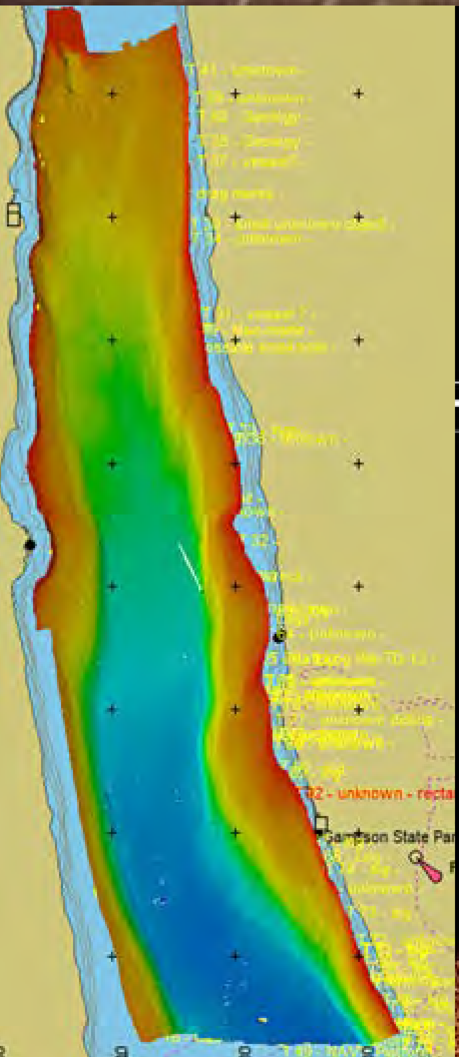

Seneca Lake Archaeological & Bathymetric Survey

2019 Final Report

Submitted by

Art Cohn, Principal Investigator

DIRECTOR EMERITUS, LAKE CHAMPLAIN MARITIME MUSEUM

Dr. Tom Manley, Chief Scientist

ASSISTANT PROFESSOR OF GEOLOGY, MIDDLEBURY COLLEGE

The Seneca Lake Survey Team

Tim Caza, Dennis Gerber, Matt Harrison, Peg Ellsworth, Craig Williams, Mark Peckham, Chris Sabick, Rob Parker, Captain Rich Furbush, Jonathan Eddy

An aerial view looking west over Willard on Seneca Lake and the area surveyed in 2018 and 2019. Bill Hecht

What Lies Beneath?

Looking out on Seneca Lake today, its beauty sometimes makes it difficult to realize the important role the lake has played in our history. The Seneca Lake Survey Project is chronicling the lake's history and unlocking the secrets of the archaeological record it contains. In addition, using state-of-the-art survey technology, the same effort being used to inventory the lake's underwater cultural heritage, is providing an opportunity to bathymetrically map the lake's dynamic underwater landscape. It is our goal, when we have completed the survey to be able to accurately explain what lies beneath.

Detail from Cadwallader D. Colden, ***Memoirs*** *prepared at the Request of the Committee of Common Council of the City of New York, 1825.*

William L. Clements Library, University of Michigan

The year 1825 was the culmination of decades of discussions, surveys, political agitation and seven years of intense construction that led to opening of the Erie Canal navigation system. This report connects that world-changing historical event with a newly-discovered submerged cultural resource collection of intact, early canal boats at the bottom of Seneca Lake.

(right) **Detail from Cadwallader D. Colden,** ***Memoirs*** *prepared at the Request of the Committee of Common Council of the City of New York, 1825.*

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June 2020

FINGER LAKES REGION
From Space

Advanced Satellite Productions, Inc., and Atwater Estate Vineyards

The Finger Lakes

The Finger Lakes are a series of eleven elongated, narrow, north-south oriented glacially-formed lakes in central and western New York State.

As the Ice Age glacial front proceeded from the Ontario Lake Plain, it encountered the north-facing escarpment of the Appalachian Upland, which was cut by a series of pre-existing stream valleys running roughly in the same direction as the ice flow. The advancing ice was concentrated into the valleys, which it scoured and deepened, in some cases by 1000 feet or more. A recessional moraine deposited to the south of the lakes functions as a divide between the Lake Ontario and Susquehanna River drainage systems.[1]

Seneca Lake is the largest of the Finger Lakes, 36 miles long and three miles wide at Dresden. The lake is 634 feet deep and flows from south to north. The Lamoka culture settled about 2500 BC near Geneva at the north end of the lake. The Seneca were established by 1400 AD but after 1779, no longer retained land holdings near the lake.

Water transport provided access and industrial and commercial opportunities around the lake. The Erie (1825), Chemung (1833) and Crooked Lake (1833) Canals made the lake commercially accessible from north, south and west. Barges, ferries, and steamboats were all important to settlement and development until the dominance of rail following the Civil War. By 1878, Chemung and Crooked Lake Canals were closed. The Erie Canal, as part of the New York State Barge Canal System after 1918, still connects Seneca Lake to the interconnected waterways of the region.[2]

(1) *The Encyclopedia of New York State.* Syracuse University Press. Syracuse New York, 2005. p. 561.
(2) Ibid, p.1393.


Seneca
Lake
(Elev. 446)
Cayuga
Lake
Owasco
Lake
(Elev. 712)
Skaneateles
Lake
Canandaigua
Lake
(Elev. 688)
Keuka
Lake
Auburn
Ithaca
Geneva
Baldwinsville

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Sunset through the rigging of the *Lois McClure*, September, 2018. From Stivers Marina at the northern entrance of the New York State Canal and Seneca Lake.

The steamboat *Seneca* at the dock at Watkins [Glen]. Built in 1870, she was originally christened the *Otetiani*, which in the Seneca language means "always ready." With changing times and declining traffic on Seneca Lake, she was dismantled in 1909. Geneva Historical Society

Executive Summary
Seneca Lake Shipwrecks and Bathymetric Survey 2019

In 2018, researchers from the Lake Champlain Maritime Museum organized a limited, submerged cultural resource survey project in Seneca Lake. The initial objective was to locate a coal-laden canal boat, the *Frank Bowley*, which sank there in 1869. A detailed and dramatic account of the vessel's loss in a severe November storm was reported in the newspapers of the day and included very specific geographic locations. On the very first day of survey operations, our side-scan sonar team was able to locate a target that proved to be the shipwreck *Frank Bowley*. When the target was examined with Remote Operated Vehicle (ROV) cameras, it was found to be the intact canal boat sitting on the bottom of Seneca Lake still loaded with her cargo of coal. Finding the *Frank Bowley* was a very positive beginning, but by the conclusion of this short-duration survey, our team had located an additional seven shipwrecks on the lake bottom.

The Bicentennial of the New York State canal system is being commemorated between 2017 and 2025. What better way to enhance our understanding of that history than by inventorying and documenting a collection of intact historic wooden canal boats? All the promising sonar targets were located in deep water and were also examined by ROV technology. These inspections revealed a collection of largely intact early 19th-century canal boats in remarkably good condition.

These results were stunning but not surprising. Seneca Lake had been an important part of the region's maritime transportation system and at its height had been linked to the Erie Canal by the Cayuga and Seneca Canal, a navigable connection that still exists. In addition, the Chemung Canal connected Seneca Lake at Watkins Glen to Elmira, Corning and the coal regions of Pennsylvania. At Elmira, the Junction Canal provided a connection to the Pennsylvania canal system and the Crooked Lake Canal connected Seneca Lake at Dresden to Crooked Lake, now Keuka Lake. The result was a dynamic waterway for passengers and commerce that helped build the region and define New York State. Competition from railroads ultimately drove the wooden boat fleet out of business, but not before sudden storm events took their toll and sent dozens of ships to the lake's bottom.

These sinkings were always a tragic loss for the boatmen and their family. While some losses, like the *Frank Bowley*, involved the economic loss of canal boat and cargo, other accounts report the loss of the valuable draft animals that lived aboard in bow stables. These economic losses were traumatic and could throw a canal boat family into poverty. In the worst accounts, the sinking would include a human toll with the loss of family members or crew.

This active commercial era lasted for more than half a century. Today, the resulting collection of shipwrecks is a public legacy managed by the New York State Museum, Office of Parks, Recreation and Historic Preservation (OPRHP), Department of State, Office of General Services and Department of Environmental Conservation. The goal of this survey, which operates under a NYS Museum permit and support from OPRHP, is to produce an inventory of shipwrecks and other submerged cultural resources contained on the bottom of Seneca Lake. This collection can be studied and managed for future generations.

Our experience from Lake Champlain has also taught us that with modern sonar technology it is possible to both inventory cultural resources and with the same effort, gather sophisticated bathymetric data that can add much to our understanding of the topography and geology of the lake bottom. The data set gathered by the multi-beam sonar system mounted on the research vessel can be transformed into maps and images of the lake bottom. Building on the success of the initial 2018 program, we incorporated the R/V *David Folger* into the 2019 survey. The R/V *David Folger,* a 48-foot x 17-foot research vessel, was funded by a National Science Foundation grant. The fine ship was named for David Folger, the head of Geology and Environmental Studies sections for the US Geological Survey based in Woods Hole, MA. David taught at Middlebury College for six years. During this time, he worked with the community and his students to provide scientific evidence in a victorious Supreme Court case involving pollution in Lake Champlain. David is credited with initiating the Middlebury College Marine Studies program.

David Folger (1931–2017)

Proposed Strategy for 2020

The 2019 involvement of the R/V *David Folger* and Middlebury College scientist Dr. Tom Manley allowed us to inventory and map the bathymetry of 30% of Seneca Lake. Support from the Sampson State Park Marina, the Willard State Drug Treatment Campus and the Romulus Historical Society made for a very efficient daily routine. Our proposed plan for 2020 was to return to Seneca Lake with the R/V *David Folger* and our experienced survey team to continue mapping. We estimate that it will require two more years to complete the mapping and fully inventory the shipwrecks. Discussions have already begun about the feasibility of executing a similar survey in Cayuga Lake.

As this report was being prepared, the world is experiencing an epic pandemic with impacts to all segments of society. The Seneca Lake Survey has cancelled its proposed plans for 2020 and now plans to implement the next on-water survey in 2021.

R/V *David Folger* Middlebury College research vessel, at the dock at the Sampson State Park Marina on June 26, 2019. Pictured left to right, Matt Harrison, Art Cohn, Captain Rich Furbush and Tom Manley. NYS Parks

Transiting the Champlain, Erie and Cayuga & Seneca Canals, June 2019

The Seneca Lake survey is taking place, in part, to coincide with New York State's canal system bicentennial. The canal system's 200 years of continuous service and its expansion into today's hundred-year-old Barge Canal still allows for the movement of heavy and oversize loads along the water highway. Transporting our research platform to Seneca Lake provides a case-in-point.

The Middlebury College 48-foot-long R/V *David Folger* proved to be the perfect survey platform for the Seneca Lake Project, however the 17-ton research vessel is 17 feet in width and could not have been used for the survey without a functioning canal. As over-the-road transport was not an option, the Barge Canal permitted the R/V *Folger* to enter the Champlain Canal at Whitehall, travel south to the Hudson River and the junction of the Erie Canal, turn west on the Erie system to Waterloo on the Cayuga-Seneca Canal to Seneca Lake.

(above) Detail. ***"Junction of the Western and Northern Canals,"*** *Colden Memoir,* 1825. (below) The junction of the two canals on June 18th, 2019 as we passed by aboard the R/V *Folger* en route to Seneca Lake.

We calculated that the all-water round trip would take us more that 500 miles and lift or drop us through more than 75 locks. Each transit was scheduled to take seven days, but heavy rains, swollen rivers and swift currents on the outbound leg almost caused that schedule to be delayed. During weather events, the 200 years of experience of the canal system and the dedication of its employees rises with the water to take care of mariners. In this tightly-scheduled journey to move the survey platform onto Seneca Lake, the Canal's section supervisors, engineers, floating plant personnel and lock operators embraced the challenges and with skill and determination, facilitated our movements to keep our schedule.

On our way out to Seneca Lake we stayed overnight at the following ports. For our transit home, we simply reversed the sequence.

1. Point Bay Marina to Fort Edward
2. Fort Edward to Waterford
3. Waterford to Amsterdam
4. Amsterdam to Little Falls
5. Little Falls to Rome
6. Rome to Baldwinsville
7. Baldwinsville to Seneca Lake

Heavy rain produced high water, strong currents and debris on the canal. Note the debris in front of the guard gate on the right. Despite the challenging conditions, with the assistance of the Canal Corporation team we were able to arrive at Seneca Lake on schedule.

The R/V *Folger* at the Rome Harbor dock heading west.

The crew celebrates their arrival at the Sampson State Park Marina. (right) Jonathan Eddy, (center) Art Cohn, (left) Captain Richard Furbush.

The R/*V David Folger* at the dock at the Sampson State Park Marina.

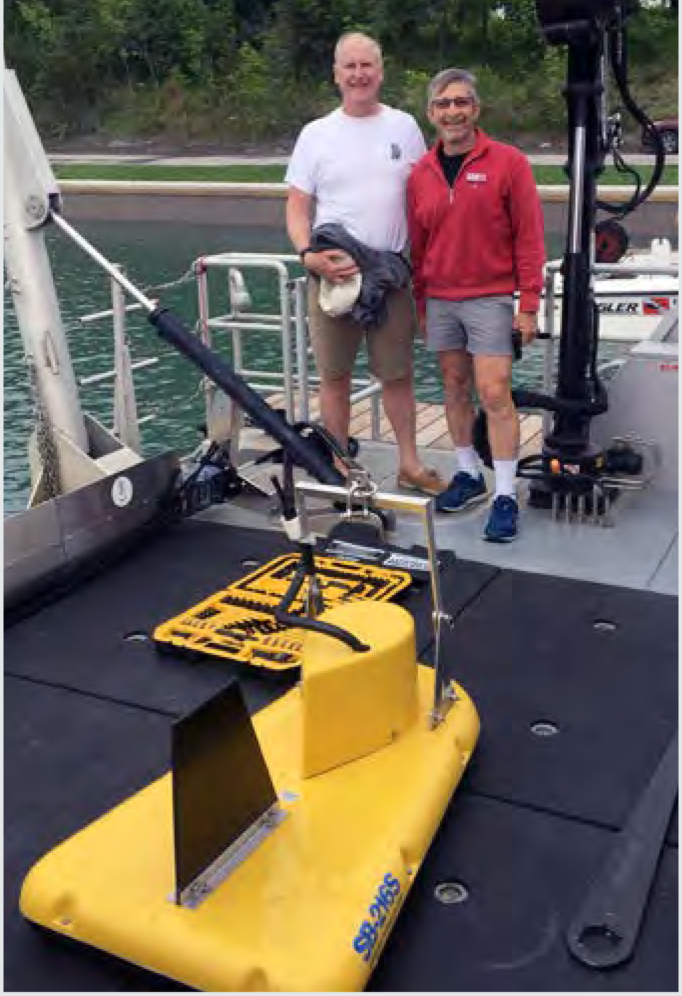
The Seneca Lake Survey Fleet. Taken by a drone as the *Underwater Research Vessel Voyager* (left) escorts the R/V *David Folger* as she travels homeward bound on Oneida Lake. Dennis Gerber

2019 Logistical Review

The 2019 Seneca Lake Survey Project was a success. The research vessels, survey team and community support all met or exceeded our expectations. The results of the survey speak to that accomplishment as we located at least seven new shipwrecks and systematically mapped the bathymetry of approximately 30% of the bottom of Seneca Lake. The two-boat operation proved to be an efficient approach to surveying and verification.

Another project accomplishment was the ability to include a large number of community members, researchers and interested parties aboard the R/V *David Folger,* as observers of the survey process. Even the weather cooperated, and although a survey of this type and duration would expect to have some poor weather days that impede operations, the 2019 survey experienced no time lost from bad weather.

Under the capable management of scientist Dr. Tom Manley, an expert in bathymetric survey, the core survey effort was assured technical excellence. The two-boat operation further maximized our efficiency. The R/V *David Folger*, a 48-foot, purpose-built survey vessel served as the primary survey platform. The R/V *Folger* has a sophisticated multi-beam sonar system permanently affixed to the vessel, a state-of-the-art navigation and positioning system, and a suite of computers to log the mass of data being compiled. The second survey vessel, *Underwater Research Vessel Voyager*, is a 24-foot platform which has the ability to investigate targets with side-scanning sonar, a tool that provides different details than the multi-beam sonar on the R/V *Folger.* In addition, this survey vessel was also used for relocating targets so they might be examined by Remote Operated Vehicle (ROV). By being able to keep these two well-equipped and expertly-handled vessels in motion, the team was able to survey a large section of Seneca Lake, locate and examine a number of shipwreck targets, and identify a number of interesting geological features that add to our understanding of the physical dynamics of Seneca Lake.



Chief Scientist Tom Manley (r) and transit crewman **Jonathan Eddy** (l) getting the R/V *Folger* ready to begin survey activities. LCMM

The Crew

The success of the 2019 survey can be directly linked to the experience, work ethic and team dynamics of the principal participants.

Dr. Tom Manley has worked as a scientist and survey specialist for three decades. Tom served as a principal investigator for the Lake Champlain "Whole Lake Survey" a ten-year effort to both inventory the submerged cultural resources as well as map the bathymetry and create new topographic maps of the lake bottom.

Captain Richard Furbush has worked aboard and commanded science vessels for more than four decades. His skill as a master-mariner as well as a science-gathering technician was invaluable.

Captain Richard Furbush, on the R/V *Folger's* upper deck at work on the hydraulic station controls. LCMM

Tom and Richard were the initiators of the National Science Foundation grant to create the R/V *David Folger,* a state-of-the-art survey and teaching platform and were the principal designers of the vessel's systems. Their combined experience allowed for any technical glitches to be rapidly diagnosed and successfully fixed.

Captain Tim Caza, is captain of the *Underwater Research Vessel Voyager*. Tim has been surveying for shipwrecks for two decades and was the principal investigator that surveyed all of Oneida Lake. He discovered the only known archaeological example of a Durham boat, a type of pre-canal watercraft. Tim actively surveys in Lake Ontario and wants to work with New York State and other regulatory agencies to help manage the state's collection of submerged cultural resources.

Dennis Gerber is a sonar expert who spent his career working with a variety of technical programs that use sonar technology. Dennis has great command of electronics and was able to troubleshoot and help repair a number of the ever-present technical issues with the gear.

Sonar experts Dennis Gerber (l) and Captain Tim Caza aboard the *Underwater Research Vessel Voyager.* LCMM

Matt Harrison** is an educator with the LCMM and a mariner. Matt provided significant support for all crew operations during the on-water survey phase of the project, helped with overall management and is a contributor to the grant-writing program. He is also developing an educational component for regional K-12 schools.

Art Cohn is the Principal Investigator for the Seneca Lake Project. He saw the need and opportunity to survey Seneca Lake and worked with NYS agencies and public and private agencies to design, permit and fund the initiation of the Seneca Lake Survey. Art has been surveying, diving and documenting shipwrecks for more than forty years and helped define the program and assemble the team.

Survey crewman Matt Harrison preparing to deploy the sub-bottom profiler from the stern deck of the R/V *Folger.* LCMM

Logistical Support

SamSen Marina, LLC, @ Sampson State Park

Given the size of the two survey vessels and the complexity of the operational plan, finding the right marina as a base was critical. During the winter of 2019, we looked at the few marinas which could accommodate a vessel the size of the R/V *Folger* and found the Sampson State Park Marina in the midst of a complete restoration. During my first visit I found a cofferdam across the entrance and a de-watered marina being excavated by bulldozers, excavators and dump trucks. Everything from the docks to the electrical service would be brand new. After hearing our plans, SamSen Marina manager Tim Wixom immediately offered to assist with the survey effort. Its location, roughly ten miles south of the entrance to the canal at the north end, would permit us to survey both north and south of the marina entrance. This facilitated the survey operation and permitted the boats to come ashore to pick up or drop off crew, guests or supplies.

Principal Investigator Art Cohn at the dedication of the new Sampson State Park Marina. Art reflected on the history of the Sampson Naval and Air Force Training Stations as well as the underwater survey's findings to-date. NYS Parks

Sampson Naval Base recruits (left) learned small boat handling on Seneca Lake during WWII in preparation for going overseas.

Dedication Day, Sampson State Park Marina, (below) June 26, 2019 with the R/V *David Folger* at the dock on beautiful Seneca Lake. LCMM

Willard State Asylum for the Insane. c.1884. The institution which is now commonly referred to simply as Willard was officially opened in 1869 as Willard Asylum for the Chronically Insane. By 1877 Willard, at 475 acres and 1500 patients, was the largest asylum in the United States. In 1995, the then Willard Psychiatric Center closed its doors.
(Romulus Historical Society)

New York State Department of Correction and Community Supervision

Willard Drug Treatment Campus

Housing the crew was another very important element of the program logistics. It needed to be both convenient to the marina and within the project's modest budget. With the help of the Romulus Historical Society, we were introduced to the Superintendent of the historic Willard State Correctional Facility. After understanding our needs, Superintendent Rickey Bartlett checked with his supervisors in Albany, and upon recognizing we were working under a New York State Museum permit and with support from the NYS Office of Parks, Recreation and Historic Preservation and Canal Corporation, graciously agreed to put the crew up in a dormitory normally used to house personnel who come to Willard for training.

Romulus Historical Society

The Romulus Historical Society provided indispensable support in arranging the marina and housing. They also provided daily logistical support for purchasing supplies. Remarkably, Craig Williams and Peg Ellsworth also procured food and cooked dinner for the crew every night for the entire team. It was an extraordinary contribution that saved the crew a tremendous amount of time and energy.

The Romulus Historical Society also provided a means to bring the results of the survey to the public. In 2018 they held a standing-room only lecture, and on July 2, 2019 they hosted a community presentation and Q and A session with the crew.

Romulus and Varick, 1874 (map detail). The local community embraced the crew and provided critical support for the survey. Romulus Historical Society

Tom talks with Geology Professor Dr. John Halfman and students from Hobart & William Smith Colleges.

(top left) **Admiral William Sampson.** Born in 1840 in Palmyra on the Erie Canal, Admiral Sampson went on to graduate first in his class at the United States Naval Academy. During the Spanish-American War he commanded the North Atlantic Squadron and was President of the Board of Inquiry to investigate the destruction of the battleship *Maine*. Sampson Military Museum

Sampson Naval Training Station

During WWII, the federal government established Sampson Naval Training Station on Seneca Lake. It opened in 1942 and during the war trained over 400,000 recruits. At the end of the war it served as a separation center for the discharge of 65,000 veterans.

After the war, the government transferred one of their huge hall facilities, like the one shown above, to Middlebury College to serve as a field house, a task it still performs. Middlebury College is a principal partner in the current Seneca Lake underwater survey. US Navy Brig Museum

On-Board Orientation

The location of the Sampson State Park Marina made it possible to offer access to interested parties to come aboard and experience the survey procedure in real time. We were able to host on board representatives of the NYS Department of Environmental Conservation, NYS Office of Parks, Recreation and Historic Preservation, NYS Canal Corporation, several professors and students from Hobart & William Smith College, and members of the Tripp Foundation.

During the survey, researchers shared the science involved with a broad audience. (below) Tom Manley provides an orientation to the public aboard the R/V *Folger*. (LCMM)

On June 26, we attended the official dedication of the newly-renovated marina. Art spoke and gave an historical perspective on the day. The team also attended the harbor dedication and opened the R/V *Folger* and *Underwater Research Vessel Voyager* to the public. More than one hundred people came aboard for an orientation to the survey.

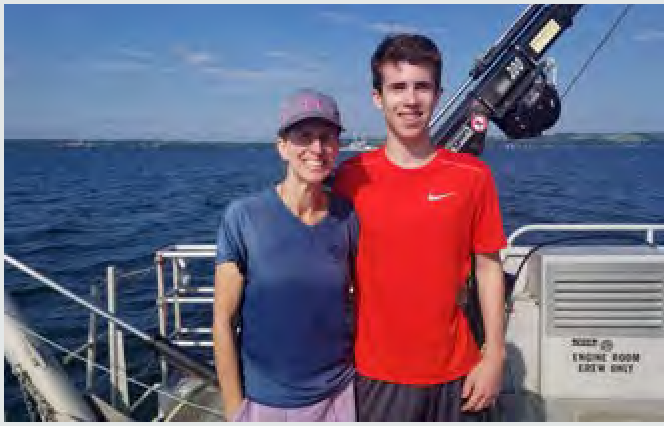
Captain Rich Furbush uses the ship-mounted hydraulic crane to position the multi-beam sonar transducer so it can be secured to the hull. Tom Manley (l) Matt Harrison (c) and Art Cohn (r).

Captain Rich Furbush with Lew McCaffrey, Senior Research Scientist, Finger Lake Water Hub, NYS Dept. of Environmental Conservation.

The *Underwater Research Vessel Voyager* at the dock at Sampson's State Park Marina, was a project workhorse which had the capability to operate both the side-scan sonar system and the ROV.

Dr. Tom Manley points to the bottom contour on one of the R/V *Folger's* in-cabin monitors. The R/V *Folger* is both a first-class research vessel and was also designed as a survey-process teaching laboratory for Middlebury College students and others.

The R/V *David Folger.* This sophisticated research platform was created by Middlebury College to teach young scientists the art of survey. Its participation in 2019 resulted in the discovery of seven additional shipwreck sites, bringing the total to fifteen.



During the two-week survey, an effort was made to involve as many community people as possible. Susan Pawlak and her college-bound son Cole were two of our visitors.

