis-use of maritime traffic into the basin areas and the conditions of the boats, it is apparent that the basin of the Pine Street Barge Canal area was selected to be a dumping ground for unwanted ships.

The first ship to be confined within the basin was *Excelsior* in 1884. While maritime traffic was still in operation going into the entrance of the Pine Street Barge Canal via the southern and northern breakwater jetties, traffic into the basin itself was minimal. The shallow depth of the basin most likely was prohibitive for deep drafted vessels to safely use without running the risk of grounding. In addition, the gap in the northern breakwater for entrance into the basin was sealed in 1893. With the basin sealed any much of the surrounding area owned by the Vermont Railroad, the basin served as a safe dumpsite for *Excelsior*.

As canal boat traffic began to decline in the 20th century, The Pine Street Barge Canal fell into disuse. In 1937, *Hildegarde* was abandoned farther outside of the northern breakwater basin adjacent to the interior of the southern breakwater father out in deeper water. Given the depth of the area, the location of the abandonment area next to the southern breakwater arm, and the fact that shipping through the Pine Street Barge canal was declining, it appears as though the decision made to dump *Hildegarde* would not have caused any danger to navigation.

The reasons for the abandonment of the Turner & Breivogel barges within the confines of the northern breakwater in 1964 are likely related to decisions made by the company owners.

Given the already limited maritime traffic and use of the area, once the barges came to the end of their use-lives, they were deposited in the basin. Before abandonment, the basin was already being used to moor the vessels during the Burlington Breakwater rehabilitation project. The remains of *Excelsior* were already in the basin, possibly influencing decisions to use the area to salvage and abandon the barges. As a ship graveyard, the abandoned barges would not have presented any danger to navigation, shipping, or transportation.

Unanswered Questions and Limitations

This thesis has several unanswered questions and limitations. One of the issues encountered during research on this thesis is the lack of historical research on *Excelsior*. As a documented vessel with service solely in the Lake Champlain waterway, there must be more information on the ship, such as the shipyard that built it, lines and construction drafts, photographs, cargo manifests, and other data. Information pertaining to *Hildegarde* and the conversion processes from sloop to a gasoline equipped freighter, and then to a steam engine car ferry and tugboat are also not known. If this information can be found, it would highlight the modification undertaken on the ship. Illumination into the decision processes related to the alteration of *Hildegarde* could provide a better understanding of why the vessel was heavily invested in.

One of the limitations in the thesis is the extent of economic statistical data for commercial products coming in and out of the port of Burlington. While the Army Corps of Engineers *Annual Reports of the Chief of Engineers* are great primary sources for data, there are discrepancies in the reports as some mention data for commodities while others do not. Further research into the Vermont State Archives is warranted in order to provide better evidence for economic correlations to the abandonment of ships in the Pine Street Barge Canal Basin.

Another limitation was the fieldwork done to record the ships using photogrammetry for three-dimensional modeling. It is acknowledged that there was the potential for human error in recording as many of the models processed through *Agisoft Photoscan* did not process. Conditions of the site presented one of the biggest limitations in terms of fieldwork. While the weather most days was good, the amount of sunlight and the gradually warming temperatures of the lake made for perfect conditions for vegetative and biological growth. The proliferation of milfoil and algae made the observation of each ship nearly impossible without clearing. Conglomerations of zebra mussels on all the ships obscured features and sadly, contributes to the overall deterioration of the vessels. There may be a time when these remains are almost entirely disintegrated by the effects of the mussels.

Suggested Possibilities for Future Research

As stated by Seeb (2007:215), "Ships' graveyards are an underdeveloped and under-researched area of the subdiscipline of maritime archaeology." Research into the collection of abandoned vessels in the Pine Street Barge Canal area helps to provide information into this subdiscipline of maritime archaeology. Along with this collection of vessels including the abandoned canal boats in the canal itself (Kane et al. 2010), the entire Burlington waterfront is littered with the remains of vessels. While is unclear if the larger collection of vessels were intentionally abandoned, they contribute to the archaeological and historical record of the maritime industry, commerce, and technological change in the port of Burlington. Research into this geographic area for ships' graveyards is minimal and the study of freshwater abandonment sites will augment the field of maritime archaeology.

The vessels found within the confines of the Pine Street Barge Canal Basin Ship Graveyard represent only a small portion of abandoned ships in Burlington Harbor, let alone in Lake Champlain. Previous research on Carolyn Kennedy's work on the Shelburne Shipyard Steamboat Graveyard (Kennedy and Crisman 2014; Kennedy 2015, 2016) identified the remains of four 19th century steamboats in the shallow waters adjacent to Shelburne Shipyard in Shelburne. Vermont. It would be interesting to study patterns of use and salvage on these vessels and generate a comparative analysis between them and the vessel remains in Burlington. Collaborate research with Kennedy and the Institute for Nautical Archaeology on ship graveyards in Lake Champlain would contribute to future research in abandonment studies.

Conclusion

This thesis established the Pine Street Barge Canal Basin Graveyard as a small-scale example of the broader changes and developments of social, economic, and technological trends pertaining to the maritime industries of the Burlington waterfront. The theoretical principles of site formation processes applied to the systemic and archaeological contexts of each vessel provided a means of better understanding their use-lives and signatures of abandonment. Research aided in generating chronological histories of the vessels while data on economic, technological, and use correlated the historic record to the archaeological record. While research has already been done on the ships within the Pine Street Barge Canal Basin Graveyard, this thesis provides a substantial contribution to previous studies. In doing so, it enhances the study of ship abandonment and graveyards in maritime archaeology. The thesis also demonstrates the importance of understanding the industrial maritime past of the Burlington Waterfront and the need to research, preserve, and educate the broader public on the history of Lake Champlain.

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APPENDIX A: PERMIT FROM THE VERMONT DIVISION FOR HISTORIC PRESERVATION


VERMONT

State of Vermont
Division for Historic Preservation
Deane C. Davis Building, 6th Floor
One National Life Drive, Montpelier, VT 05620-0501
www.accd.vermont.gov/strong_communities/preservation/

[phone] 802-828-3540

Agency of Commerce and Community Development

Archaeology Permit No. 2017-5

In accordance with Title 22 of Vermont Statutes Annotated, Chapter 14, Subchapter 7, Section 764 or Subchapter 9, Section 782, permission is hereby granted to **Paul Willard Gates** to carry out archaeological investigations and underwater survey as described in a permit application dated **July 22, 2017**. The work covered under this permit will generally consist of **thesis research for East Carolina University and the Lake Champlain Maritime Museum**.

This permit is subject to the special conditions specified on Page 2, and to the general conditions agreed to by the applicant on July 22, 2017 in the 2017 permit application.

Effective Date: July 22, 2017

Expiration Date: July 22, 2017

By: ______________________

Jess Robinson, PhD.

Vermont State Archaeologist

APPENDIX A. State of Vermont Division for Historic Preservation archaeology permit No. 2017-5, page one (Courtesy of the State of Vermont Division for Historic Preservation).

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