The Legacy

> *Captain Bishop of Geneva, the veteran lake captain and pilot thinks there are no less than 100 coal barges at the bottom of Seneca. Captain Charles Carpenter of Watkins recalled in a recent talk how one time when Superintendent Dey ordered him to start out in a gale with a tow for Geneva, he refused to go. He had seen Captain Stannard start out some time before with 20 boats, eleven of them were swamped. Some of them however were light and did not go down.*
>
> Newspaper account, October, 1900

The legacy of the thousands of canal boats that transited Seneca Lake is just beginning to be discovered. While most vessels made the journey without mishap and proceeded on to their final destination with horse or mule, newspapers from those times tell another tale. The combination of a heavily-laden coal or lumber-carrying canal boat just barely afloat on the lake, coupled with fierce winds that blew from each end of the long, narrow valley doomed many a vessel. Not all of them made it. Of these vessels, some lost their cargos but the boats and family-crews survived. Sometimes the boats were lost and the indispensable horses or mules traveling aboard in their bow stables drowned. In the worst of the disasters, the lake tragically swallowed up the people as well as their boats.

The Seneca Lake Survey Project has begun to shed light on this economic and human drama, one that will come into focus better with each new season's survey.

Canal boats on the North* [Hudson] *River, 1852. Canal boats unloaded their cargos directly into ocean-going vessels at the crowded piers and slips that lined lower Manhattan and Brooklyn. The success of the canals transformed New York into the Empire State with New York City as the nation's principal seaport. *Gleason's Pictorial*

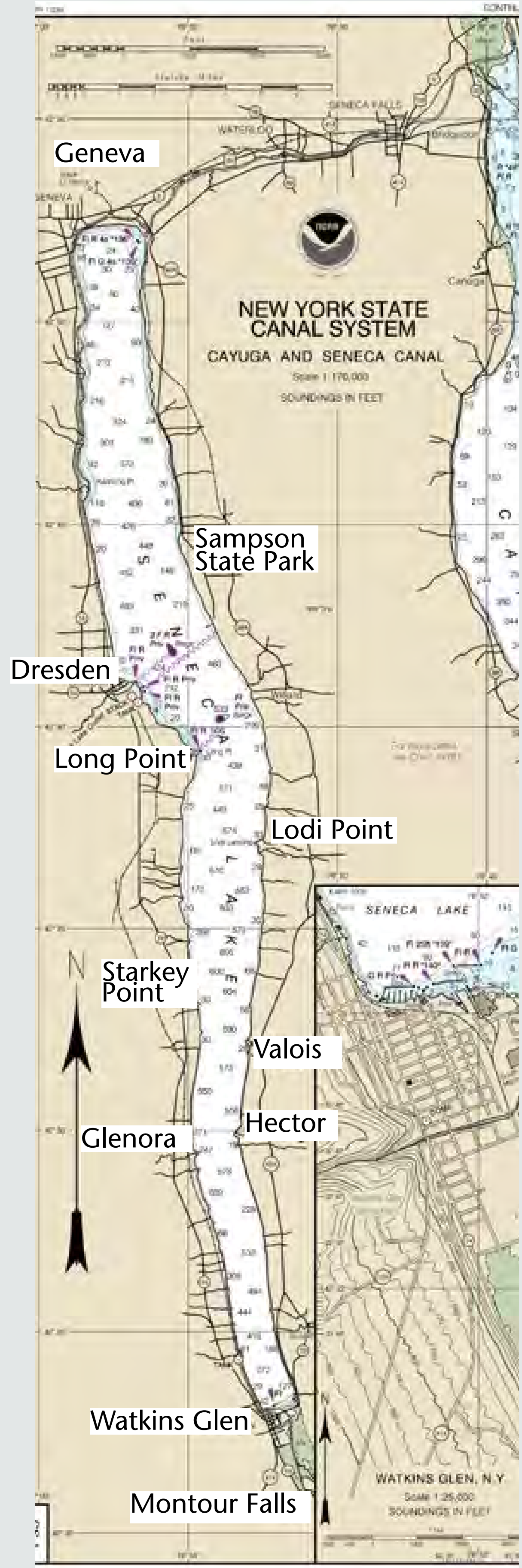
An Overview of the Maritime Heritage of Seneca Lake

Seneca Lake is a beautiful, glacially-formed lake that reaches over 600 feet of depth and often does not freeze over in winter. Always a rich agricultural region, today her temperate weather has given rise to a surrounding landscape populated by vineyards and orchards. Long the domain of the Iroquois Confederacy, in 1779 Generals Sullivan and Clinton, under orders from General George Washington, marched through the lake region putting the torch to more than forty Native villages. After the war, the rich farmland and energetic real estate speculation repopulated the area with American and European settlers who further developed the land and utilized a transportation system largely based on water travel. In 1825, a new Erie Canal system incorporating Seneca and Cayuga Lakes radically changed western New York and beyond. Two decades later, railroads followed and soon out-competed the water-based commerce system.

The unique combination of deep water and temperate climate that kept Seneca Lake mostly ice-free in winter allowed maritime activity to extend into the time of year when most jurisdictions were forced to cease operations. During the 19th century, this permitted steamboats to continue on a regular schedule, moving people and freight even after the canals had closed for the season.

Off the coast of Dresden, a Navy sonar laboratory serves as a reminder that during World War II and the Korean War, the eastern shoreline of Seneca Lake held an ammunition depot and Navy and Air Force training facilities. Hobart & William Smith Colleges in Geneva, auto racing at Watkins Glen and a landscape filled with waterfalls, parks and vineyards now support the region through tourism, a dominant industry that holds promise for the future.

Our experience tells us that all actively used water bodies contain collections of sunken watercraft that traveled over them. Studying the history and maritime use of a water body produces a list of the types of watercraft that archaeologists would expect to find. This brief overview of the maritime history of Seneca Lake will provide a glimpse of the kinds of watercraft which were known to be used through the ages to move people and goods and which the Seneca Lake Survey might expect to locate.



Seneca Lake chart. The lake is anchored by Geneva in the north and Watkins Glen and Montour Falls in the south and shows some of the principal maritime ports. NOAA

The First Peoples

For millennia, the region's waterways and forests provided food, shelter and means of transportation to Native peoples. Since roads were often non-existent or in poor condition, rivers and lakes often provided the best option for travel. Prior to construction of New York State's canals, Native peoples used birch bark and dugout canoes as the dominant maritime conveyance. When European explorers came to the New World, their military forces brought with them double-ended *bateaux,* which could be rowed or sailed, and carried troops and supplies. The waterways provided conduits for these military forces to control the natural resources of the New World.

New York State in the American Revolution
Sullivan and Clinton's Campaign, 1779

The western frontier along the Mohawk River corridor also became a contested territory that saw frequent raids by British loyalists and their Native allies. After a particularly horrific period of border terrorism, George Washington sent Generals John Sullivan and James Clinton with an army of 5000 men into the Southern Tier of New York to punish the British-aligned Iroquois nation and destroy the villages that served as their base of operations. Sullivan's and Clinton's efforts were aimed at reducing the Native threat and although direct combat was limited, the Americans destroyed almost all of the long-established Native American villages within the Finger Lakes. The Native peoples never recovered from this campaign and their power as the League was broken.

The Hudson River and Lake Champlain corridors leading north and south from New York City to Canada provided invasion routes that helped define the outcome of the war.

The Battle of Valcour Island, by Henry Guilder, 1776. This pivotal engagement fought on Lake Champlain on October 11, 1776, delayed the British invasion of the Colonies and helped bring about the American victory a year later at Saratoga.
Her Britannic Majesty, Queen Elizabeth II

Divers confirming the discovery of Gunboat* Spitfire *on the bottom of Lake Champlain, by Ernie Haas. Sunk by her crew during the retreat from Valcour Island, the *Spitfire* rests intact in the deep waters of Lake Champlain. As the nation approaches the 250th anniversary of the Revolutionary War, the *Spitfire*, remains a powerful legacy of that conflict with the power and potential to inspire future generations.
Private Collection

Post Revolutionary War

After the war, many Native peoples displaced by the Sullivan-Clinton Campaign returned home. They were joined by an ever-increasing number of settlers, many whom had first seen the Finger Lakes region as soldiers. Each year more people arrived and established roots on the rich farm and forestland surrounding the lakes and rivers of the Southern Tier. Early settlers used all existing means of water travel and added Durham boats to the menu of watercraft available for travel and freight hauling. These were shallow-draft, double-ended boats that could be sailed or poled to their destinations. The Durham boats were particularly useful in hauling the barrels of potash produced by settlers cutting down the forests and burning the trees to convert acreage into farmland. Potash was used in the manufacture of wool, glass and soap and could be bartered for a variety of goods needed in the frontier settlements.

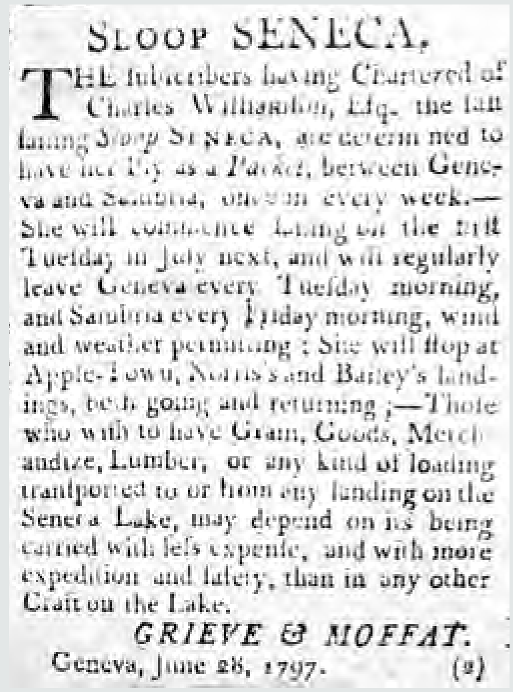
A View of Boats & Manner of Navigating on the Mohawk River. By J. Riley, 1810. Canal Society of New York State

Arks and log rafts, watercraft designed as one-way conveyances, were also used by settlers on the Ontario and Chesapeake watersheds to transport farm and forest products to market. This activity was described in *Lumbering in the Susquehanna Valley* by Albert Hilbert, recollecting:

> "Rafts…consisting of 2 to 10 'platforms' each 12´ x 20´ connected and floated endwise…the arks were a hybrid, one-way boat. A combination of raft and boat, for it was designed to be disassembled for lumber at the end of its journey…these Arks were cargo carriers for grain, whiskey, barrels of port and venison plus frontier products such as maple sugar, potash and salt. It was reported the 1090 rafts and 1037 arks had arrived at Fort Deposit, Maryland in 4 months…in 1826…most of the crews walked back [to the Southern Tier] but some worked back on Durham boats bringing supplies back up the river."

A View of West Point on the River Hudson, with the Steamboat Invented by Mr. Fulton. By Charles-Balthazar-Julien Févret de Saint-Mémin. Steamboats dramatically changed the transportation patterns along the Hudson-Champlain waterways, with the St. Lawrence River soon to follow. New York Public Library

Surrounded by forests, these waterways and their navigable channels were regularly clogged and degraded with obstructions of trees and sediment, and efforts were made to improve their efficiency. In addition, along the rivers were occasional waterfalls, like the Cohoes and Little Falls on the Mohawk River, where boats were required to stop, unload, and transfer their cargos and vessels around the obstruction. This was a significant amount of work, and between the undependable channels and the predictable portages, the system had limitations. In 1792, the Northern and Western Inland Lock Navigation Companies were established as private companies to bypass these barriers to navigation. They were a precursor to the canals that would follow three decades later.



SLOOP SENECA.

THE subscribers having Chartered of Charles Williamson, Esq. the fast sailing Sloop SENECA, are determined to have her Ply as a Packet, between Geneva and Salubria, once in every week.— She will commence sailing on the first Tuesday in July next, and will regularly leave Geneva every Tuesday morning, and Salubria every Friday morning, wind and weather permitting: She will stop at Apple-Town, Norris's and Bailey's landings, both going and returning;—Those who wish to have Grain, Goods, Merchandize, Lumber, or any kind of loading transported to or from any landing on the Seneca Lake, may depend on its being carried with less expense, and with more expedition and safety, than in any other Craft on the Lake.

GRIEVE & MOFFAT.

Geneva, June 28, 1797. (2)

Western New York became an active region for land speculation, which attracted wealthy investors and a steady stream of people ready to leave the east to settle in this western wilderness. As they arrived, Seneca Lake was reported to have a "four-handed bateau" which "ply[ed] the lake for many years, doing a successful business." On-lake activity increased, and there was need and opportunity for more water conveyances, resulting in improvements in the maritime infrastructure.

In 1796, the first commercial sloop was built and launched on the north end of the lake at Geneva by Charles Williamson, the resident agent of a land syndicate headed by British Lord Poultney, one of the largest landholding speculators. The sloop, christened *Seneca*, was of forty tons burden and was intended to run as a packet between Geneva in the north and Salubria, today's Watkins Glen, in the south. The launching of the sloop was a landmark occasion that stirred the sparsely populated area to a rare gathering. The 1799 newspaper account reads, "The occasion of the sloop's launch was a significant event in Seneca Lake maritime progress. The circumstances of the sloop, however trifling in itself, was of sufficient importance to assemble several thousand people, and no circumstance having occurred to draw together the different settlements the people composing them were not a little surprised to find themselves in a country containing so many inhabitants and these so respectable."[1]

(above) **Sloop *Seneca*,** newspaper announcement, June 28th, 1797. The new sloop served as both a passenger packet and a freight carrier.

Geneva sur le lac Seneca. Etablishement d. Ch. Williamson.
Watercolor and pencil sketch in the sketchbook by Edouard Charles Victurmen Colbert (1758–1820) 4–5 October 1798. Geneva Historical Society

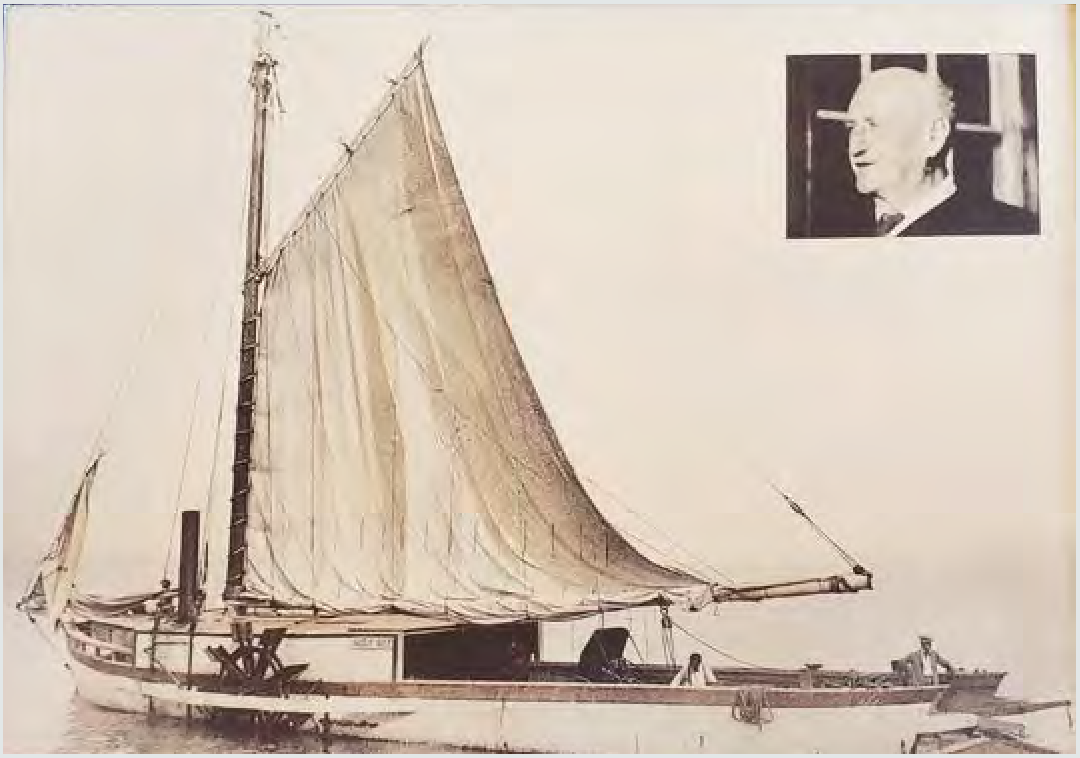
[1]E. Thayles Emmons, "The Story of Geneva," *The Geneva Daily Times*, Geneva. NY 1931; A Description of the Settlement of the Genesee Country, New York. 1799.

Cross-lake Ferry service

Another important maritime development was the launch of numerous ferry services. Settlers traveling the trails and bad roads west still needed a means to make east-west crossings of the Finger Lakes. Early ferries were first rowed, then sailed, then powered by steam. A short-lived niche even included a few watercraft powered by horses. The first ferry in the Finger Lakes was established at the north end of Cayuga Lake in 1788 to facilitate people traveling on the east-west Genesee Road. This service ceased after a wooden bridge was built around 1800. Ferries would periodically return when the bridge was washed out or was out of service. A steam-ferry, the *Enterprise,* was launched on Cayuga in 1820 to enhance the Newburgh-Catskill Turnpike by transporting people from Ithaca at the lake's south end, to the stage that traveled the Seneca Turnpike at the north end of Cayuga. This ferry route was used until 1907, and a ferry between Kings Ferry and Kidders ran from 1825 to 1913.

The ferry *Goodwin*, on Seneca Lake, was established in 1805 to travel between North Hector and Starkey. The view looks north from Starkey Point ca. 1875.

On Seneca Lake, the *Goodwin* was built by John Goodwin in 1805 and crossed the lake between North Hector, (now Valois) and Starkey. A steam ferry was chartered in 1825 to operate between Baileytown (now Willard) and Dresden "…sufficient for the transportation of passengers, horses, teams, carriages, sleighs, cattle, goods and chattles across the lake…." Another ferry ran between Peach Orchard Point and Big Stream. Seneca Lake also had numerous steamboats that ran the length of the lake and made stops all along the way at landings on both shorelines, moving both people and freight.

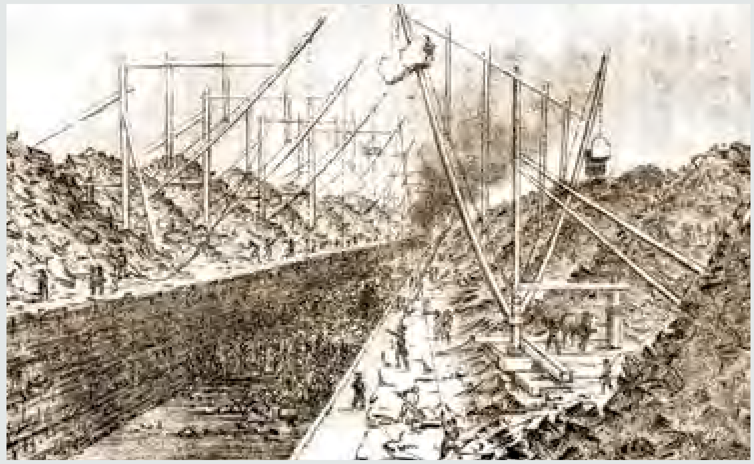


The *Busy Bee,* a Cayuga Lake Ferry. The *Busy Bee* was built for service between Kings Ferry and Kidders. She was 67 feet overall length with a beam of 17 feet, and could be powered by sail or steam. At the height of her activity she made regular trips every day to meet the trains and carry mail and was steered by a rudder that was a heavy detachable paddle. The ferry was owned and operated by Captain James Quick (inset), who operated ferries until trains and automobile put him out of business. Research indicates the *Busy Bee* was abandoned and we expect to locate it when the survey extends into Cayuga Lake.

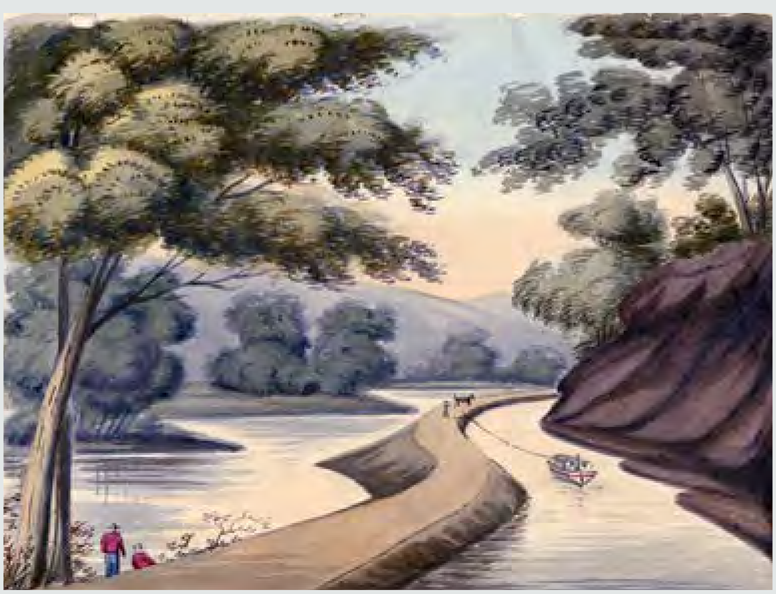
New York State Canals: A Triumph of Engineering

At the beginning of the 19th century, a number of essayists, engineers, and promoters pressed for construction of canals from the Hudson to Lake Erie and Lake Champlain. DeWitt Clinton, mayor of New York City and later governor, became one of the canal's most ardent proponents. The New York State Legislature authorized a survey of potential canal routes in 1808, appointed a Canal Commission in 1810, and finally, in 1817 authorized construction of two canals. After much debate and lobbying it was decided that the Western (Erie) Canal would connect the Hudson River with Lake Erie and the Northern (Champlain) Canal would connect the Hudson to Lake Champlain. The official ceremony beginning the construction of the Western or Erie Canal was held at Rome, New York on July 4, 1817.

After the Western and Northern Canals were authorized by the New York State Legislature in 1817, the potential of the new waterways became more apparent with each construction season. A public works project this large and complex required a group of talented people that formed the ranks of the nation's first civil engineers. These mostly self-taught problem solvers were able to overcome all challenges they faced and often invented the means to accomplish seemingly impossible tasks.



Building the Erie & Champlain Canals was a triumph of engineering. The deep cut west of Lockport allowed Lake Erie water to supply the western end of the canal from Buffalo to the Seneca River. The flight of five locks at Lockport (bottom) were a great engineering feat. From Cadwallader D. Colden, *Memoir prepared at the Request of the Committee of the Common Council of the City of New York,* 1825. Canal Society of New York State



(left) ***Canal Boat on the Erie Canal,*** November, 1825. Rev. John Henry Hopkins. A canal boat travels west on the new Erie Canal separated by the towpath from the Mohawk River. William L. Clements Library, University of Michigan

The *Mary & Hannah* and the Appearance of Sailing-Canal Boats

The new water highways created new opportunities for maritime commerce. Some merchants and mariners decided that the connection of Lake Champlain to the Champlain Canal could be exploited by building a new type of watercraft. This vessel would sail on Lake Champlain to the entrance of the Champlain Canal, then take down its sailing rig, hoist its centerboard and transit the canal with horses or mules walking on the towpath to the Hudson River. Once on the river, the vessel could return to sail and embark for New York City. In September 1823, a boat called *The Gleaner of St. Albans* "built as an experiment," was the first boat to transit the new Northern Canal. We now know that the *Gleaner* was a Lake Champlain sailing canal boat.

Woodcut depicting the *Mary and Hannah* leaving Seneca Lake in the fall of 1823 for New York City via the new Erie Canal. Geneva Historical Society

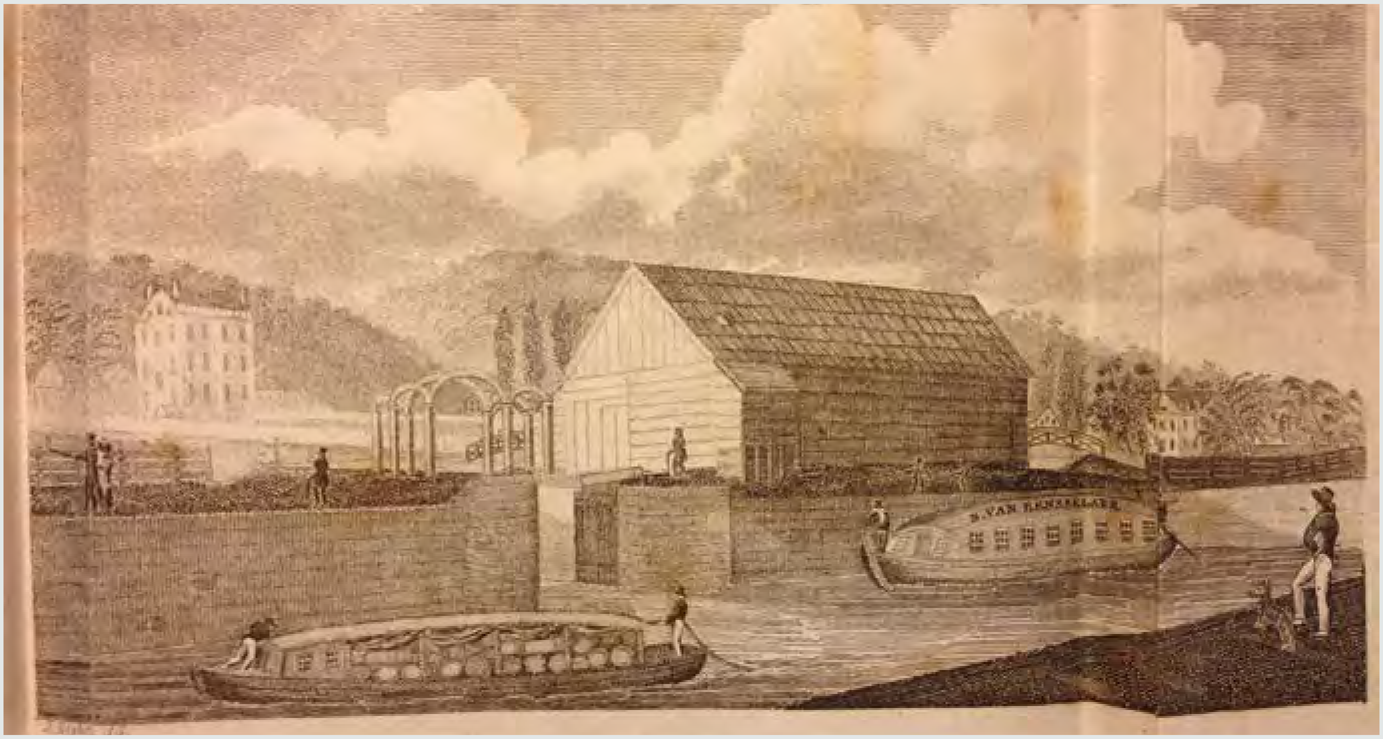
> ***"The canals of the State of New York: an example to the world of what may be accomplished by the enlightened Citizens of a Free-Government."***
>
> The Banquet President's toast in NYC for the Seneca Lake owners of the *Mary & Hannah*

That same fall and two years before the Erie Canal was completed, two farmer-businessmen from Hector on the southeastern shore on Seneca Lake, Samuel Seeley and John Osborne, built another "experimental" boat to haul their wheat to market. The boat, christened the *Mary & Hannah*, was named for their wives and was the first documented sailing canal boat from Seneca Lake. She sailed from Hector in October with a load of wheat, three tons of butter and several barrels of beans. Pre-dating any Seneca steamboats, she sailed to the Seneca River inlet at the north end of the lake where she took down her masts and hooked up to the draft animals that would tow her to Albany. Here she raised her sailing rig and sailed down the Hudson River to New York City. Her arrival in New York City was anticipated and a banquet was held in the owners' honor. So momentous was the perceived impact of their delivery of wheat from the hinterland that at the banquet the pioneers were presented with a silver pitcher to "*Commemorate their enterprise in having first navigated the Western Canal and Hudson River from Seneca Lake to this City with a Cargo of Wheat in Bulk.*"

Another sighting of an early sailing-canal boat.

Friday, October 17, 1828 [Erie] Canal—arrived at Albany, on Saturday, canal boat "MARY," of Milan, [Ohio] Capt. Edward Meeker, from Huron county, state of Ohio, with a cargo of pot ashes, staves, and sundries. This boat, the Albany papers says, was built at Huron, at the head of Lake Erie. She crossed the lake 250 miles to Buffalo, and thence, by way of the Erie Canal, 362 miles, to Albany, and is bound for New York, making a total distance of 752 miles. She is 49 tons burthen, and is schooner rigged, and carries two masts. We believe she procured a clearance at the custom-house at Milan, for the port of New York.

Cleveland Weekly Herald



Entrance of the Canal into the Hudson at Albany. *Cadwallader Colden Memoir,* 1825.
William L. Clements Library, University of Michigan

The Erie Canal Opens in 1825

As great strides were being made to move people across and through the Finger Lakes, some roads were planked and improved but still limited by bad weather and carrying capacity. While the sloops, ferries, and steamboats provided an improved transportation system for moving people and freight over the Finger Lakes' inland waters, moving east and west across New York State was still a significant challenge. In 1817, after decades of debate, studies, surveys, and lobbying, the New York State Legislature authorized construction of the Northern and Western Canal systems. These remarkable waterways were built between 1817 and 1823 and 1825 respectively.

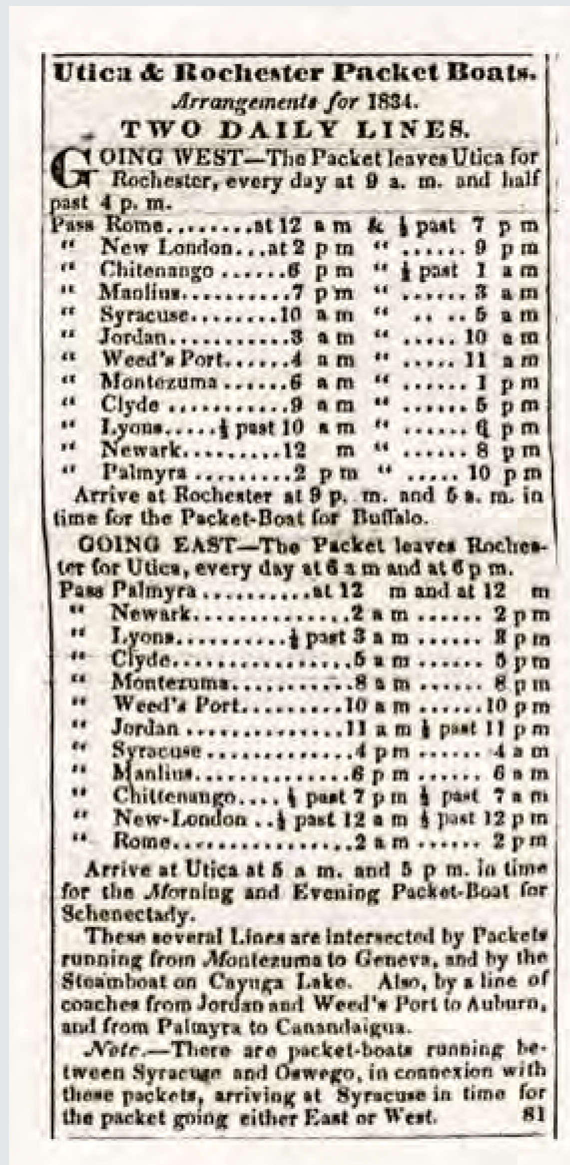
The Erie and Champlain Canals connected the Hudson River and Lake Champlain in the east to Lake Erie and the Great Lakes at Buffalo in the west and, as predicted, the new waterways revolutionized travel. Even the most enthusiastic advocates of the canal were surprised at how well the system worked. Vessels loaded with cargo at distant harbors could travel to marketplaces throughout the system without the need to transfer freight between different vessels. Even before the canals were completed end-to-end, "packet boats" appeared on finished sections of the canal. These sleek express vessels were towed by three horses in a line at a speedy four miles per hour and enjoyed a right-of-way over slower moving freight boats. Passengers could eat, drink, sleep, and view the countryside on this new type of boat. Their ability to provide long-distance travel without the bumps and ruts of overland made them very popular and increased east-west migration. The explosion of demand for wooden canal boats filled the boatyards and dry-docks with boat builders, as young men left the farms to become mariners on this new inland waterway. Most packet boats disappeared before the age of photography, and to date, an archaeological example of a packet boat has not been located. It is possible that a packet boat may exist in one of the Finger Lakes.

Broadside, 1834 (detail). Canal Society of New York State

The success of the new canals contributed to a "canal mania." The logic seemed to be that if the Erie could stimulate so much prosperity, then why wouldn't those benefits befall our region if we just build a canal to connect to it? Local businessmen and politicians lobbied for lateral canals through their region that would connect them to the main Erie highway.

On the largest Finger Lakes, Cayuga and Seneca Lakes, the Erie Canal came tantalizingly close to their navigable waters. The need to circumvent the Seneca Falls actually saw construction activity that pre-dated the Erie Canal and boats were able to navigate around the falls in 1818. Construction of the twenty-three mile Cayuga and Seneca Canals connected them to the Erie system. This connection was completed in 1828 and dramatically increased the commercial traffic entering the Erie system from the lakes and the surrounding country. These obvious benefits soon gave rise to proposals for two additional canals, one to connect Seneca and Crooked Lake (Keuka Lake) and one to connect Seneca Lake to the Chemung River. Proponents once again argued that the increased commerce would enrich New York State. After a long, hard sell, the Legislature finally authorized the construction of these two canals.

Corning, New York, ca. 1860.
Communities all throughout the Southern Tier of New York benefited from being on the canal system. Corning, located on the southwestern end of the Chemung Canal, was a distribution center for Pennsylvania coal. Corning Museum of Glass



Utica & Rochester Packet Boats.

Arrangements for 1834.

TWO DAILY LINES.

GOING WEST—The Packet leaves Utica for Rochester, every day at 9 a. m. and half past 4 p. m.

Pass Rome	at 12 a m	& ½ past 7 p m
New London	at 2 p m	9 p m
Chitenango	6 p m	½ past 1 a m
Maolius	7 p m	3 a m
Syracuse	10 a m	5 a m
Jordan	3 a m	10 a m
Weed's Port	4 a m	11 a m
Montezuma	6 a m	1 p m
Clyde	9 a m	5 p m
Lyons	½ past 10 a m	6 p m
Newark	12 m	8 p m
Palmyra	2 p m	10 p m

Arrive at Rochester at 9 p. m. and 5 a. m. in time for the Packet-Boat for Buffalo.

GOING EAST—The Packet leaves Rochester for Utica, every day at 6 a m and at 6 p m.

Pass Palmyra	at 12 m	and at 12 m
Newark	2 a m	2 p m
Lyons	½ past 3 a m	3 p m
Clyde	5 a m	5 p m
Monterzuma	8 a m	8 p m
Weed's Port	10 a m	10 p m
Jordan	11 a m	½ past 11 p m
Syracuse	4 p m	4 a m
Manlius	6 p m	6 a m
Chittenango	½ past 7 p m	½ past 7 a m
New-London	½ past 12 a m	½ past 12 p m
Rome	2 a m	2 p m

Arrive at Utica at 5 a m. and 5 p m. in time for the *Morning* and Evening Packet-Boat for Schenectady.

These several Lines are intersected by Packets running from *Montezuma* to Geneva, and by the Steamboat on Cayuga Lake. Also, by a line of coaches from Jordan and Weed's Port to Auburn, and from Palmyra to Canandaigua.

Note.—There are packet-boats running between Syracuge and Oswego, in connexion with these packets, arriving at Syracuse in time for the packet going either East or West. 81

Utica & Rochester Packet Boats. Arrangements for 1834. *Geneva Gazette,* August 6, 1834. The packet boats were the buses of their time, making regularly scheduled stops along the canal. They coordinated their schedules with other packet boat and stage lines. Richard Palmer

Chemung and Crooked Canals: Canals and Railroads Briefly co-exist

The Chemung and Crooked Lake Canals proved to be marginal, short-lived affairs. To save construction costs, both were built with timber locks that were inefficient and high-maintenance. They also followed a tortured route of steep elevation that required a large number of locks over a short distance. Overcoming the change in elevation on the Chemung Canal required construction of 44 locks over ten miles. The Crooked Lake Canal was only eight miles long but required 27 locks. Both canals were opened in 1833 and both made a significant contribution to regional commerce. The Chemung Canal connected New York State to the coal mines of Pennsylvania and the forests and farms along its route. The Crooked Lake Canal connected the farms and forests of Crooked Lake and Steuben County to marketplaces previously only dreamed about.

These new connections further created a demand for hundreds more wooden canal boats on Seneca Lake, along with fleets of steamboats capable of towing rafts of assembled boats. It was not uncommon to see a steamboat towing heavily-laden canal boats, often in great numbers. The side-wheel steamboat *Ben Loder* reportedly held the record when she moved seventy canal boats through the lake at one time. Canal boats arrived at Watkins Glen with coal, lumber or farm products and were assembled into tows headed towards Geneva and the entrance to the Cayuga and Seneca Canal. From this point, the entire Erie system was available to the canal boats, allowing them to continue on to New York City.

The journey along this canal-lake-river system required two types of power to move the heavily-laden canal boats. The canals were designed with tow-paths alongside, and draft horses or mules pulled the boats through the canals using a long rope towline. Once on Seneca Lake or the Hudson River, the animals were relieved of their burden and the canal boat joined a fleet of similar boats assembled for the next steam-powered towboat heading in the direction they were bound. This era of combination of steam and towpath-animal power proved so successful that it lasted almost a century.

The volume of business was so significant and regular that formal boat lines along well-traveled routes began to organize and advertise their connection to and from New York City. The "New York, Elmira and Corning Line," as presented in the advertisement on page 25, was one example of this expanding reach.

Millport on the Chemung Canal. ca. 1860. This woodcut, with the Chemung Canal (left) and the railroad (right) illustrates the 19th century phenomenon of railroad lines steadily increasing their presence along established canal corridors. Schuyler County Historical Society

Corning & Blossburg Railroad—Daily line.

A LOCOMOTIVE ENGINE with a train of passenger and freight Cars will leave Corning at 6 o'clock A. M. of each day for Blossburg and the intermediate places, connecting with a splendid line of Post Coaches running to the Williamsport and Elmira Railroad at Trout Run. Returning in the afternoon of the same day.

Passengers from Geneva by steamboat will arrive at Corning the same day by a line of stages direct from Jefferson to Corning.

MILLER FOX, Engineer.

March 16, 1840. tf31

Detail, "Map of New York State Showing the Location of its Canals and Rail Roads" 1857, by David Vaughan. Rivers flowing south from the Southern Tier, and coal coming north from Pennsylvania helped fuel interest in the Chemung Canal (1833) and Corning & Blossburg Railroad (1839). New York State Archives

(left) **The Corning & Blossburg Railroad** began operations in 1839 with one wood-burning locomotive brought from Albany on a canal boat. It connected the coal fields in Pennsylvania with the Chemung Canal at Corning. After 1850, Corning became a distribution connection for the canal and the region's rapidly expanding railroads.

GENEVA GAZETTE.

Wednesday, May 14, 1828.

STEAM BOAT LAUNCH!

☞ Having made particular inquiries, we are authorized to state that no event has occurred or is anticipated, to prevent the launch of the new Steam Boat in this village at the time appointed—To-Morrow, at 3 o'clock precisely. Should the weather prove favorable, no doubt an immense assemblage of people will witness the pleasing spectacle.

Steam Boat Launch! With the launching of the *Seneca Chief* in May 1828, a robust steamboat era began that would move passengers, freight and canal-boats throughout Seneca Lake.

The Steamboat Era

In 1807, water transportation took a dramatic leap forward when, after decades of experimentation and failure, the *North River* steamboat designed by Robert Fulton became the first commercially successful steam-powered watercraft. Steamboats appeared on New York's Hudson River and Lake Champlain and revolutionized travel by water. With steam power able to move watercraft whenever desired, society was no longer dependent on oars, paddles, wind or horses.

Seneca Lake's first through-lake steamboat was launched in May, 1828 and was christened *Seneca Chief*. As the newly-completed Cayuga and Seneca Canal connected Seneca Lake to the Erie Canal system, the *Seneca Chief's* first trip in early July was towing three canal boats through the lake. Her first excursion for passengers took place on July 4th, and this dual capability of towing canal boats and carrying passengers and public excursions set the stage for an impressive list of steamboats that would perform these same tasks and more on Seneca Lake for the next 100 years.

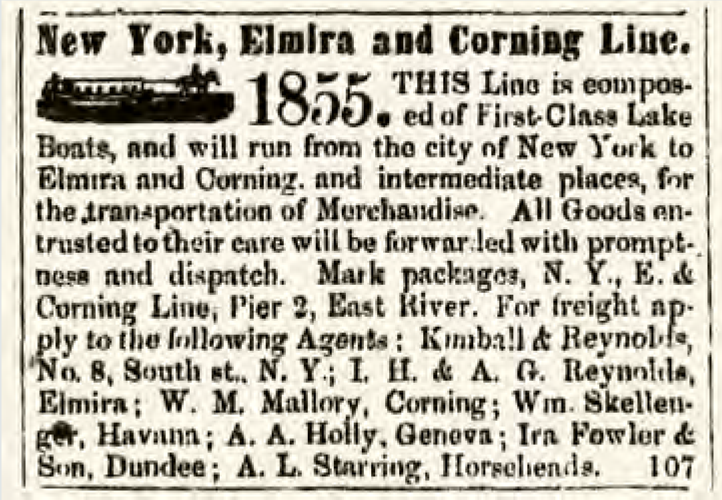
In 1833 the *Seneca Chief's* name was changed to *Geneva* and she continued to ply the lake for fifteen more years. A newspaper of that time reports that on July 4th, 1847, as part of the patriotic celebration, the *Geneva* was blown into "ten thousand pieces." This disposition by explosion was to repeat itself with another steamboat, the *Onondaga,* in 1898.

Seneca Lake now had three canals bringing and taking canal boats through the interconnected maritime system and no competition yet from the railroads. The opportunity to expand harbor facilities and capitalize on this era of plenty seemed endless. The *Richard Stevens* was launched in 1835, followed by the *Chemung* in 1841 and the *Canadesaga* in 1847. These were followed by the *Ben Loder* in 1849, which was the largest

View of Geneva, Ontario County, New York, taken from the foot of Seneca Lake in July 1836. Note the nice view of the Cayuga-Seneca Canal to the right. Geneva Historical Society

steamboat ever to be built on Seneca Lake. She had a length of 250 feet, a beam of 58 feet and was propelled by a 400 horse-power engine.

As the railroads began to reach the southern end of Seneca Lake, they provided another way to haul coal from Pennsylvania to Watkins Glen and more towboats were needed to move the canal boats from the south to north on the lake. After 1850, the propeller-driven *Seneca*, *John Arnot*, *Watkins*, *Schuyler, A.L. Griffin, Onondaga and Otetiani* (meaning "he [Red Jacket] is always ready" in the Seneca language), were added to the fleet. The *Onondaga* was launched in 1870 and described as follows: "*Her internal arrangement-Ladies' Cabin, Gentleman's Cabin, Dining Room, State-Rooms, Bar Room, Barber Shop, Kitchen, & c. are all admirable, combining a degree of comfort, ease and luxury, for the benefit of the traveling public, never before seen on Lake Seneca*."



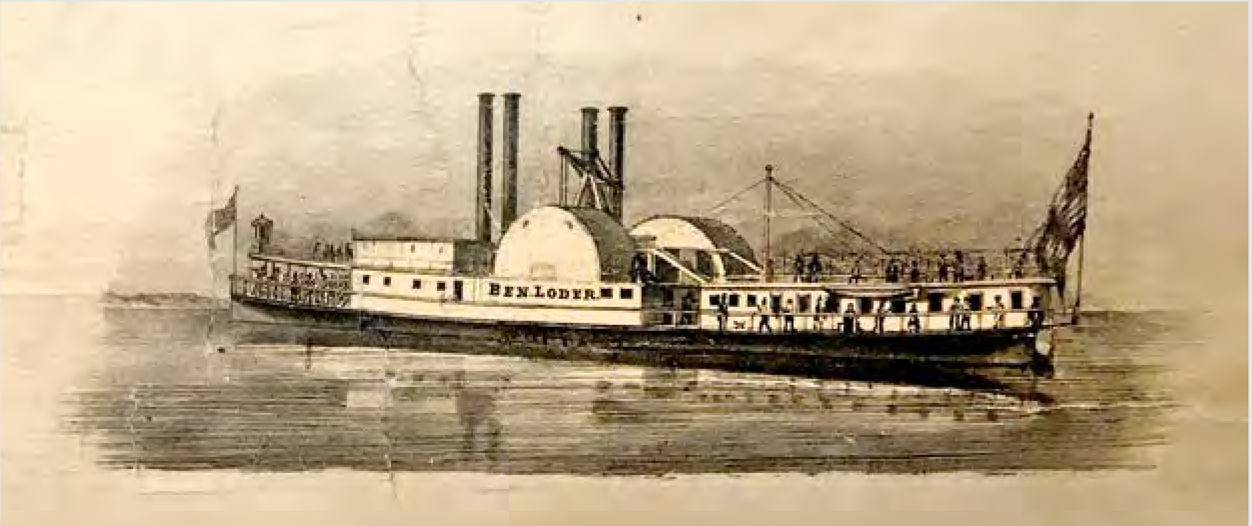
New York, Elmira and Corning Line.

1855. THIS Line is composed of First-Class Lake Boats, and will run from the city of New York to Elmira and Corning, and intermediate places, for the transportation of Merchandise. All Goods entrusted to their care will be forwarded with promptness and dispatch. Mark packages, N. Y., E. & Corning Line, Pier 2, East River. For freight apply to the following Agents: Kimball & Reynolds, No. 8, South st., N. Y.; I. H. & A. G. Reynolds, Elmira; W. M. Mallory, Corning; Wm. Skellenger, Havana; A. A. Holly, Geneva; Ira Fowler & Son, Dundee; A. L. Starring, Horseheads. 107

New York, Elmira and Corning Line 1855. This ad for the "New York, Elmira and Corning Line" describes a well-established freight route from NYC to Corning. The "First-Class Lake Boats" described in the ad may have been the next generation sailing canal boats.

With each decade, steamboats increased in size and horsepower as they towed ever more tonnage. Passenger volume rose and included vast numbers of tourists traveling the lake for enjoyment. The completion of the Junction Canal in 1856 connecting the Chemung Canal at Elmira to the waterways of Pennsylvania created even more demand. The Civil War added to the demand for coal to fuel war industries. Many a soldier took Seneca Lake steamers as their first leg to the front. But while the tonnage increased and canal boatman looked for new and inventive ways to capitalize on the times, there were dark clouds forming upon the horizon that would radically affect this maritime prosperity. The most significant threat looming was the railroads.

Steamboat *Ben Loder,* 1849. (Detail from a map of Geneva, published by M. Dripps, 1850.) The steamboat *Ben Loder,* named for an Erie Railroad official, was built in 1849 when Elmira was the western terminus of the Erie Railroad. Designed to move passengers through the lake to connect with rail, she was the largest and most powerful steamboat ever built on Seneca Lake. Reaching speeds of 18 knots, she made four round-trips daily during the height of the season. In 1853, she was sold to a new owner to tow canal boats through the lake. In 1861, she was caught in a sudden gale in which three coal-carrying canal boats and one loaded with barley were lost. No one was lost in that disaster but six horses drowned. Later that year while docked at the Watkin's coal trestle on the night of June 2, the *Ben Loder* was found to be on fire and was cut adrift so as not to ignite the coal facility. She burned to the water line and her engines were later salvaged and transferred into another steam towboat. Geneva Historical Society



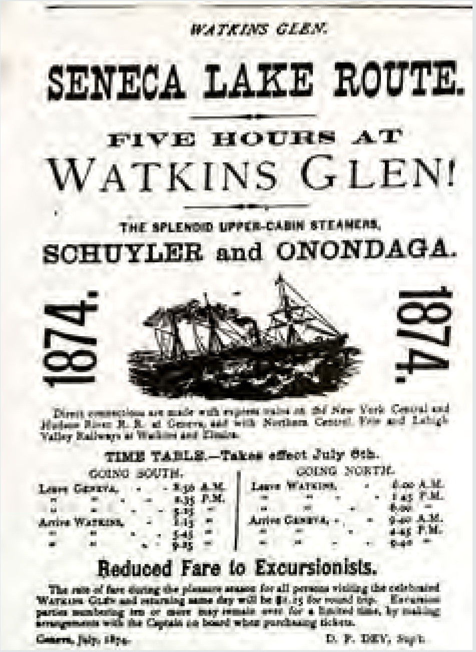
Geneva N.Y. in 1856, by J.H. French, Syracuse NY. Three canal boats in tow for Geneva Harbor and the Cayuga & Seneca Canal, a common sight on Seneca Lake when the Chemung Canal route generated scores of vessels loaded with Pennsylvania coal. At Watkins Glen these diminutive vessels were organized into small fleets for their passage through Seneca Lake and the Erie Canal. The rear-most canal boat of this image appears to be a typical Chemung-class boat with a bow-stable. Geneva Historical Society

Other steamboats appearing on Seneca Lake included, *D.S. Magee, Henrietta, W.B. Dunning, Ontario, Elmira, A.W. Langdon 1862, Estelle, P.H. Fields* and *Onnalinda.* But the times were changing. As sharply as demand rose, it could also fall. The closing of the Crooked Lake Canal in 1877 and the Chemung Canal in 1878 reduced the number of freight boats arriving at Watkins Glen. The commercial waterway's viability was further eroded by the steady expansion of railroad lines. A newspaper from 1890 observed, "*With the new railroad route soon to run along the east shore of Seneca Lake…there is no encouragement offered the Seneca Lake Navigation Company to build new and elegant steamers for this lake. The company will put the old floating palaces in prime condition and run them as long as they are safe, which will be a good many years yet.*"

The steamboats working on Seneca Lake frequently changed names and when accident or age ended their usefulness, their engines and boilers were often transferred to the next generation of vessel. While most retired steamboats were taken apart and recycled, it is likely that some steamboats may still lay on the bottom of Seneca Lake waiting to be discovered, identified and studied.

Perhaps the most dramatic story of a steamboat's demise and destruction is that of the steamboat *Onondaga*. The *P. F. Field* was a large and powerful steamboat built in 1860 to serve as a towboat on Seneca Lake. In 1870, the *P. F. Field* was acquired by the Seneca Lake Navigation Company and rebuilt by Bruce Springstead. When she was relaunched, she was re-christened *Onondaga*. "*The* Onondaga *is a very fine steamer, the best, unquestionably, west of the Hudson…everything will be finished in the best style, both in convenience and comfort.*" She began her new career as a passenger boat but was gradually assigned the less glamorous job of canal towboat.

Steamboat *Onondaga* 1860–1898. The steamboat *Onondaga* began her career in 1860 as the towboat *P.F. Field*. As use of the Chemung and Crooked Lake Canals declined, the towboat was converted into a passenger excursion steamer. With this new use, the steamer was renamed the *Onondaga*. She kept a regular route between Watkins Glen and Geneva and was also available for private excursions. On one such outing, she is said to have carried 800 passengers for a Grand Army of the Republic clambake at Long Point. Geneva Historical Society



1874 Broadside: Train Connections and Excursions. The steamers on Seneca Lake in 1874 made three round trips a day between Watkins Glen and Geneva so travelers could make rail connections. In addition, the steamboats offered "Reduced Fare to Excursionists" traveling to enjoy the "celebrated" beauty of Watkins Glen and Seneca Lake.
Schuyler County Historical Society

By 1895, the Chemung and Crooked Lake Canals had been closed for almost two decades and without enough work to support operational expenses, the *Onondaga* was tied up at the pier in Geneva.

"For three years it was moored to a pier at Geneva. Its usefulness had gone forever for in the advance of progress, the railroads had extended lines down the shores of the lake and the mail contract had been taken away from the steamers. The death knell of Seneca Lake shipping had sounded."

LEGAL.

FINAL CLOSING OF CHEMUNG CANAL.

OFFICE OF SUPERINTENDENT OF PUBLIC WORKS,
Albany, October 7th, 1878.

IN pursuance of the provisions of Chapter 404, Laws of 1878, the Chemung Canal will be finally closed on the 31st day of October, 1878, and abandoned and discontinued from that day.
B. L. W. CLARK,
Supt. Public Works.

Final Closing of the Chemung Canal. The fortunes of the canal system in large part dictated the commercial use of Seneca Lake. When the Erie Canal opened in 1825, no one ever expected that railroads would ever out-compete the canal system. The Chemung and Crooked Lake Canals were doomed by changing times and technology and by 1878 both were closed.

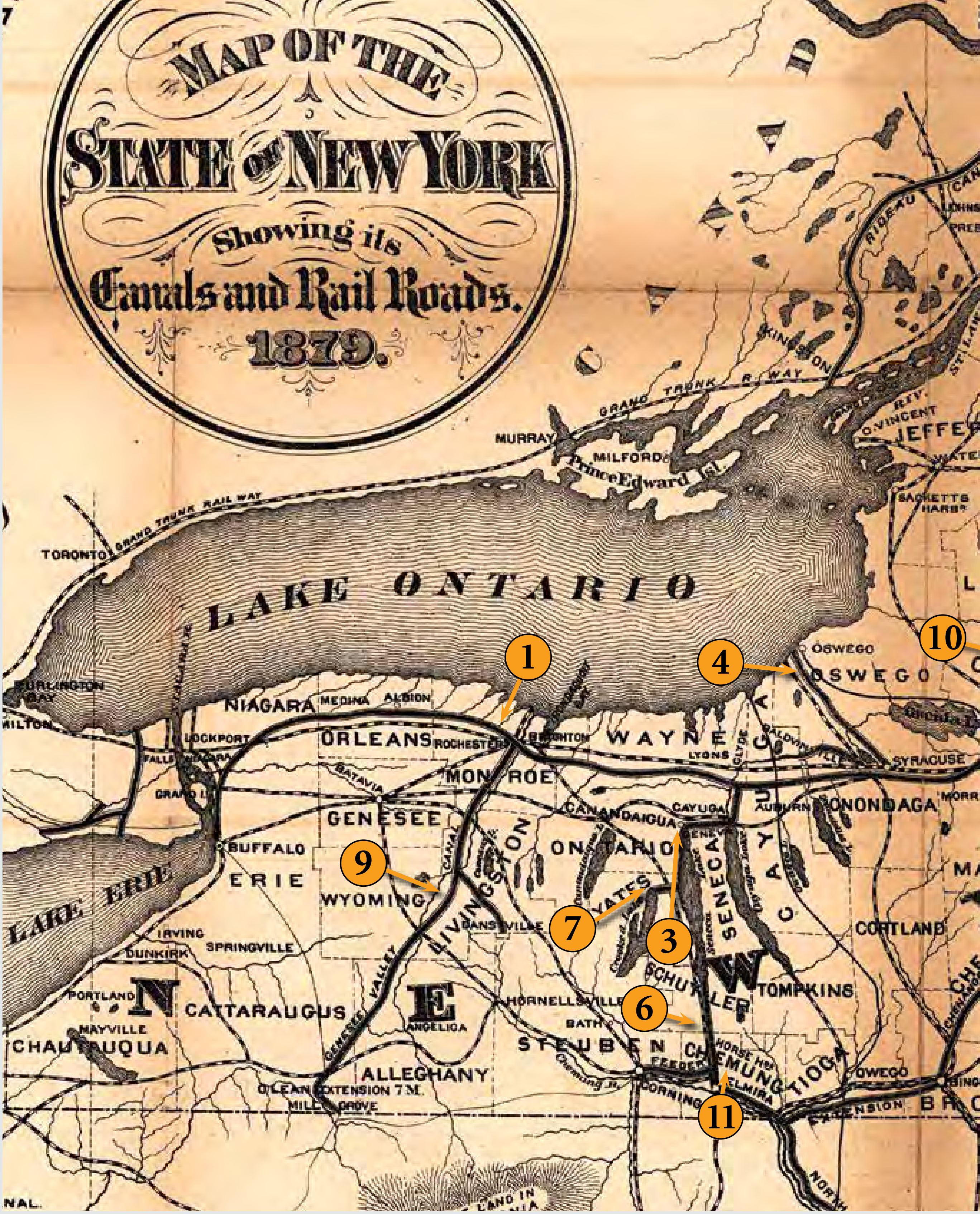
As she waited for fate to dictate the once palatial steamer's future, "…Into Geneva came a traveling theatrical troupe and among the show people the dreaded disease 'smallpox' was discerned." A place was needed for them to be quarantined and the vacant *Onondaga* was pressed into service. When the quarantine period was over and the troop left for their next engagement, the *Onondaga*, which had performed this valuable community service, was viewed as tainted.

It was the time when the Spanish-American War was in the news and the shocking account of the blowing up of the battleship *Maine* in Havana Harbor had recently reached the Finger Lakes. It was then that some savvy steamboat executive hatched the concept of recreating that event by blowing up the steamboat *Onondaga* and the Seneca Lake Steam Navigation Company decided to blow her up in a public display.

On September 14, 1898, as the *Onondaga* was towed out to the middle of the lake, and thousands of people gathered on the shorelines in a festival atmosphere to witness the old boat's destruction. In preparation, *"…500 pounds of dynamite and 300 pounds of 'blasting pounder' were loaded aboard. No torpedo of modern warfare could have been more effective. There was a terrific explosion, a cloud of smoke drifted skyward and the* Onondaga *had disappeared beneath the waves…The* Onondaga, *once a fine ship, was no more*."

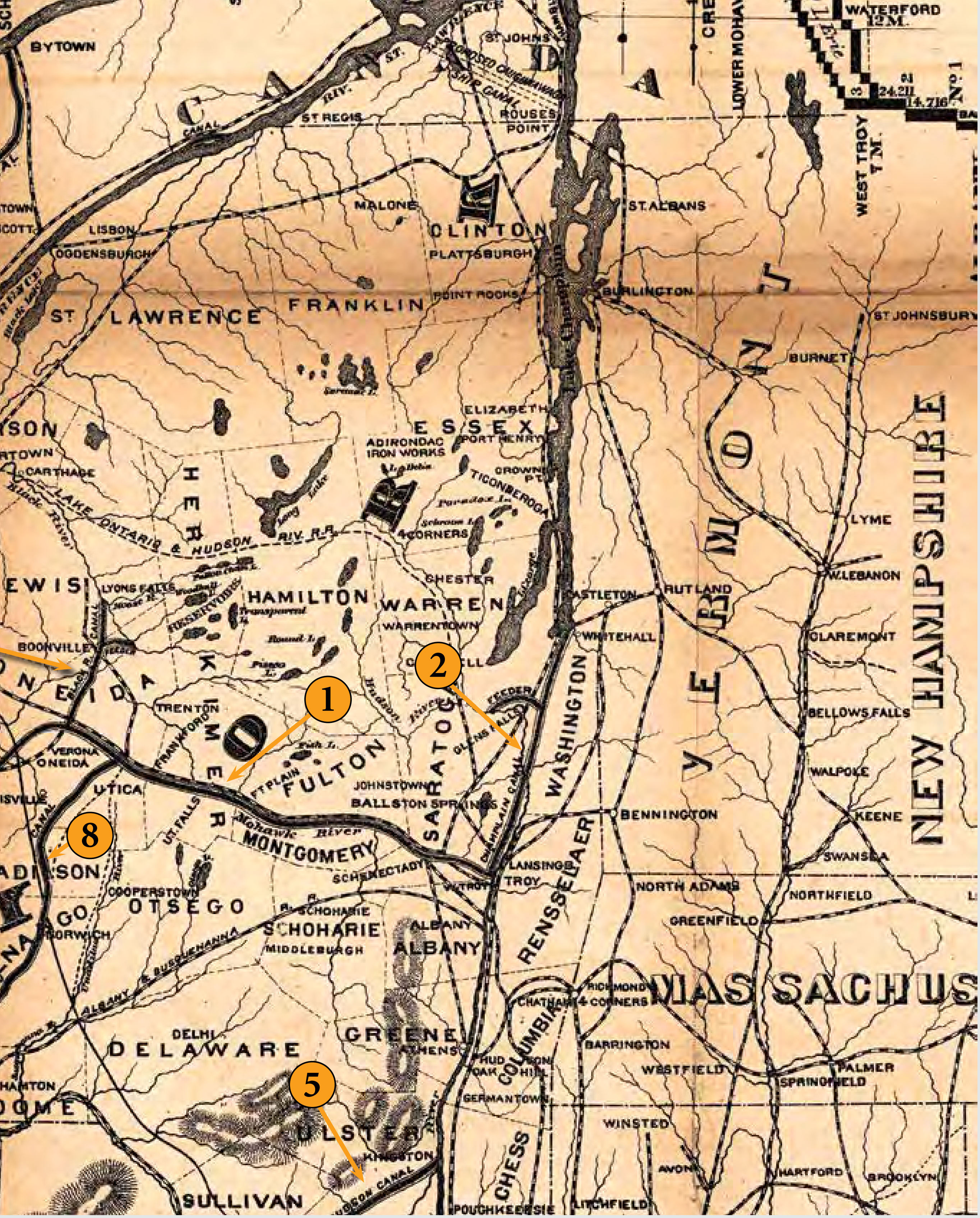
The *Onondaga* and her dramatic story are part of the Seneca Lake cultural legacy. In 2012, a team of shipwreck hunters using a side-scan sonar searched in the deep reaches of Seneca Lake and located the *Onondaga* in over 400 feet of water. The discovery revealed a roughly 175-foot long vessel still relatively intact in the deep, cold waters of Seneca Lake.

Remembering the *Maine*,1898. The decision to blow up the steamboat *Onondaga* to commemorate the recent events of the Spanish-American War was also a powerful comment on the changing times on Seneca Lake. The commercial era was drawing to a close and the modern recreational era was beginning.
Schuyler County Historical Society

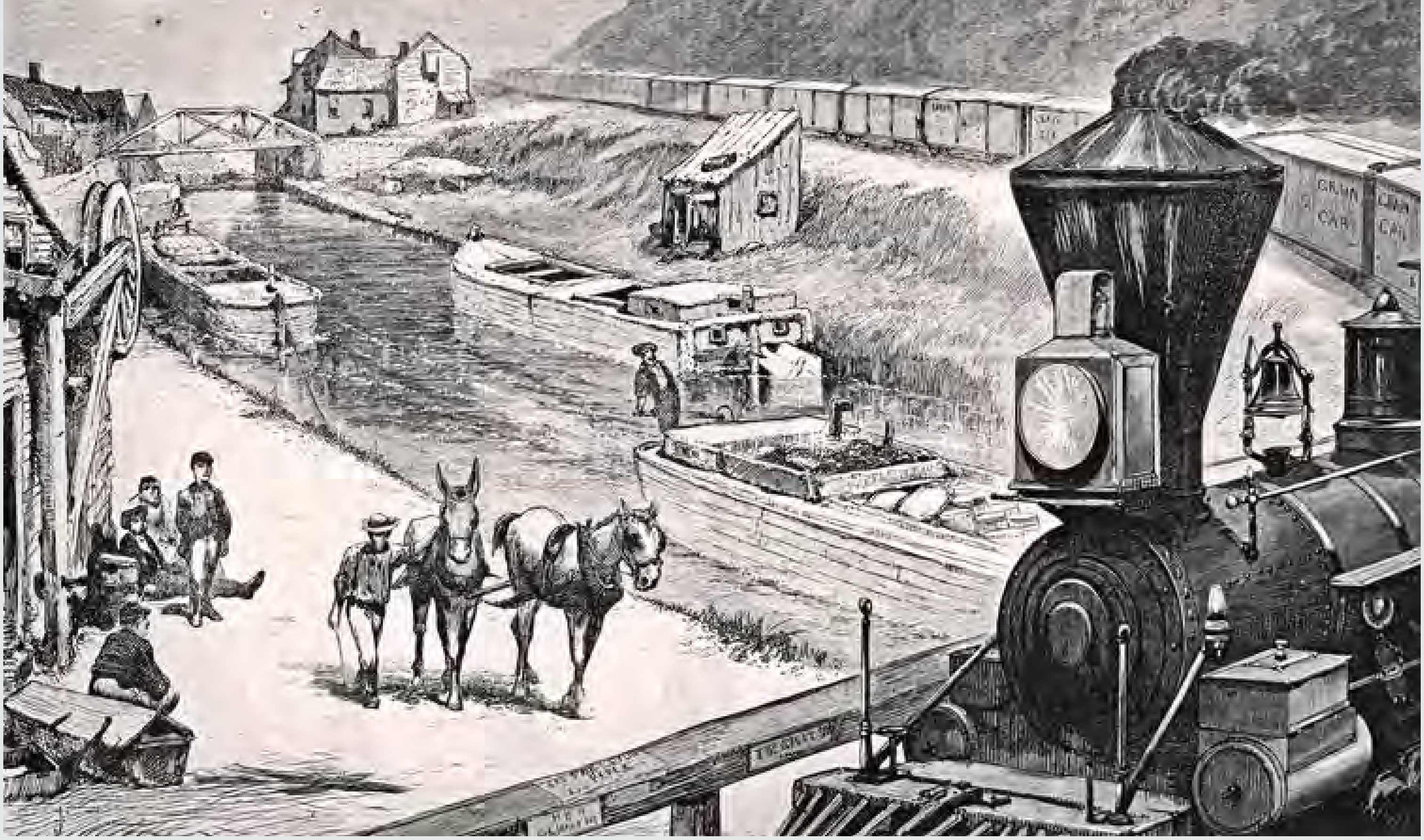


Almost all of New York's canals were built and operated as state-financed public works projects. Faced with engineering challenges, high construction costs, limited traffic and toll revenues, and increased competition from railroads, most of the canals started in the 1830s were abandoned by the 1870s. Although they were not financial successes in their own right, these "laterals" encouraged settlement throughout the state.

Detail from *Canals and Feeders and Junction of the Lateral Canals with the Erie, 1879.* From *The Annual Report of the State Engineer and Surveyor...1878.* Canal Society of New York State



1. Erie Canal, 1825–present
2. Champlain Canal, 1823–present
3. Cayuga and Seneca Canal, 1828–present
4. Oswego Canal, 1829–present
5. Delaware & Hudson Canal (private), 1828–1898
6. Chemung Canal, 1833–1878
7. Crooked Lake Canal, 1833–1877
8. Chenango Canal, 1836–1877
9. Genesee Valley Canal, 1857–1877
10. Black River Canal, 1855–1924
11. The Junction Canal (private), 1856–1872



Canals and railroads worked the same corridor. Railroads steadily gained a larger percentage of the business.
Canal Society of New York State

Railroads bring about the End of an Era

The success of the original canal gave rise almost immediately to expansion plans. If 90´ x 15´ locks on a four-foot deep canal could work so well, locks of 110´ x 18´ operating on a canal seven feet deep would work better. By 1835, expansion of the Erie and Champlain canal systems was authorized and the view from the canal was one of unrestrained optimism about the future. But all this success and optimism failed to take into account the impact of a growing rail system, which would parallel and out-compete many of the canal routes. For while the canals had to close in winter, the railroads did not.

Railroads made their debut just after the Erie Canal opened in 1825 but their imminent threat to canal travel was not immediately understood. The publicly-funded canals' success created a protective paternalism from the NYS Legislature and the privately-funded railroads were initially restricted in their competition. Before 1847, railroads were only permitted to haul freight after the canals closed for the winter. From 1847–1851, railroads could carry freight year-round, but had to pay extra tolls for carrying freight during the canal season. However, after 1851 the railroads' growing influence removed all these restrictions and as a result, canals had to reduce their rates to compete.

The relentless expansion of the railroad. The railroads provided a more efficient, year-round service and as they expanded their reach, the canal system found it ever more difficult to remain viable.
Chemung Canal Trust Company

While the main Erie and Champlain Canals suffered from this competition, the marginal lateral canals were even more vulnerable. This was especially true of the lateral canals that used Seneca Lake as a link in their transportation system. The Chemung Canal connecting the Pennsylvania coal mines to the south end of Seneca Lake at Watkins Glen saw a railroad built parallel to its route. The numerous locks that each vessel had to pass through were small, limiting the size and carrying capacity of the canal boats used on the system. Crooked Lake to the west had the same limitations. In hindsight, it was now clear that the economic decision to build the locks out of timber rather than stone, while less expensive to build, required more maintenance and frequently failed in heavy rain events.

Compounding that problem, when the mainline canals authorized expansion, the lateral canals were not included. The Chemung Canal made torturous efforts to increase its draft, but in the end, it was too small to accommodate the Erie's larger vessels. By the 1870s, the Legislature moved to close these marginal canals and the last canal boats passed through Crooked Lake in 1877 and the Chemung Canal in 1878. With their closing, the numbers of canal boat trips on Seneca Lake plummeted. Although regional interest groups lobbied the Legislature to invest vast sums to restore the doomed systems, they could not reverse the steady of expansion of the railroads. The steam towboats that were the workhorses of the canal towing business adapted to taking passengers, left the lake or were broken up.

Steam-powered construction machinery, concrete, and electricity were hallmarks of the 20th-century canal system.
New York State Archives

The Barge Canal: if we Build it They Will Come

In retrospect, the blowing up of the *Onondaga* in 1898 was a clear symbol of the end of an era. At the turn of the 20th century, Geneva and Watkins Glen were still the anchor harbors for commerce at the north and south ends. Smaller ports existed along the eastern and western shorelines. All these harbors had maritime infrastructure with the piers, warehouses and breakwaters that defined a working waterfront. As lake traffic transformed from commerce to recreation, the harbors began to adapt. The big paddlewheel steamers were replaced by specially-designed excursion boats that were powered by gas and diesel engines. Automobiles and trucks joined the parade of changing transportation options and had their own impact.

Canal advocates did not relinquish their place in the transportation system easily. As the tonnage figures revealed an ever declining industry carrying bulk cargos of coal, stone, newsprint and lumber, the canal advocates marshaled their forces. With the support of Governor Teddy Roosevelt, they achieved one last expansion of the entire canal system designed to save the water highway from extinction. Using the argument that "if we build it bigger, they will come back," the NYS Legislature endorsed the construction of the New York State Barge Canal to replace the old "expanded" system. The new system eliminated the century-old towpath and draft animals were replaced by internal combustion engines. The 200-ton capacity wooden barges were replaced by modern steel barges with 1000-ton capacity. The new Barge Canal consolidated the number of locks, with the dynamic Flight of Five leading the way west from Waterford. Opened with great fanfare and expectations, the new system had some initial success, especially moving fuel oil to waterfront tank farms all along the system.

However, in the second half of the century, as communities re-discovered their waterfronts, they concluded that using them for bulk storage of fuel products was perhaps not the best use of the shoreline. Gradually the land was reclaimed for public use and as the tank farms diminished, the number of tugboat-driven barges and self-propelled vessels steadily declined. Today there are just a few niche remnants of these bygone commercial days. Stone barges still use the Champlain Canal to transport oversized loads too big and heavy to move by the road or rail, demonstrating the efficient beauty of moving weight over water.

The opening of the Waterford Flight at the eastern end of the Erie Barge Canal on May 15, 1915 marked the beginning of a new era for New York's canals and the communities on their banks. Nearly a hundred years later, the five locks at Waterford still make the highest lift in the shortest distance of any canal in the world. New York State Museum

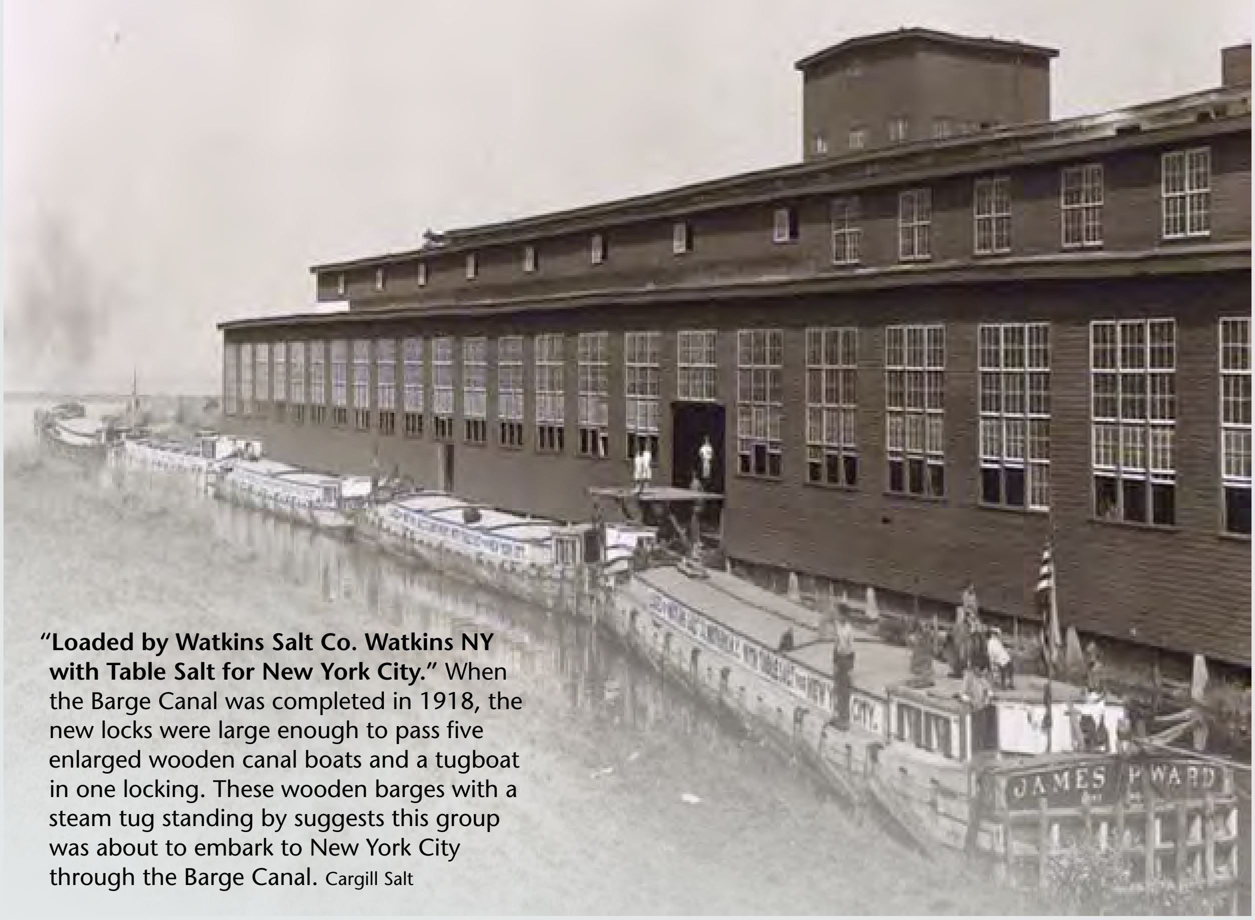
The *I.L.I. 101* (today's *Day Peckinpaugh*) received a great deal of attention during her maiden voyage through the Barge Canal in 1921. After 73 years of commercial service and twelve years of retirement, she returned to New York's canal system in 2005 to begin her career interpreting New York State's canal heritage. Canal Society of New York State

The 20th Century on Seneca Lake

The New York State Barge Canal incorporated the Erie, Champlain, Oswego and Cayuga and Seneca Canals into its expanded network. On Seneca Lake this gave rise to the movement of salt from two companies operating out of Watkins Glen. Excursion boats became the best on-water option for tourists now arriving in the Seneca Valley by car. As the wooden canal boats and steam towboats struggled to survive changing times, the beautiful inland Finger Lakes region adapted to a new lifestyle of recreational use. As the last wooden ferry *Goodwin* was retired, it was drawn out of the water and used as a summer camp. With the invention of the internal combustion engine, these boats could now be equipped with engines that ran on gasoline or diesel engines. Flotillas of smaller recreational wooden sail or power boats provided water access to a new generation of lake lovers. Talented craftsman who had built small boats for themselves and their neighbors saw a rising demand for fishing boats, sailboats, rowing boats and canoes. This became the basis for transforming these modest builders into business enterprises that catered to new generations of recreational boaters. Devoted lake users often gathered for regattas of friendly competition and social interaction, a tradition begun in the second half of the 19th century that continues to this day. The signature wooden boat industry of the Finger Lakes gradually gave way to mass-produced aluminum and fiberglass boats. However, the many Finger Lakes craftsmen who flourished during the height of this period have left a legacy wooden watercraft now housed at the Finger Lakes Boat Museum in Hammondsport. This impressive collection is now preserved and interpreted by a mostly volunteer effort and should not be missed.

Steamer *Colonial,* ca. 1900. The steamboat *Colonial* was designed to take advantage of the new excursion business. Geneva Historical Society

"None Better Built:" The Fay & Bowen Engine Company was part of the recreational revolution and built fine boats on the Geneva waterfront from 1904–1929. Today a number of these classic wooden boats are preserved and interpreted at the Finger Lakes Boating Museum in Hammondsport on Keuka Lake.



"Loaded by Watkins Salt Co. Watkins NY with Table Salt for New York City." When the Barge Canal was completed in 1918, the new locks were large enough to pass five enlarged wooden canal boats and a tugboat in one locking. These wooden barges with a steam tug standing by suggests this group was about to embark to New York City through the Barge Canal. Cargill Salt

During World War II and the Korean War, the federal government established a number of military installations around Seneca Lake. The Sampson Naval Training Station was opened in 1942 and trained over 400,000 naval recruits during its three and a half years of operation. In 1945, the base was re-designated as a separation center, discharging over 65,000 veterans of World War II back to civilian life. The base closed in 1946 but was re-activated for the Korean War in 1950 as the Sampson Army Airfield, training air force recruits until it closed again in 1955. A transfer of over 1,000 acres to New York State led to the establishment of Samson State Park, an active venue for summer visitors. The 1,000-bed hospital on the property served military and civilian patients until it closed in 1971. The nearby Seneca Army Depot was opened as a weapons storage facility in 1941 and continued in use until 1995. Its role in housing nuclear weapons during the Cold War for Air Force planes operating out of Griffiss Air Force Base was very controversial at that time.

Sampson Air Force Base, Geneva N.Y. in the Finger Lakes. Named in honor of Palmyra native Rear Admiral William Thomas Sampson, the Sampson Naval Training Base, became the Sampson Air Force Base and is now a New York State park. Located on the eastern shore of Seneca Lake, the base provided training for 5,000 naval recruits at a time. By the war's end Sampson had trained more than 410,000 sailors. Sampson Military Museum

Geneva Waterfront, looking east from the "I Love New York" Visitors Center along the route of the original Cayuga and Seneca Canal. Today, the Geneva waterfront beckons to thousands of visitors and residents.

Seneca Lake Today

Today the Seneca Lake region is a vibrant area with vineyards and orchards that generate significant tourism activity. Geneva and Watkins Glen have emerged from their commercial past. Geneva's new state-of-the-art "I Love New York" Visitors Center is a sharp contrast to the working waterfront that was active here for more than a century. As the lake transitioned from commerce to recreation and tourism, the waterfront was filled in and gentrified. Where breakwater, warehouses and bars once dominated, the new Visitors Center provides a comprehensive starting point for exploring the region. Looking south across Seneca Lake, it has enormous potential to present the lake's history and the unfolding story of its legacy of intact shipwrecks and maritime past.

At Watkins Glen, the working harbor on the south end of the lake, Cargill and US Salt have facilities to harvest salt caused by the evaporation of a huge sea over 300 million years ago. Today Watkins Glen enjoys worldwide fame as an automobile racing center and since 1863 has preserved a special tract of land that is now home to the state park honoring the community's namesake. In both of these once important commercial harbors, public access has been expanded by parks and walkways that are ideal locations for interpretive panels that reflect on the bygone days of these working waterfronts.

Vineyards and orchards. Today the landscape of Seneca Lake is dominated by the orderly rows of grape-vines that has fueled a dynamic and popular visitor experience.
Atwater Vineyards

The *William Scandling* is a 65-foot, steel hull vessel built for the US Navy in 1954 to be a harbor-mine servicing vessel. She is now used by researchers from Hobart and William Smith Colleges for a wide variety of Finger Lakes research and educational programs.

Hobart and William Smith Colleges have provided higher education opportunities to students from their Geneva campus for more than 200 years and their research vessel, the R/V *William Scandling,* provides dynamic on-lake study opportunity for students.

Recreational activity on the lake has become firmly entrenched as each summer season sees owners and renters return to the lake shore to enjoy the region's beauty with family and friends. State parks, waterfalls and the beauty of the setting draw thousands of visitors each year and tour boats operating out of Geneva and Watkins Glen provide visitors with opportunities to experience the lake the way previous generations have.

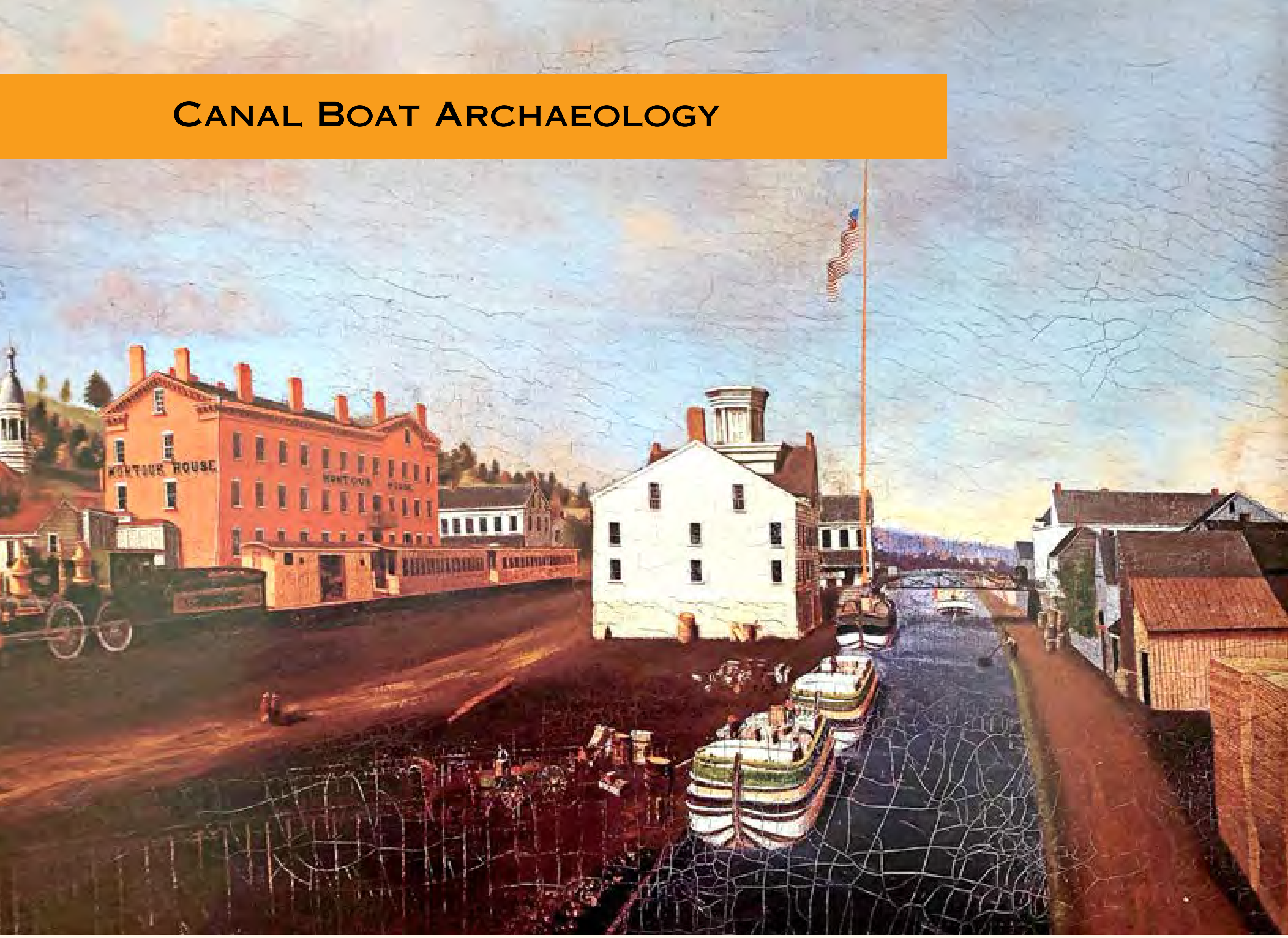
Seneca Lake's vibrant commercial past is not apparent to today's residents or visitors. It is our expectation that the results of the of the Seneca Lake Survey will reveal an extraordinary collection of historic shipwrecks reflecting on the regions commercial heritage. In addition, the survey is now also capturing the dynamic geological features of this underwater landscape.

True Love. (Formerly *Verona* II). Designed by the famous yacht designer John G. Alden in 1926, the *True Love* enjoyed an impressive career as a racing yacht and was also featured in a number of important movies. She was brought to the Seneca Harbor Park Pier in 2010 and now serves as an excursion boat.

The *Seneca Legacy* is a sight-seeing and dining-excursion vessel that is operated by Captain Bill (Simiele) out of the old Northern Central Railroad Station on the Watkins Glen waterfront.

Mural at the Finger Lakes Boating Museum (FLBM), Hammondsport, Keuka Lake, NY. The FLBM moved into the former Taylor Wine facility in 2014 and preserves and interprets a rich collection of more than 200 Finger Lakes-built watercraft.

Geneva, NY, "I Love New York" Visitors Center. The new pavilion provides information and exhibits about a wide variety of attractions throughout the Finger Lakes region. (right) The waterfall at Glenora.



***Montour Falls* [aka Havana], ca. 1860.** Artist, E.P. James. The Chemung Canal as it passed through the village of Montour Falls with the Montour House on the left and the railroad paralleling the canal. The boats depicted are "lakers," and may have had the ability to sail upon Seneca Lake. Montour Falls Library

Reflections on the towpath-era canal boats

From the moment that sections of the Erie Canal were completed enough to hold water, boats designed to move passengers and freight appeared. The canal boats were larger than the river vessels they were replacing, but smaller than the canal boats that followed after each expansion. The new water highway system depended on the power of draft animals pulling on a rope towline. The original Erie and Champlain Canals had standardized lock dimensions that measured 90′ x 15′ and limited vessels to a four-foot draft. The boats that traveled the new canal were approximately 79′ x 14′, and with a maximum draft of four feet and a maximum cargo capacity of about 75 tons.

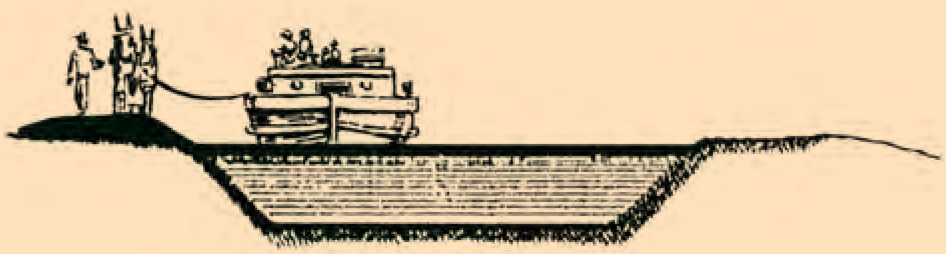
From the first day that vessels could transit on the canal, the system demonstrated its potential to change the lives of those who lived and worked alongside it. Almost immediately the discussion turned to making the canal bigger so that it could accommodate larger vessels hauling greater tonnage. In the following decade, a "canal mania" swept the state and communities not on the original canal route began to survey for "lateral canals" that might provide a connection to the prosperity.

It is easy to understand how the immediate success of the original system could create such a frenzy and by 1835 the first "enlargement" was authorized, and a series of lateral canals had been opened or planned. It now seems clear that these early canal proponents were blinded by the expectation of prosperity and did not foresee the imminent arrival of the railroads and the impact they would have on the canal transportation system.

By 1862, the first canal expansion was completed and the locks on the busier Erie system were enlarged to 110′ x 18′ x 7′. The system could now accommodate vessels that were 97′ x 17′ x 7′ which tripled their carrying capacity to over 200 tons. In addition, the distinctive shape of the canal boat bow had become standardized. While many early boats had been built with a scow shaped bow, in actual practice this shape was found to cause damage to other boats and to the canal itself and was outlawed by 1842. Existing scow-shaped boats were grandfathered and allowed to operate but any new boats built after the law was adopted needed to conform with the gentle curve. By the time photography appeared, most of the original Clinton's Ditch canal boats were gone and little is known about the actual construction of these first-generation watercraft.

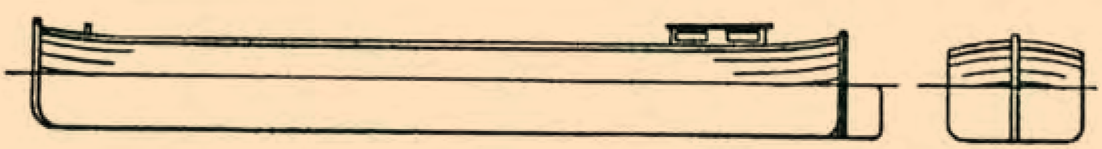
Canal Boat and Canal Prism Size Comparison

1825 40′ top width by 26′ bottom width x 4′ deep.

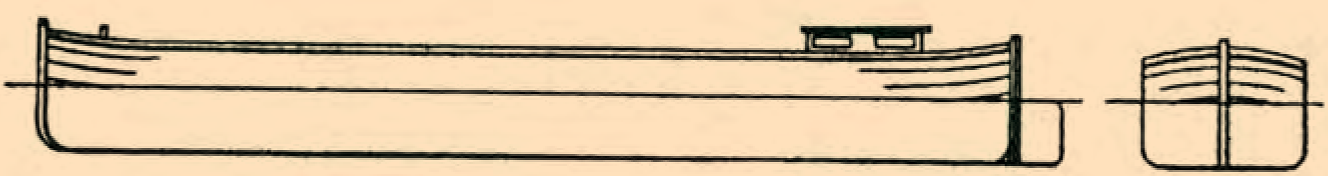


1862 70′ top width by 44′ bottom width x 7′ deep.

A note about dimensions
The "Original Erie" canal boats were roughly 79′ x 13′ x 4′, while the "Enlarged Erie" were up to 97′ x 17′ x 7′. In analyzing the size of the targets located in 2018 and 2019, we can scale the sonar image for rough measurements, and also try to get a sense of the size category from the video examination. That said, the size findings should be considered "preliminary" until we can get more precise measurements.



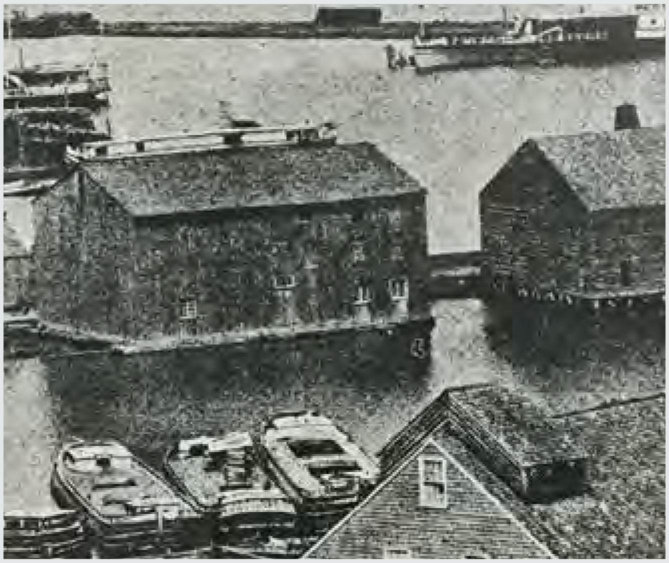
1825 Original Erie canal boat size: 79′ length x 14′ beam x 4′ draft.



1862 Enlarged Erie canal boat size: 97′ length x 17′ beam x 7′ draft.

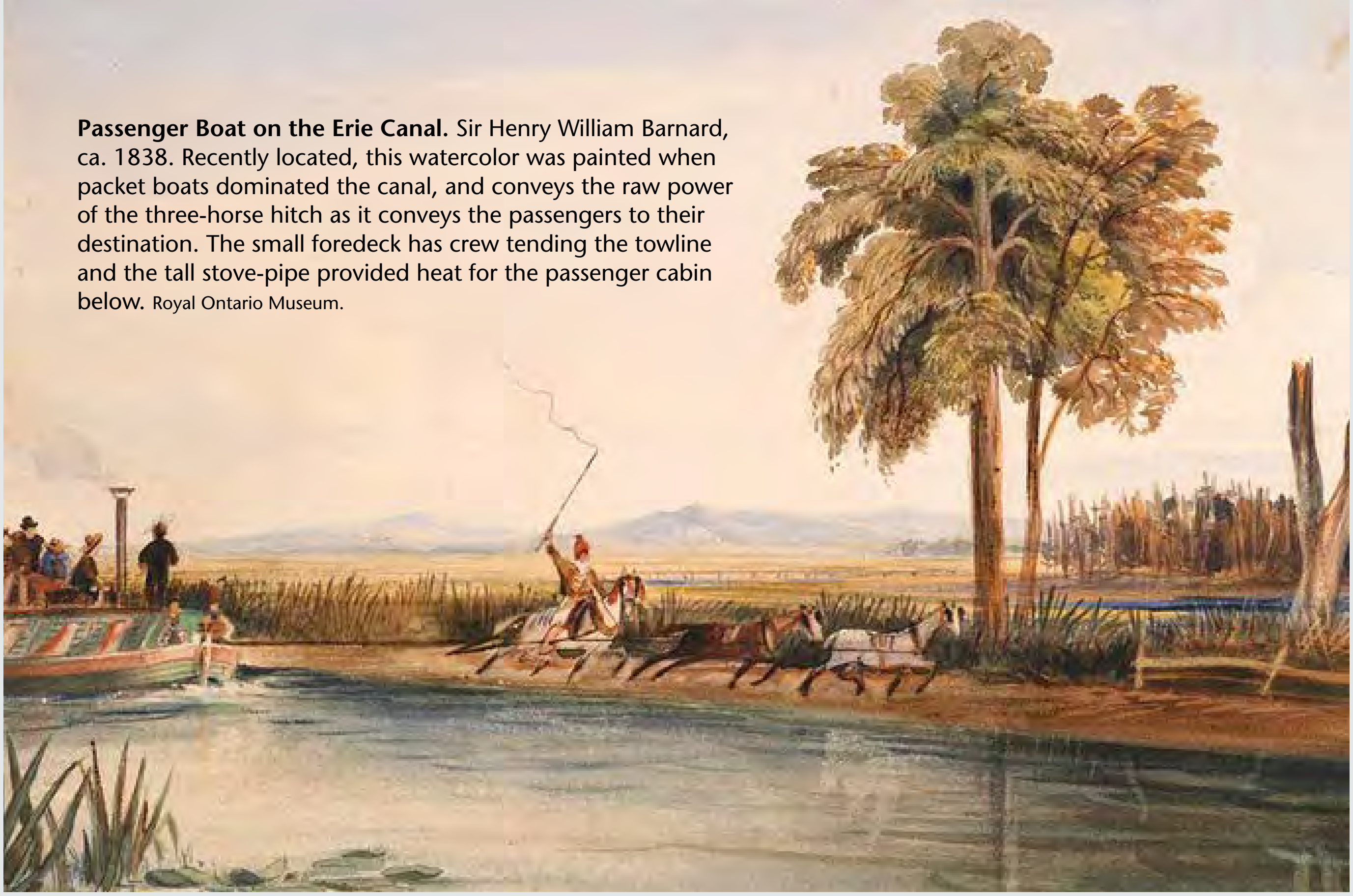
Drawings by Scott McLaughlin

Paintings, sketches, travelers' descriptions and engravings of the canal from this era provide many of the best clues as to what these vessels looked like and how they were built. Experience on Lake Champlain and other canal-connected waterways have demonstrated that another important source of canal boat information still exists underwater. The Seneca Lake Survey was conceived, in part, with a belief that the best evidence of these early canal-era vessels might be found on Seneca Lake's deep bottom. In the first two years of survey and documentation, Seneca Lake did not disappoint. This report will share preliminary findings of a growing collection of submerged towpath-era canal boats.



(Detail, above): **Geneva New York Harbor, ca. 1880.** Note the three canal boats lined up in the harbor. All three appear to be equipped with the bow stable feature seen on targets 4 and 16. Geneva Historical Society

(Detail right): ***Montour Falls*** [aka Havana], ca. 1860. Artist, E.P. James. The artist took great pains to illustrate the canal boats used on the Chemung Canal. These canal boats were all of the original "Clinton's Ditch" size and capacity. The most diagnostic feature seems to be the horse-stable in the bow. Several of the targets already located have a similar feature. Montour Falls Library



Passenger Boat on the Erie Canal. Sir Henry William Barnard, ca. 1838. Recently located, this watercolor was painted when packet boats dominated the canal, and conveys the raw power of the three-horse hitch as it conveys the passengers to their destination. The small foredeck has crew tending the towline and the tall stove-pipe provided heat for the passenger cabin below. Royal Ontario Museum.

While the general goal of the Seneca Lake Survey was to inventory the deep lake bottom and the shipwreck collection that logic dictated would be there, one of the specific objectives of the survey was to find a packet boat. Packet boats carried passengers, like today's long-haul buses, and began operations as early as 1819. At the time the underwater survey began in 2018, no surviving example of a packet boat was known to exist.

What was known was that when the Erie Canal was completed in fall 1825, the packet boat *Seneca Chief* celebrated the momentous event by traveling from Buffalo to New York City with Governor DeWitt Clinton to announce it to the world. As the Bicentennial loomed, advocates known as the "Buffalo Packet Boat Project," launched an effort to build and operate a packet boat by 2025 as a signature event to commemorate this world-changing accomplishment. To that end, a vigorous research project to gather information about the packet boat historical record has been underway and much time was spent in historical societies and museums looking for information on technical details of the vessels and how they operated.

Artist depictions of packet boats convey details of construction and operation. Journals, letters and newspapers provide rich descriptions of life aboard these swift-moving watercraft.

New York, June 19, 1822

GRAND CANAL

We are informed by a gentleman who has just returned from a visit to Buffalo and Niagara Falls, that he traveled 160 miles in the new convenient passage boat on the Erie Canal, viz.:

On this route are already seven passage [packet] boats with good accommodations, and hundreds of other boats transporting immense quantities of produce to Utica;…

The passage [packet] boats are drawn by three horses tandem rigged; the other boats by one or two horses, according to the size of the boat—a boy rides the rear horse, and travels from three to four miles per hour.

(Left) ***Laid up For the Winter–Atlantic Basin, Brooklyn.*** 1873. Although canal boats were built to the size of the canal in use at the time of their construction, they came in all shapes and layouts. Note the bow of the center canal boat appears to have the split Y-shaped stem-post found on target 5. Geneva Historical Society

What Lies Beneath?
Who manages historic shipwrecks?

The technology of surveying for shipwrecks has made significant strides over the past seventy years. The advent of self contained underwater breathing apparatus (SCUBA) equipment made shipwrecks accessible down to a depth of 130 feet of water. More recently, the development of remote sensing equipment such as sonar and metal detecting gear has opened up the exploration of shipwreck collections thousands of feet deep. This improved capability has been a double-edged sword, as many significant shipwrecks have been found and poorly managed. In recent times, New York State, the federal government and the United Nations have all made significant efforts to better define "underwater cultural heritage" and develop a protective legal framework for management. The Seneca Lake survey project operates under NYS Museum Section 233 permit #4319 and is a good example of a project operating under both the Abandoned Shipwreck Act (ASA) of 1987 and NY state law.

Finding shipwrecks is the easiest part of the job. Managing shipwrecks for their public value is hard.

New York Education Law, Section 233, 1958
New York State has long managed its archaeological collections under Section 233. "…no person shall appropriate, excavate, injure or destroy any object of archaeological…interest, situated on or under state lands owned by the state of New York, without written permission…"

The Federal Abandoned Shipwreck Act (ASA) of 1987
Ownership of shipwrecks is rooted in the ancient Law of Salvage, much of which is still in use today. However, as survey technology advanced and more historic shipwrecks were exposed to salvage and degradation, the Abandoned Shipwreck Act of 1987 was enacted by Congress. The new law protected submerged historic vessels over 50 years old and transferred management responsibilities to the states in which these public resources came to rest.

UNESCO Convention on the Protection of Underwater Cultural Heritage, 2001
The 2001 UNESCO Convention represented an international response to the looting and destruction of underwater cultural heritage by treasure hunters and others. It provided new protections and principles designed to preserve underwater cultural heritage world-wide.

The State Education Department
New York State Museum
APPLICATION FOR AUTHORIZATION TO COLLECT AND EXCAVATE ARCHEOLOGICAL OR PALEONTOLOGICAL MATERIALS ON STATE LANDS
(This application is made pursuant to Section 233, subsectons 4 and 5, State Education Law L. 1947, c. 820, amended L. 1958, c. 121, eff. March 6, 1958.)

Permit Number: __4319________
(For Agency Use - do not fill in this item.)

Application is made for a permit to conduct research activities on state lands at the following location: (site/town/county)

Near Lodi Point, Seneca County, **NEW YORK STATE**

The research activities to be undertaken are fully described in the proposal attached to this page, and include:

- hypotheses being tested
- Research goals
- field methodologies
- crew characteristics (with resumes)
- techniques of collection, excavation, data recovery and analysis
- facilities for treatment, preservation and storage of materials
- disposition of artifacts and specimens

Signature of Applicants: On file **Date: 6/29/18**
Attach firmly to proposal and forward to Room CEC 3097, Empire State Plaza, Albany, NY 12230. Do not write below this line.
Recommendation: *Proceed*

SIGNATURES
For the Commissioner of Education:

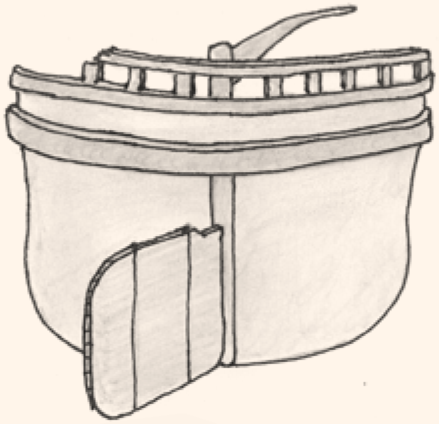
Date:___
June 29, 2018________

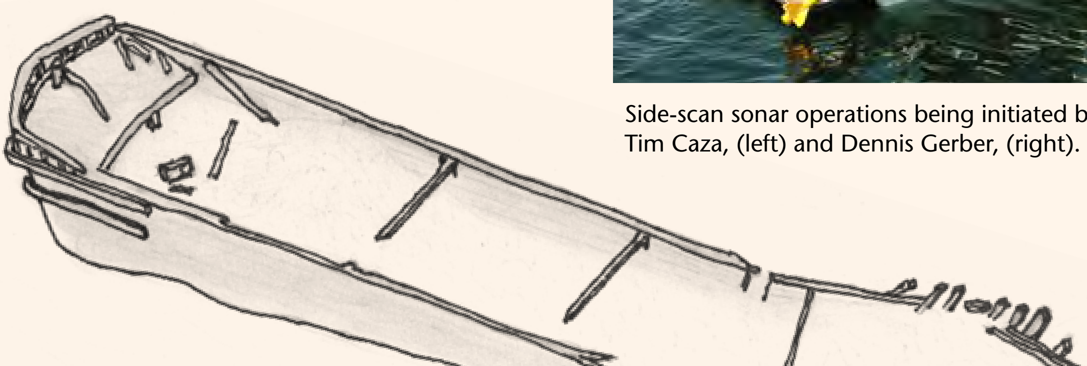
Sunken Military Craft Act of 2004 (SMCA)
Thousands of U.S. warships lie in waters around the world. The SMCA preserves the right, title and interest of the United States in any sunken US military craft, regardless of the passage of time. The SMCA prohibits any activity directed at sunken military craft except those authorized under a permit issued under the provisions of the Act.

2018 Results

Target 1

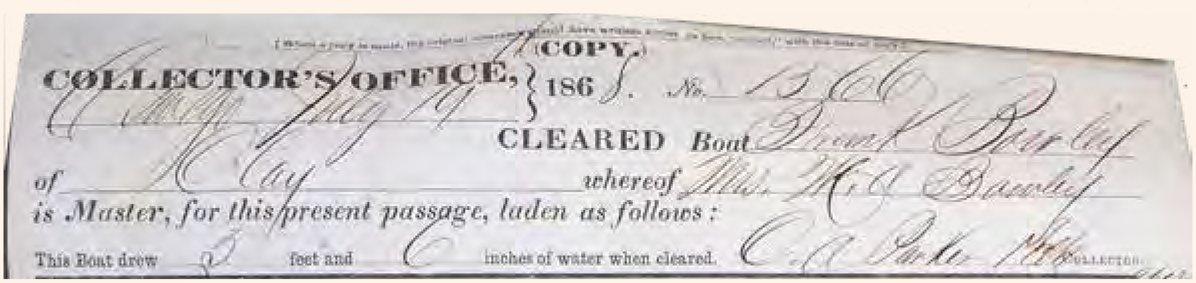
It was the discovery of an 1869 newspaper account of the loss of the canal boat *Frank Bowley* that became the catalyst for the 2018 Seneca Lake Survey. Target 1 was located on the first day of the survey exactly where that the article said she went down. She is an Enlarged Erie-class vessel and loaded with a cargo of Pennsylvania coal from Coal Point at Watkins Glen.



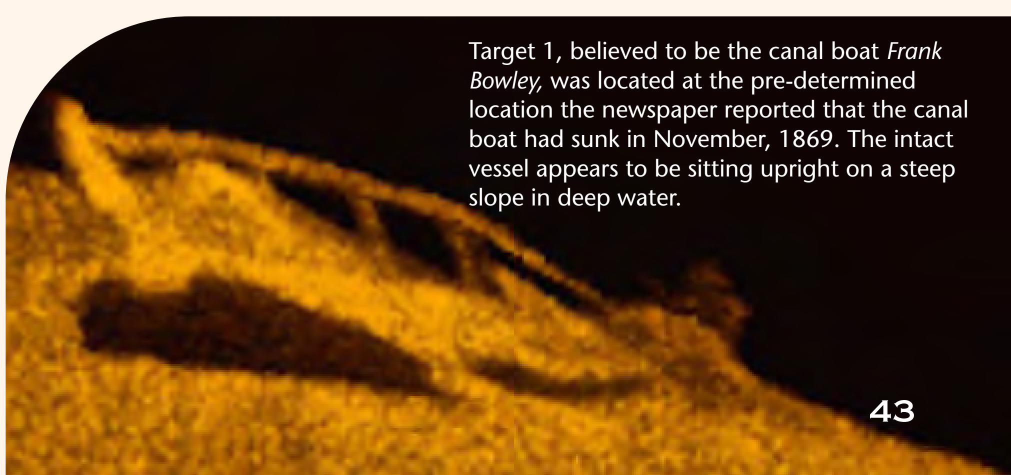


Side-scan sonar operations being initiated by specialists Tim Caza, (left) and Dennis Gerber, (right).

Drawings by Tim Caza

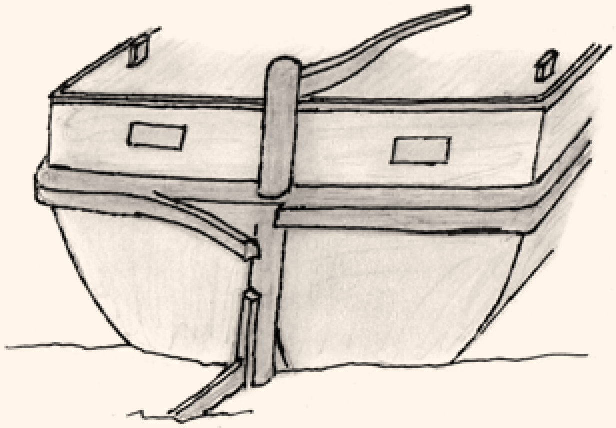

(COPY.)
COLLECTOR'S OFFICE, 1868. No. 1366
CLEARED Boat Frank Bowley
of H Clay whereof Mrs. W. A. Bowley
is Master, for this present passage, laden as follows:
This Boat drew 3 feet and 6 inches of water when cleared. C. A. Parker Collector.

An interesting canal "Collectors Office" receipt was located in the New York State Archives in which the "Boat *Frank Bowley*" was cleared the previous year on July 19, 1868, with a load of lumber from Oswego to Syracuse. What makes this document so important is that it lists the Master of the *Frank Bowley* as Mrs. W.A. Bowley, a rare example of a woman operating a canal boat upon the Erie Canal.
New York State Archives

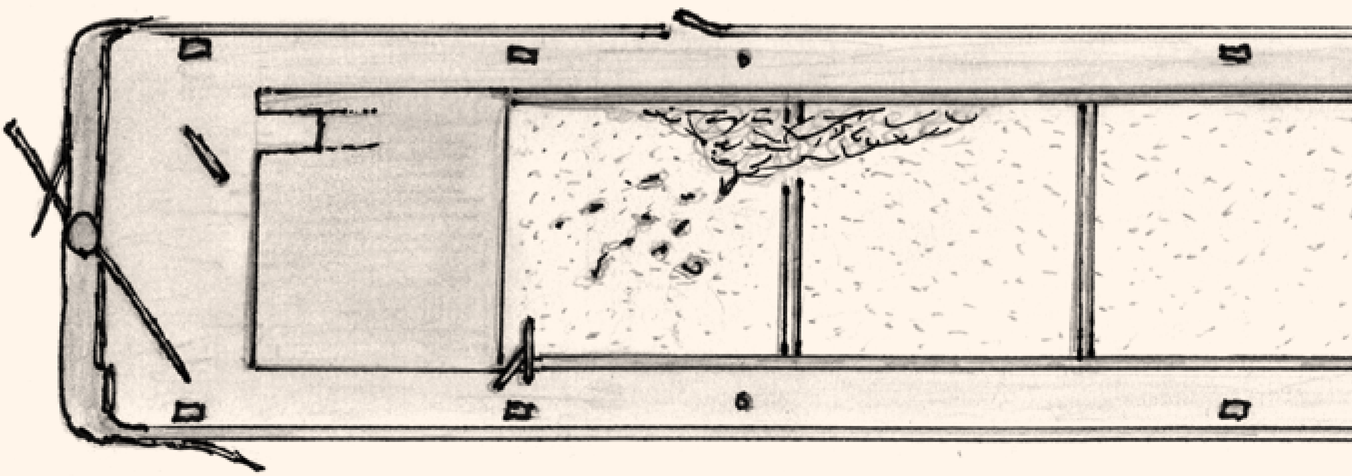


Target 1, believed to be the canal boat *Frank Bowley,* was located at the pre-determined location the newspaper reported that the canal boat had sunk in November, 1869. The intact vessel appears to be sitting upright on a steep slope in deep water.

Target 2



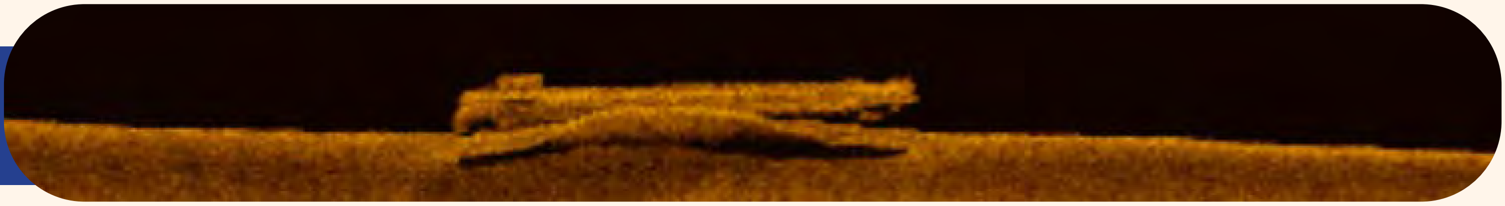
Stern section



Drawings by Tim Caza

Stern section

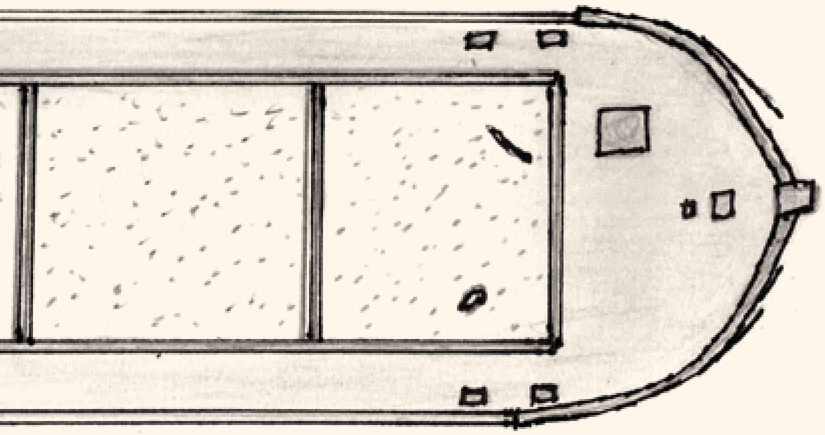
Forward edge of stern cabin

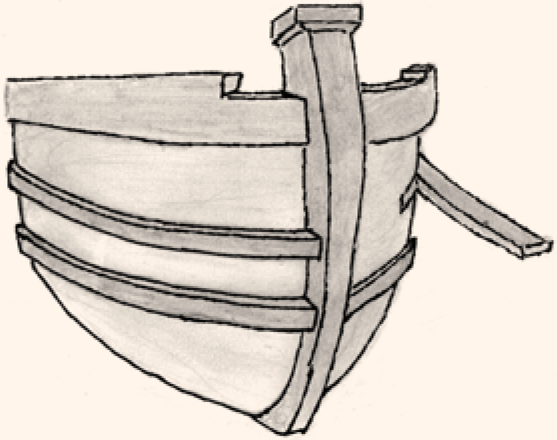


Sonar image, target 2

Target 2 is an intact Original Erie-class canal boat.

- A large **cargo hatch** that runs nearly the entire length of the vessel.
- This hatch is completely **full of cargo,** which is covered with sediment but is assumed to be coal.
- Numerous wooden **bitt posts** along it sides.
- The **stern cabin** is intact and may contain a significant artifact collection.
- The foredeck is dominated by a single large **bitt post.**





VIEW AFT FROM STARBOARD QUARTER

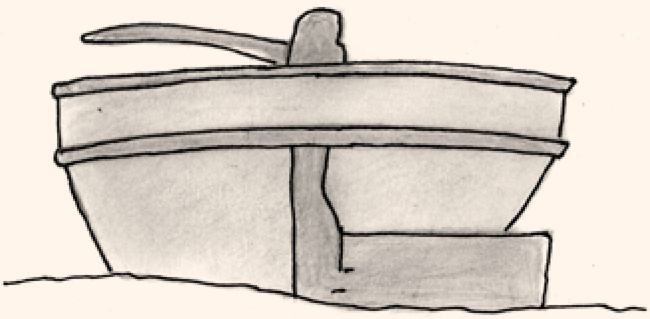
BOW SECTION

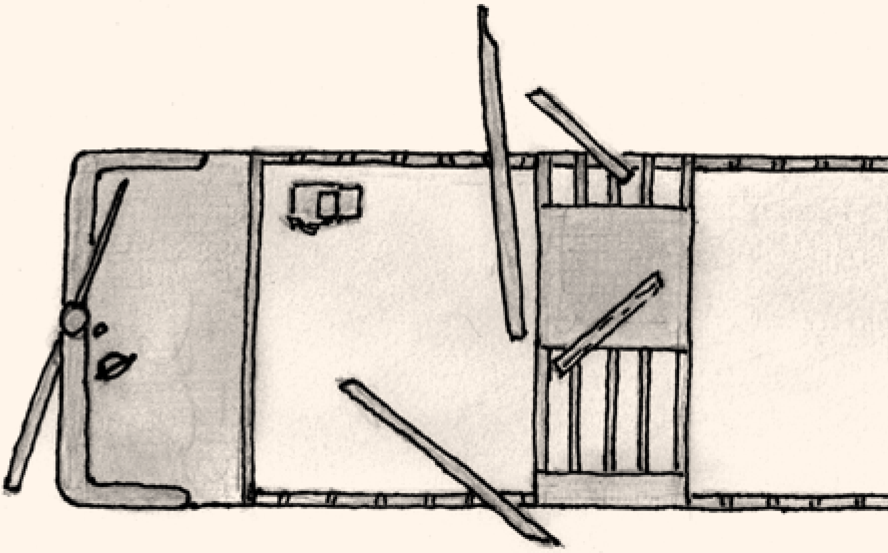
Target 3

Sonar image, target 3

Target 3 is a scow-ended Original Erie-class canal boat.

- A large **cargo hatch** that runs nearly the entire length of the vessel.
- The **stern cabin roof** is missing and the cabin trunk has collapsed.
- A **woodstove** is evident in the cabin remains.
- **Small deck** between cabin and cargo hold.
- Small **foredeck,** but no walkways along the sides.





Drawings by Tim Caza

STERN

STERN QUARTER

STERN CABIN INTERIOR

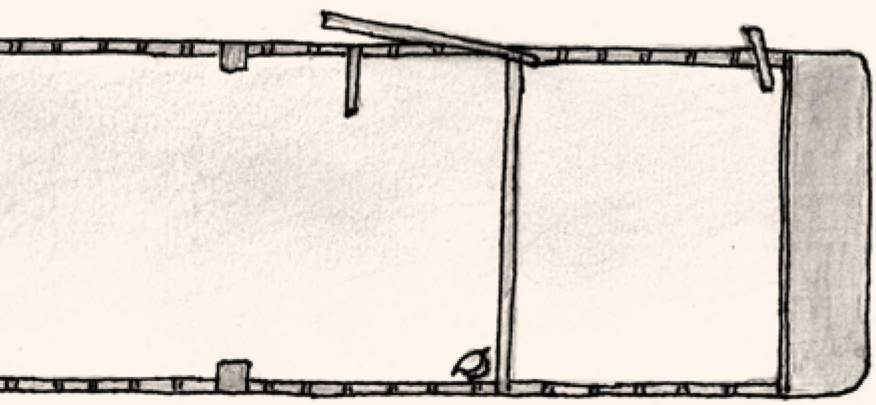
All of the canal boats are expected to have woodstoves and family possessions within the cabins.

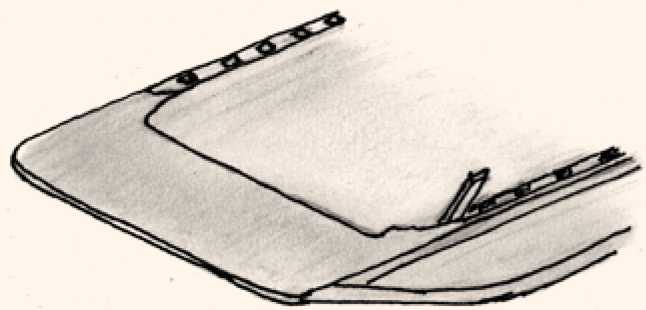
Scow-shaped vessels were subject to additional regulation even before they were finally banned in the 1840s.

CANAL REGULATIONS.

At a meeting of the Board of Canal Commissioners in the city of Albany, on the 10th of March, 1826, the following rules and regulations, in addition to those provided by law relating to the Erie and Champlain canals, were adopted to wit:…

5. Square headed or sharp cornered scows, or boats, shall have a semicircular platform firmly fastened upon the bow thereof, so as to prevent and protect other boats or scows from a contact with either of the corners thereof: and every square headed or sharp cornered boat or scow which shall navigate the canal without such platform, shall be charged in addition to the present rates of toll four cents per mile.





BOW

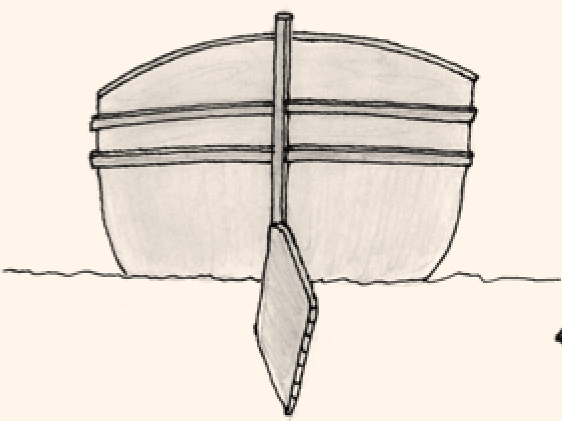
The scow shape and shallow draft indicates target 3 is an early canal boat. The scow shape was outlawed in the 1840s because it damaged the canal and other vessels. The familiar compass shape was mandated at that time. A similarly dimensioned canal boat has been found and studied in Lake Champlain.

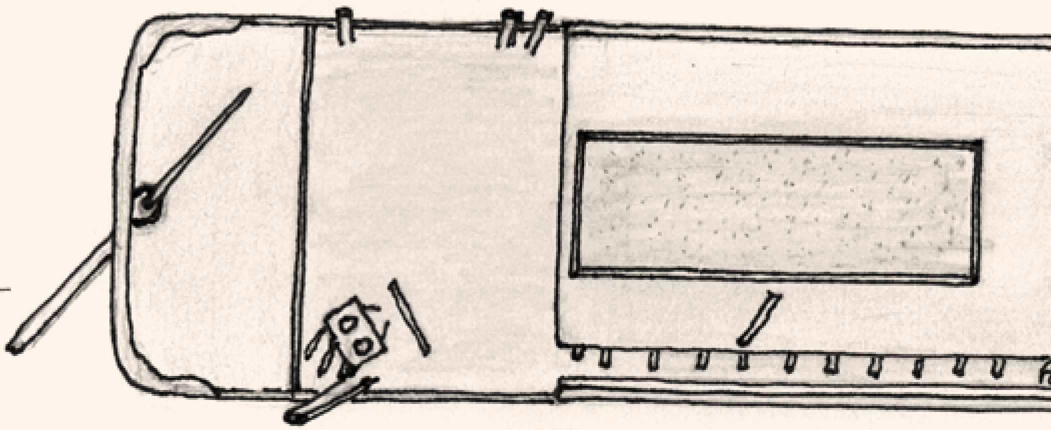
Target 4

Target 4 is an Enlarged Erie-class canal boat

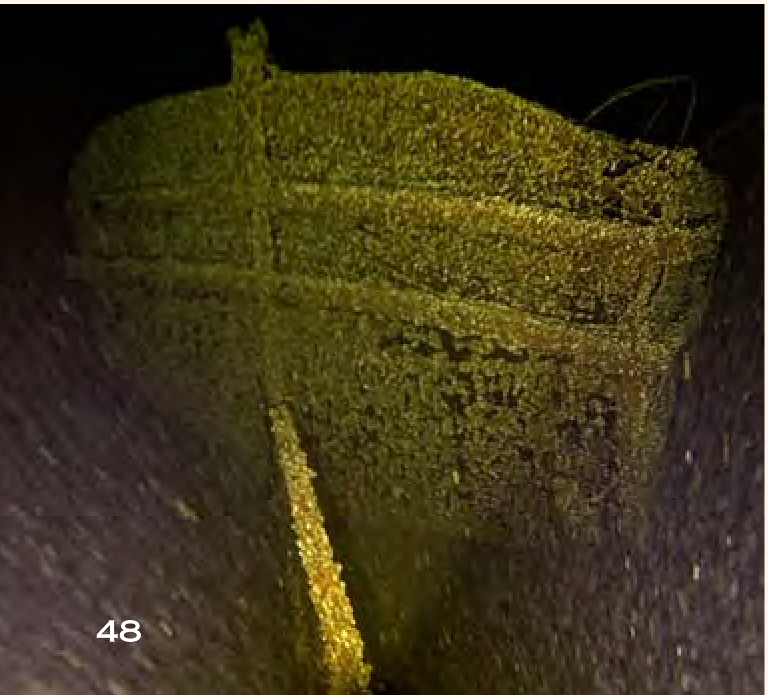
- Intact **horse stall** on the foredeck.
- **Ship's anchor** hanging inside forward cargo hatch.
- **Stern cabin** collapsed and roof missing.
- **Woodstove** visible in cabin remains.
- **Iron cleats** along vessel sides.

Sonar image, target 4



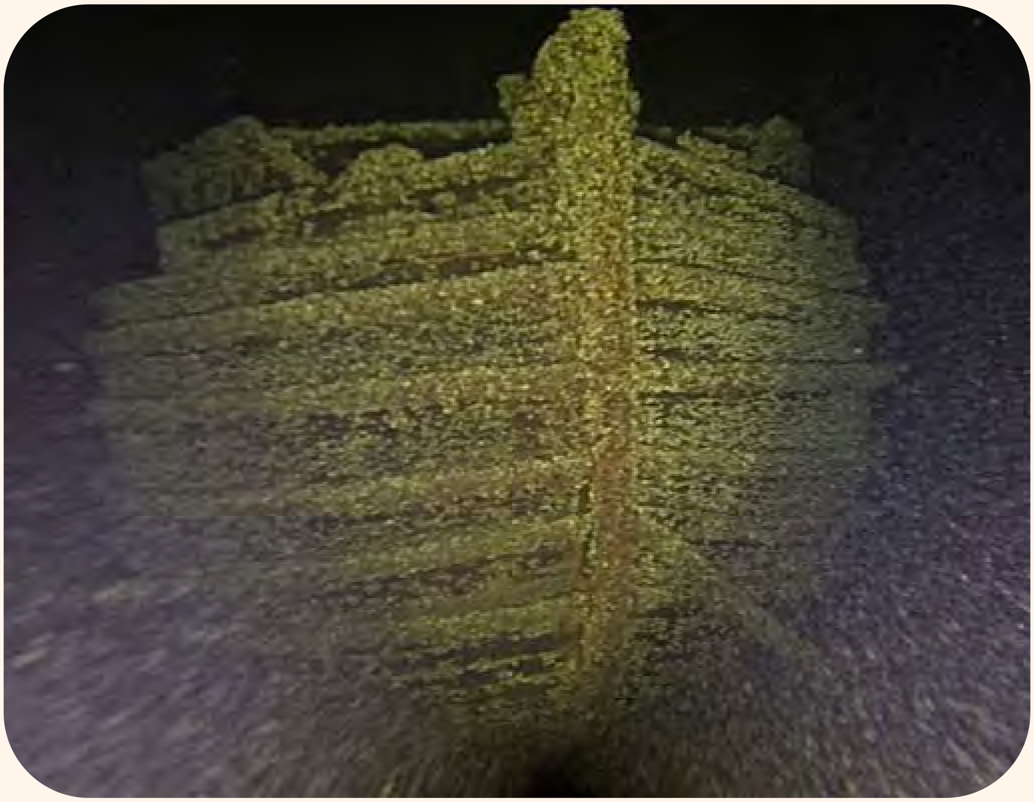


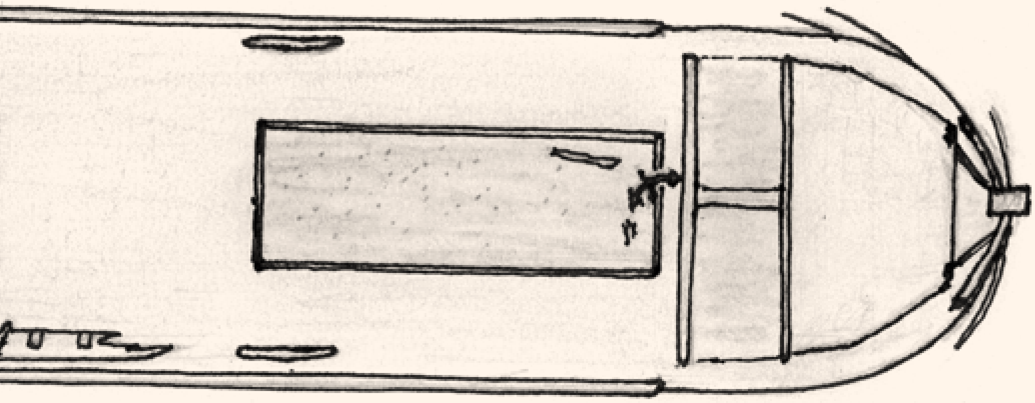
STERN, RUDDER AND RUDDER POST

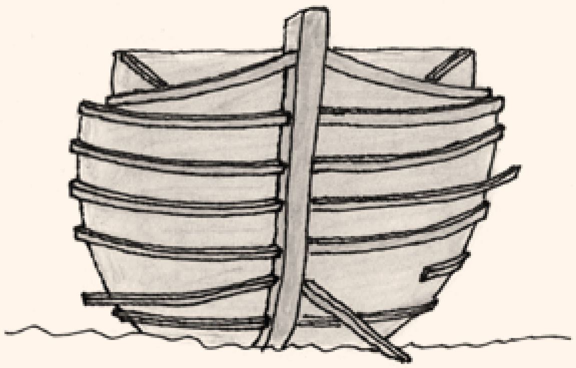


PROFILE OF RUDDER

BOW





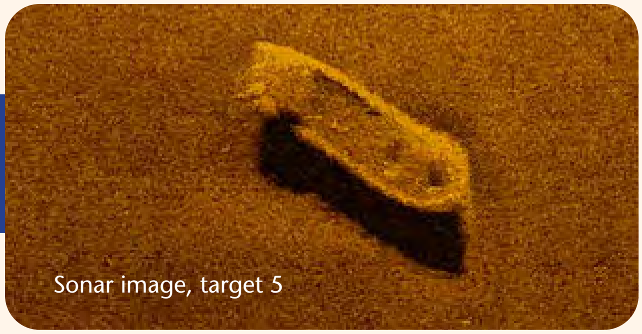


Drawings by Tim Caza

IRON CLEAT

HORSE STALL

Target 5



Sonar image, target 5

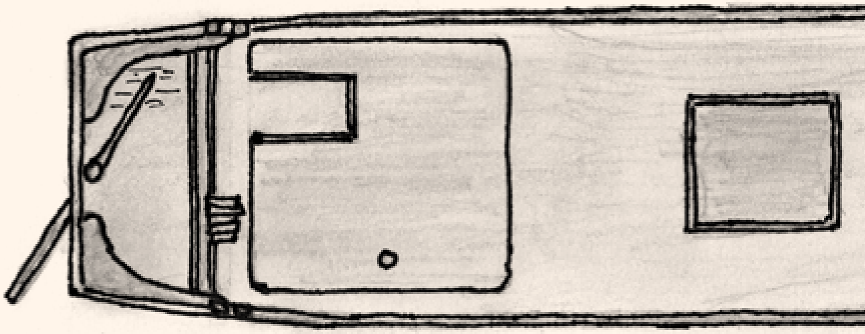
Target 5 is an Enlarged Erie-class canal boat

Possibly a sailing canal boat.

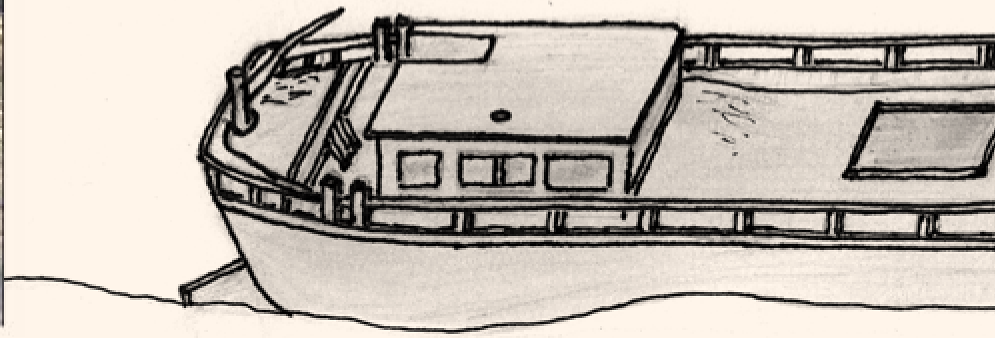
- **Collapsed cabin** or **horse stall** on the foredeck.
- Unusual **Y-shaped stem.**
- Possible **mast step** amidships.
- A tall **railing** around entire vessel.
- Two small **cargo hatches.**
- Intact **stern cabin.**
- Wooden **bitt posts** along sides of vessel.

INTERIOR OF STERN CABIN

STARBOARD STERN QUARTER
WITH TRANSOM AND TILLER



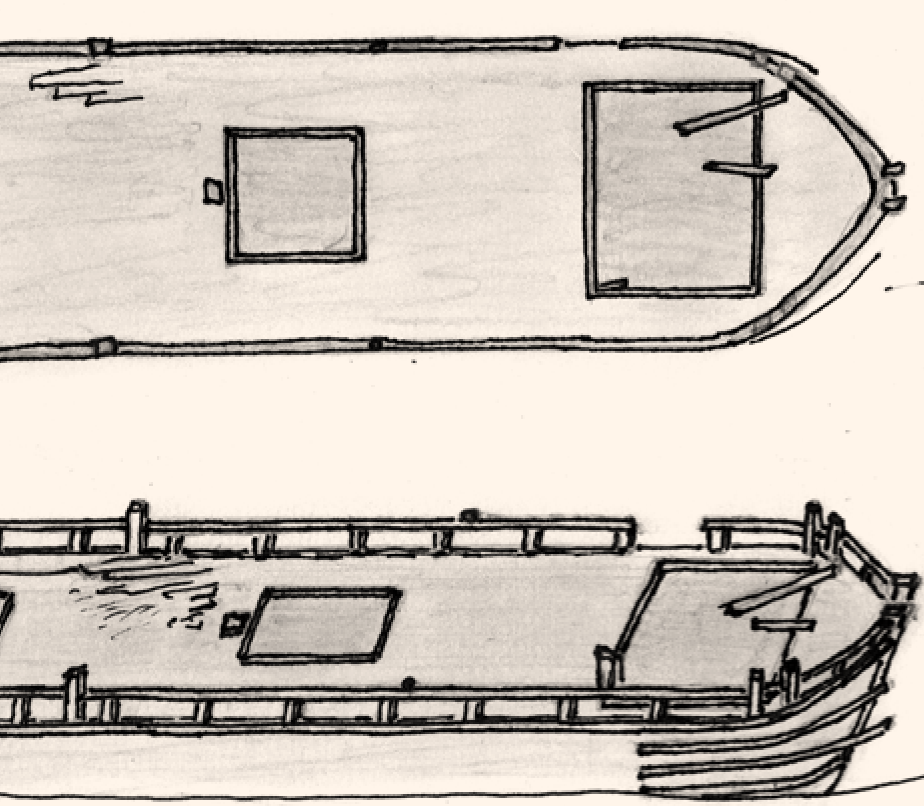
STARBOARD STERN QUARTER
WITH CABIN AND DOUBLE BITTS

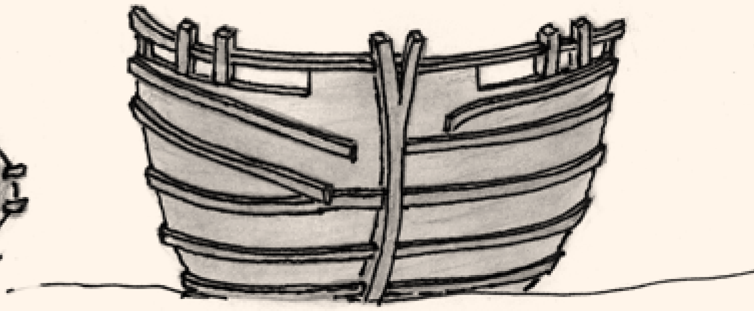


Drawings by Tim Caza

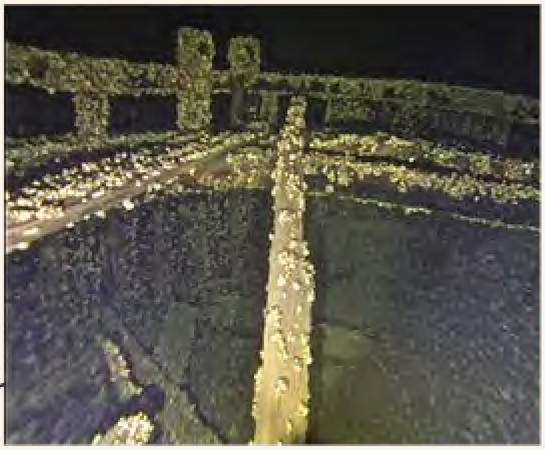
FORWARD CARGO HATCH WITH POSSIBLE MAST STEP

Rare photographic view of lateral canal boat bows.
Note the vessel to the left has a similar Y-shaped stempost to target 5. Junction Canal and Rolling Mill near present Washington Avenue Playground. Elmira, NY. Chemung County Historical Museum



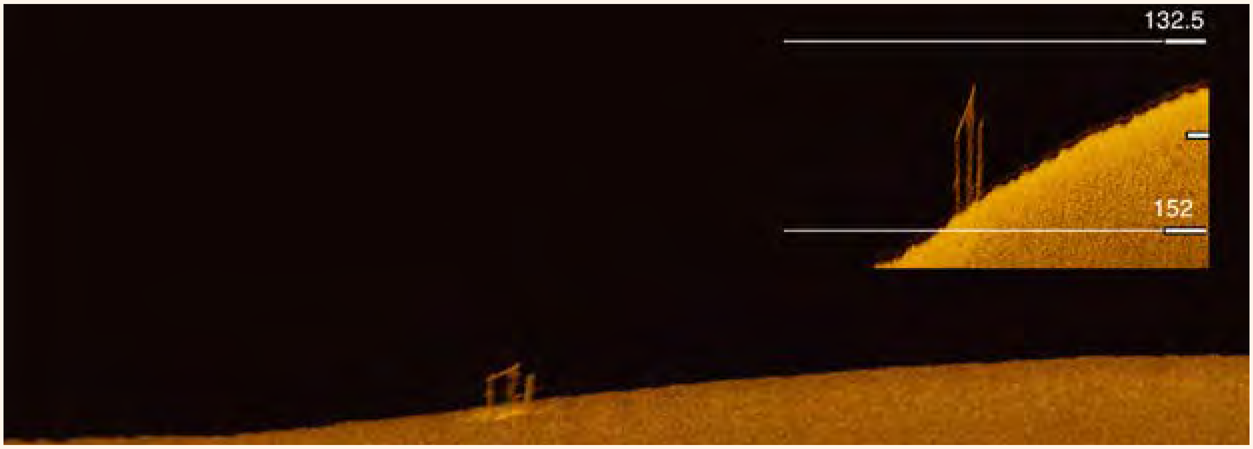


Y-SHAPED STEM



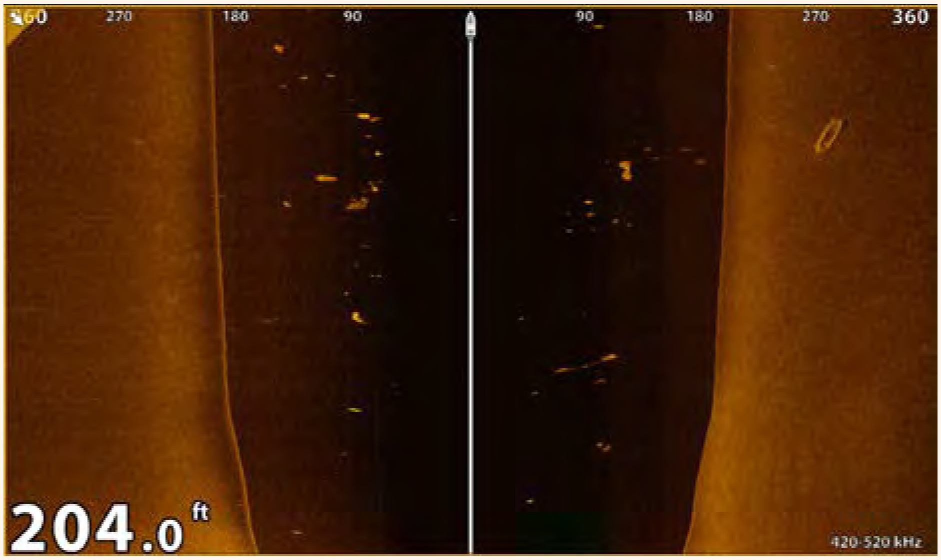
INTERIOR OF COLLAPSED FORE CABIN OR HORSE STALL

Target 6



The underwater survey is interested in a variety of cultural features. While shipwrecks are the prime targets of interest, maritime infrastructure from breakwaters, wharves, docks and bridges or objects such as fishing shanties, horse-drawn sleighs or automobiles, or anything of cultural origin is of interest. Target 6 presents as a cultural object standing almost 20 feet off the lake bottom, but it is clearly not a conventional shipwreck target. We reexamined the target in 2019. See page 72 for the results.

Target 7



This underwater target appears to clearly be a canal era shipwreck but time and weather did not permit us to examine the site in 2018. We re-examined the target in 2019. See page 73 for the results.

All shipwrecks located within the waters of New York State are considered public resources under the Federal Abandoned Shipwreck Act of 1987. All the shipwrecks located under this survey's permit have been reported to the New York State Museum and entered into the state's archaeological inventory.

Reflecting on Maritime Loss

This collection of intact 19th-century wooden canal boats recently discovered resting on the bottom of Seneca Lake reflects the intensity of past maritime activity and are an archaeologist's dream. In our enthusiasm for the new discoveries we cannot forget that the events which claimed these vessels also connects us to harrowing maritime dramas and sometimes tragic loss of life. Beyond the value of their boats, their horses, mules and cargo, the human loss associated with this legacy collection must be appreciated. The discoveries connect us to the wooden boats and the families that made their living following the inland waterways delivering freight as the tractor-trailers of their day. The bicentennial of the Erie Canal system which began in 2017 and culminates in 2025 makes the timing of these discoveries even more poignant as they add to our understanding of the maritime use and economy of the Seneca Lake region.

TERRIFIC GALE ON SENECA LAKE
THREE CANAL BOATS SUNK
October 15, 1868

The *Geneva Gazette* of last week has the following account of a disastrous gale on Seneca Lake:

On Wednesday last occurred the most terrific gale of the season. As a mariner would say, it "blew great guns," and our usually quiet little Lake was lashed into a perfect fury of billowy foam.

The steamer *Arnot* left Watkins Tuesday night with 22 boats in tow. On nearing harbor, such was the violence of the gale, the waves made a clean breach over several of the heavily laden boats. Three of those consisting of the rear tier in the tow, and most exposed to the fury of the waves, filled and sunk. Their names are as follows:

Boat *Little John* Capt. J.T. Eaves–
cargo 180 tons bituminous coal.
Boat *Clark* Capt. A Provoe –
180 tons of bituminous coal.
Boat *Verbena* Capt. Geo Taylor, (colored)–
150 tons of bituminous coal.

All these boats were loaded by the Morris Run Co. of Coal Point [at Watkins].

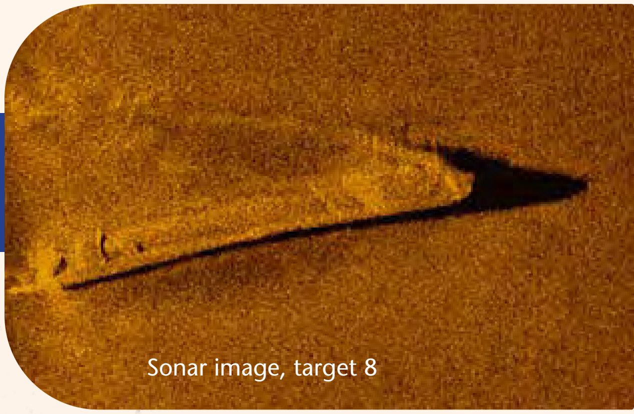
The *Verbena* was the first boat to sink – her fate being hastened by the breaking of her tow lines, which unfortunate event allowed her to swing round [in] the trough of the seas, when she immediately filled and went down. This occurred about 2½ miles from Geneva, as related to our reporter by Captain Orman of the *Arnot.* As the other two which went down were made fast the *Verbena's* stern, of course they soon shared her fate on being cast loose into the raging billows.

Several other boats were in danger of sinking, and it was found necessary to cast overboard a portion of their coal to lighten them up. One of the boats that sank dumped her load and came to the surface, and drifted ashore near the bluff, where she now lies.

The tow presented at this time an exciting scene. The boats careened so that it was difficult to stand on decks, which were completely flooded with water. The Captains of the old and heavily laden boats moved their families and personal effects on board those which they considered more safe. The deck of one boat – the *Ed Gleason* – on its arrival to the canal, was covered with trunks, furniture & etc. The boat *Mary Reis* has her bustle and rudder carried away by a boat astern being driven against her. There was no insurance to cover any of the losses.

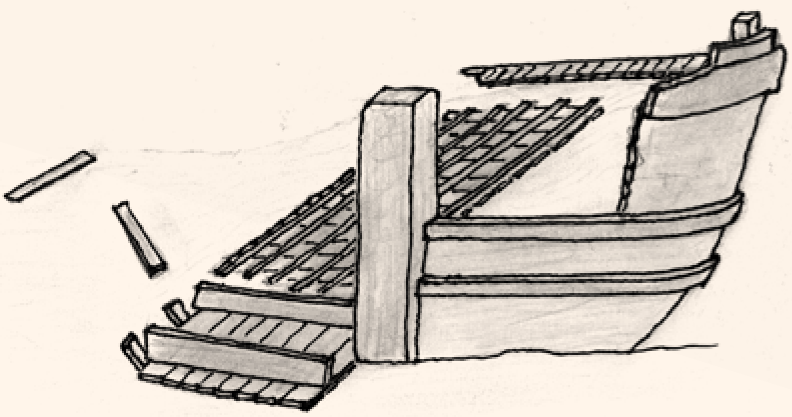
Watkins Express

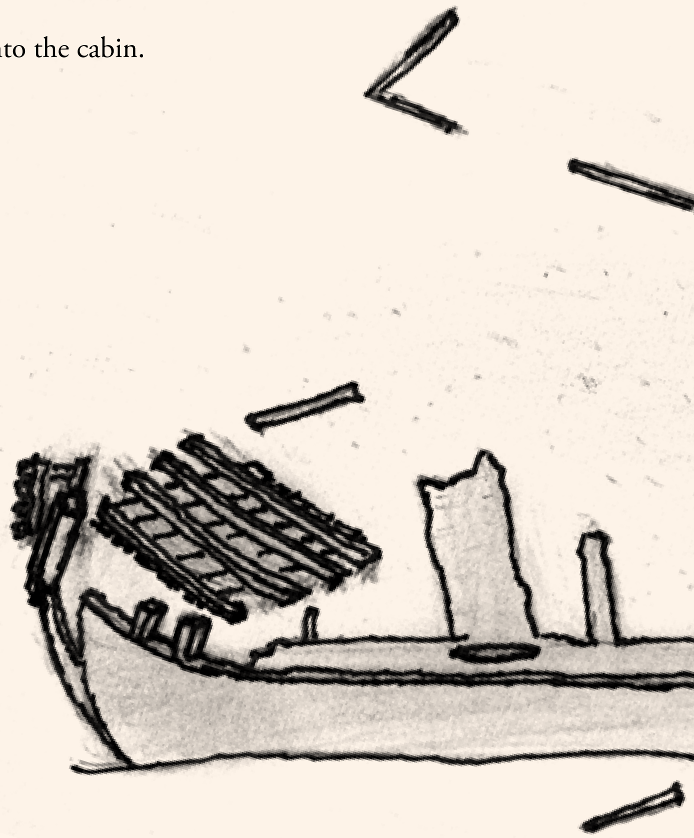
Target 8


Sonar image, target 8

Target 8 Badly damaged canal boat

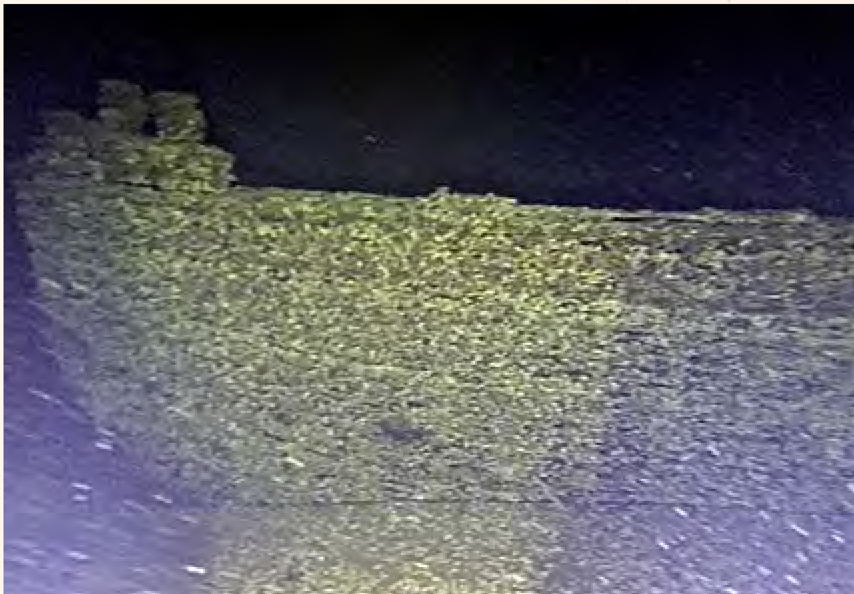
- Entire port side of vessel has pulled away.
- Large **central cargo hatch.**
- Large portion of cargo hatch cover, or cabin roof has fallen into the cabin.
- Small **forecastle hatch** offset to starboard on the fore deck.



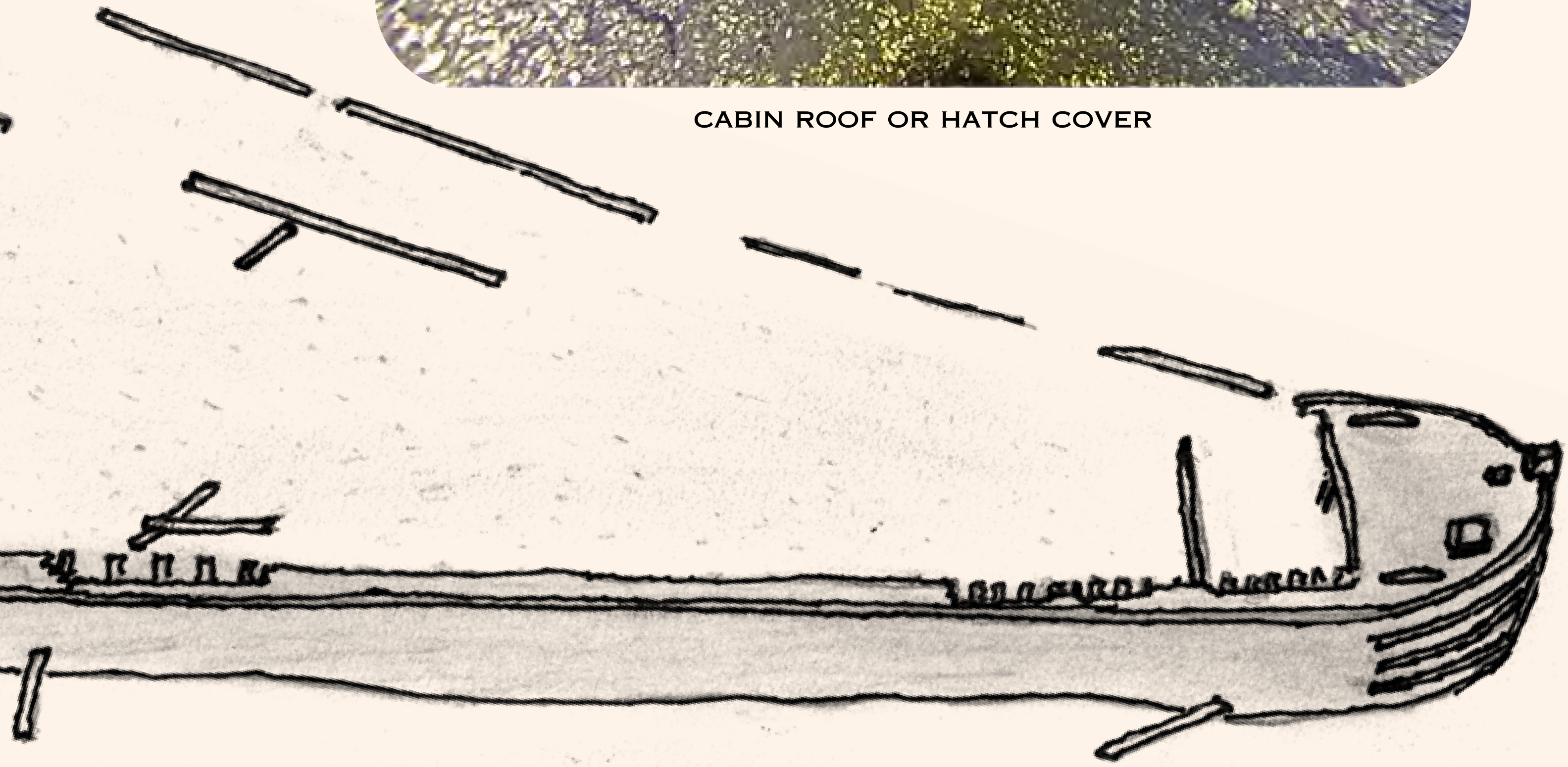


VIEW OF WRECK FROM STERN

STERN PROFILE SHOWING WOODEN BITTS



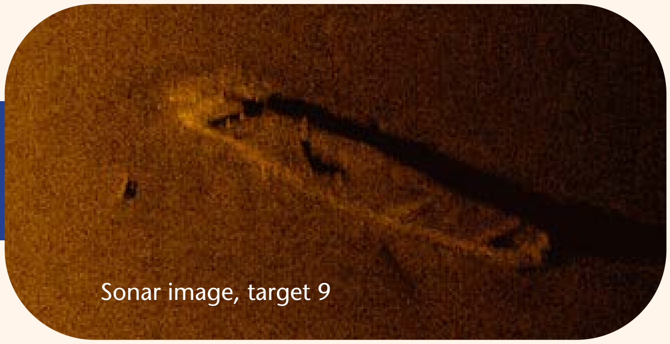
CABIN ROOF OR HATCH COVER



Drawings by Tim Caza

IRON CLEAT ON FORE DECK

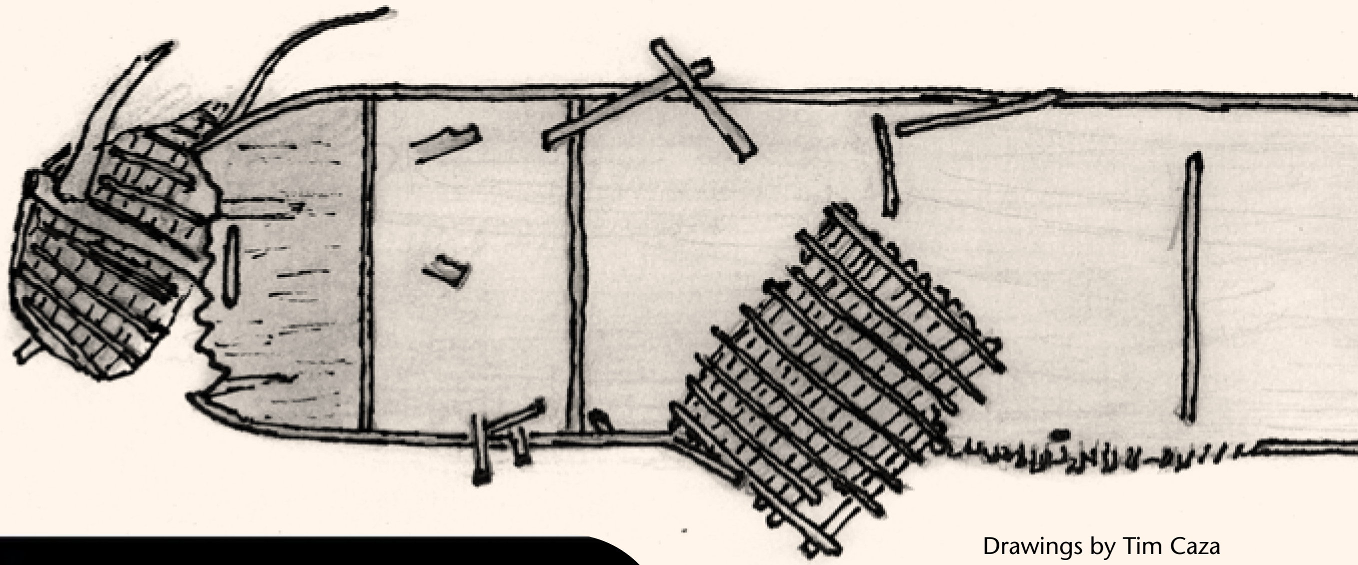
Target 9



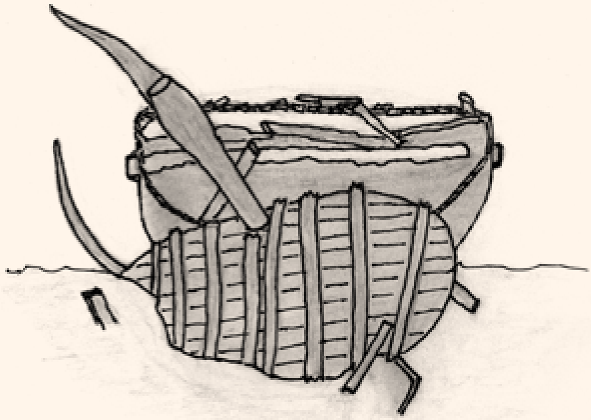
Sonar image, target 9

Target 9 Original Erie-class canal boat

- **Transom** has been pulled away.
- Small **stern cabin** has collapsed.
- Large portion of **cargo hatch cover** has settled on wreck.
- **No walkways** along sides of vessel.
- Extremely **small foredeck.**
- **Cargo hatch** runs nearly the entire length of the vessel.



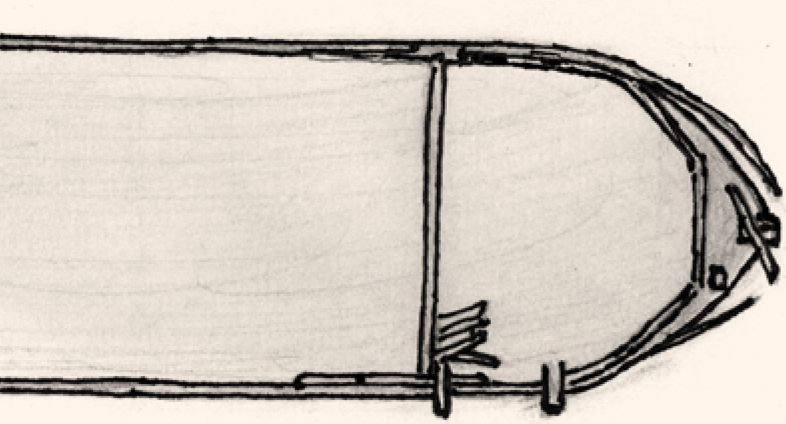
Drawings by Tim Caza

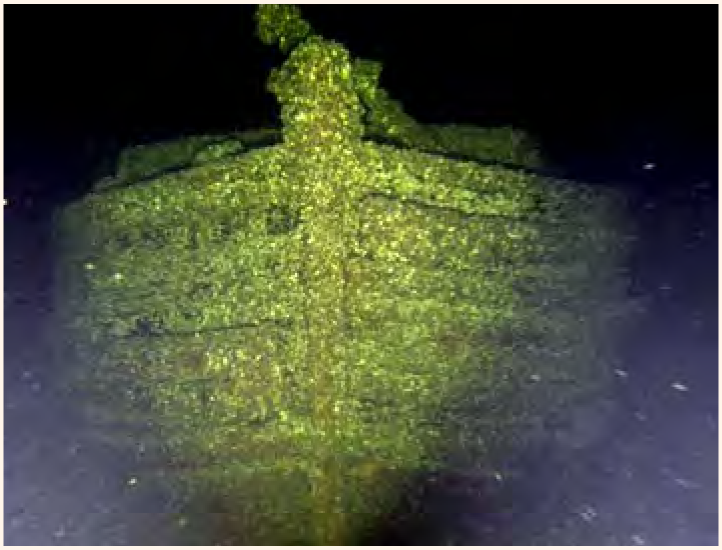


INTERIOR STRUCTURE OF TRANSOM

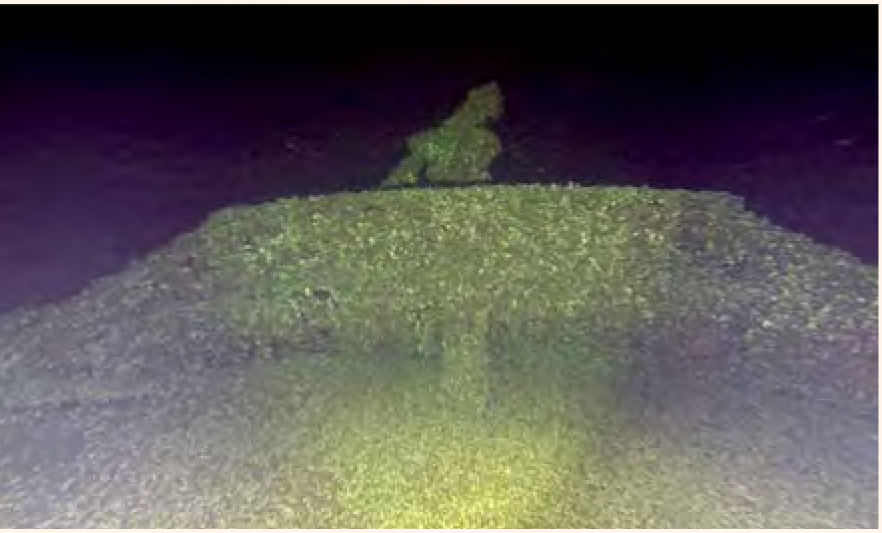
STERN DECK AND TILLER BAR

BOW PROFILE

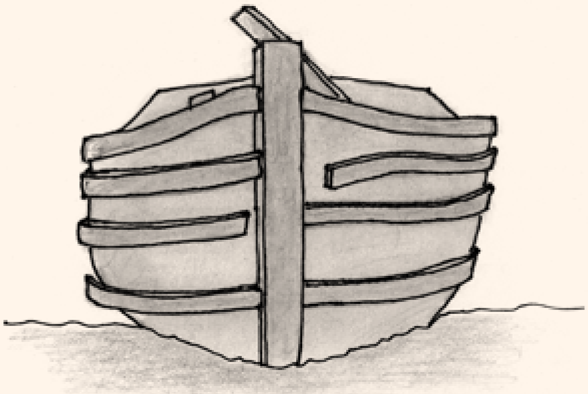




BOW



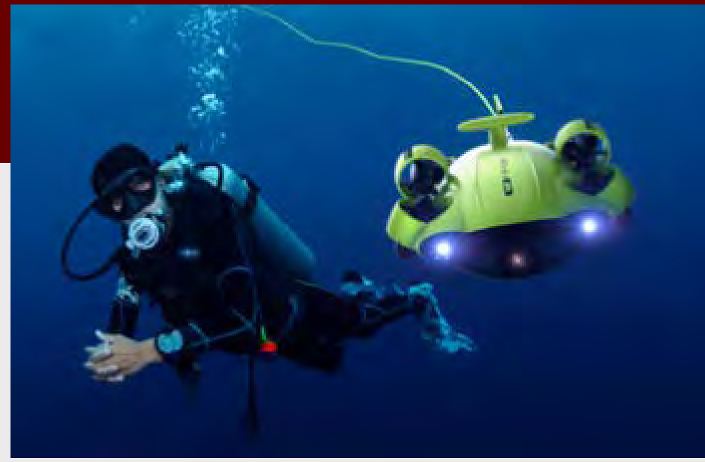
FORWARD END OF CARGO HATCH



The success of the 2019 field season was due to several key variables. As survey planners suspected, Seneca Lake, with its intense 19th-century maritime legacy, contains a significant collection of underwater cultural heritage. A first-class team of experienced surveyors, mariners and historians was recruited for the survey and to put target discoveries into context. The research platform R/V *David Folger,* a vessel specifically designed for this type of deep-water survey, supplied multi-beam sonar survey capabilities. With interior space to provide multiple workstations and the ability to gather and archive massive amounts of archaeological and bathymetric data for post-processing, the R/V *Folger* proved to be the perfect research vessel.

A note about the pandemic. The 2020 plan to return to Seneca Lake with the Middlebury College research vessel R/V *David Folger* is a casualty of the times. We now plan to return with that research platform in 2021.

An experienced diver-archaeologist inspects the shipwreck *Water Witch*, which lies at a depth of 90 feet in Lake Champlain. LCMM



Improved new survey technology has led to finding shipwrecks at even greater depths. Project planners can now choose, depending on the water depth and conditions, to either send divers or to deploy ROVs to examine and document shipwrecks. QYSEA Technology Co.

One of the most important tools integrated into the Seneca Lake Survey's toolbox has been the remote operated vehicle (ROV). Previous survey efforts relied heavily on experienced divers with nautical archaeology backgrounds to investigate newly-located survey targets. However, when working in waters deeper than 130 feet, ROVs are essential to the verification process. These "flying cameras" can examine these deepwater targets and spend more time at depth than a diver could. The ROV can explore and record the underwater site for hours, while the survey team monitors what the camera sees in real time from aboard the ship.

Since the vast percentage of Seneca Lake bottomland is more than 130 feet deep, the survey team was prepared to use both divers and ROVs to verify cultural targets. During the first two years however, all the located targets were deeper than 130 feet. While we do anticipate locating targets within diveable depths, these deeper targets were verified with small, easy-to-deploy, lightweight ROV systems. This ROV data has been used to create the drawings, photographs and the site descriptions presented here.

The new challenge faced by survey operators is that Seneca Lake's deepest waters exceed the depth range of our current ROV systems, which is roughly 380 feet. Targets #14 and #15, located in 2019, both lay in water exceeding that depth. The capability to operate in water depths up to 700 feet is anticipated and a primary mission of the 2020 field season will involve experimenting with alternative ROV systems that are capable of reaching the lake's deepest bottomlands.

Recent advancements in diving technology have extended divers' depth range and increased their time on-bottom. New procedures using a variety of blended breathing gas mixtures permit diving beyond 130 feet. Technical diving procedures also add a new dimension in designing public access programs to submerged cultural sites located in deeper waters. LCMM

The working end of the *Underwater Research Vessel Voyager* used on Seneca Lake. It carries both the side-scanning sonar (left) and the ROV systems, which are visible with their associated reels and cables. LCMM

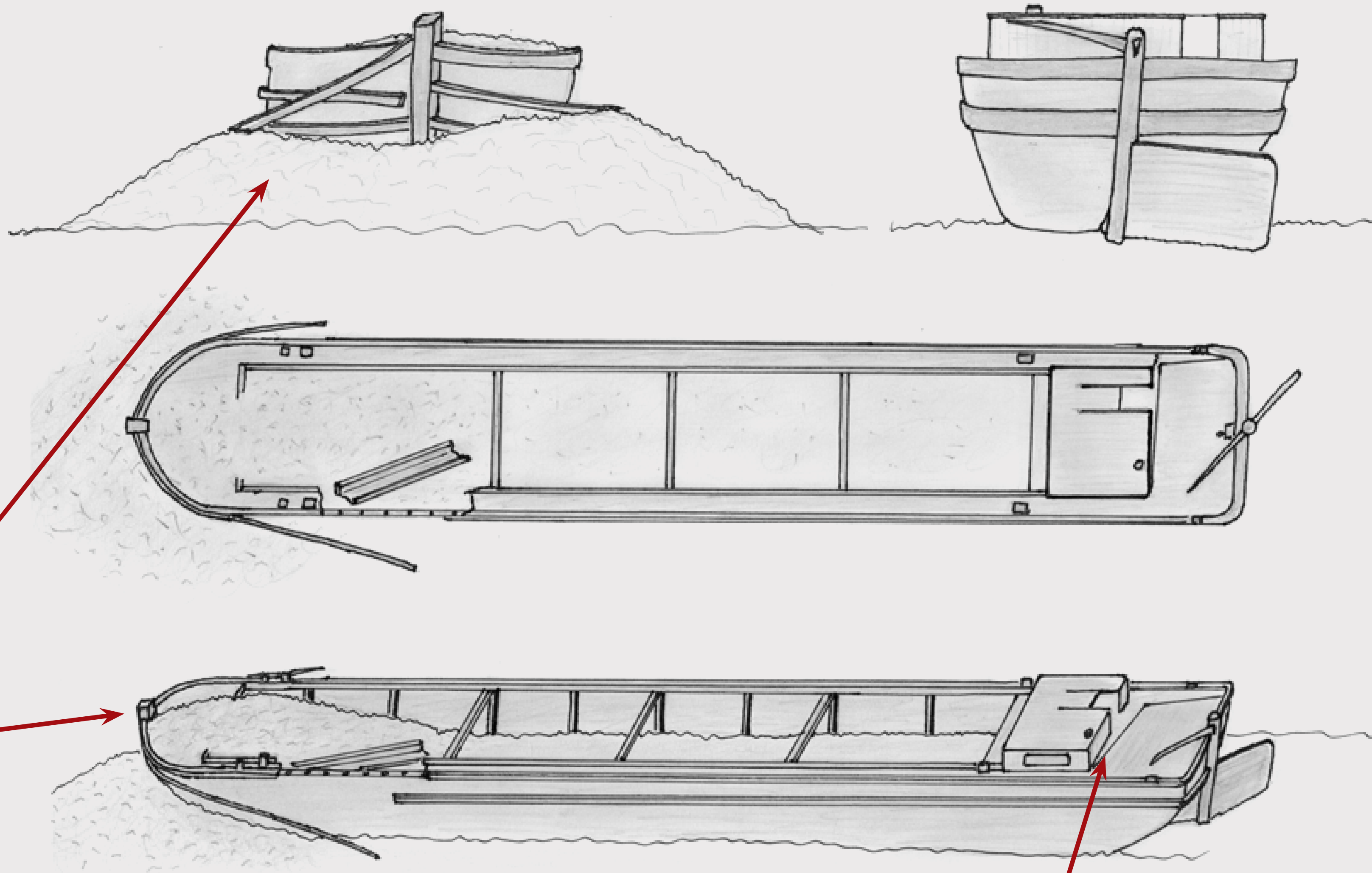
Target 10


Sonar image, target 10

Target 10 is an "Original Erie" sized canal vessel.

- **Cargo hatch** runs the length of the vessel from just aft of the bow forecastle to the forward bulkhead of the crew cabin in the stern. A timber plank coaming surrounds the cargo hold. Two deck beams run athwartships through the hatch.
- **No stable** feature is visible.
- Double **bitt posts** forward. Single bitt post midships and aft.
- **Stern cabin** intact with access hatch offset slightly on the starboard side, stove pipe visible coming through cabin top on the aft, port side.
- **Interior partition** separating the cabin from the cargo hatch is visible through the companionway, with a possible doorway offset to starboard providing access.
- Single rectangular, narrow **cabin windows** port and starboard side.
- **Walkways** down post and starboard side of the cargo hatch, across the vessel just forward of the rear cabin.
- **No stanchions** visible under deck beams, possible knee support where deck beam meets the deck.
- **Cargo** appears to be present and shifted forward. On the outside of the bow is a large debris pile, possibly large coal.


BOW

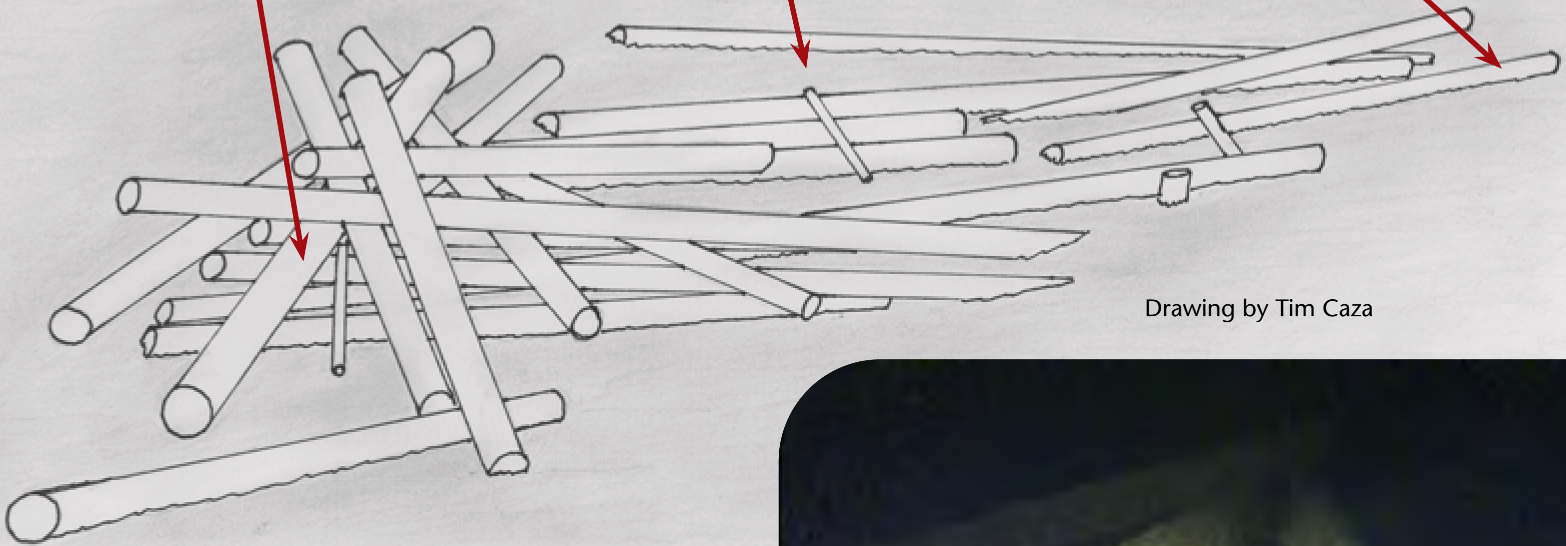


Drawings by Tim Caza

TILLER (LEFT), STERN DECK, CABIN HATCH (RIGHT)

Target 11

Sonar image, target 11



Drawing by Tim Caza

Raft in a Squall on Lake St. Peter [St. Lawrence River], W.H. Bartlett, 1842. Depicts the fragile nature of a log-raft in foul weather. We suspect target 11 is the victim of one of these wind events.
Private Collection

Target 11 is the remnants of a log raft.

Target 11 appears to be the tangible remains of a log raft, a maritime conveyance that was once common on Seneca Lake and the canals and rivers of the region. Seasonal fluctuations in water levels created the typical sequence of activity. A log raft consisted of timber generally cut in the winter and skidded over the snow to an assembly area near the water's edge. In the spring, as snow melt and rain raised water levels, smaller raft sections were assembled into the larger raft and, depending on their destination, were either sailed or floated with the downstream current or towed by animals or steam tugs. Rafts could be steered in shallow water by poling or by the use of long, rudder-like sweeps.

Target 11 appears to be a pile of round, hardwood logs from 10″ to 20″ in diameter. Found off-shore in deep water, the presumption is that these logs were being transported on Seneca Lake when a storm stressed the raft until it broke up, depositing this grouping of logs on the lake bottom. That these logs sank instead of floated suggests that they are a green hardwood, perhaps white oak, a valuable tree for shipbuilding.

A Brief History of Regional Log Rafts

Perhaps the most dramatic description of a Lake Champlain log raft was found in a St. Albans, Vermont newspaper from 1808. This was an important year because the federal "Embargo Acts" had recently been enacted by Congress which forbade trading with British interests. On Lake Champlain, where almost all trade followed the waterway north to British Canada, this created an intense period of smuggling: "*On Saturday evening last, the wind being favorable, the then remaining rafts joined, making a surface, it is said, of about ten acres, and carrying forty-sail, made an expeditious and safe exit from the United States*."

St. Albans, Vermont *Adviser*, May 26, 1808

Log Rafts on Lake Champlain. LCMM

Early canal regulations included both boats and rafts as illustrated by the 1826 requirement for both to carry a conspicuous light on the bow:

CANAL REGULATIONS.

At a meeting of the Board of Canal Commissioners in the city of Albany, on the 10th of March, 1826, the following rules and regulations, in addition to those provided by law relating to the Erie and Champlain Canals, were adopted to wit:

1. Every boat passing on either of the above canals, is required at all times during the night, to carry a conspicuous light on the bow of the boat, and every raft navigating either of the canals at night shall carry a like light on the forward end of the same; and every infraction of this regulation shall subject the master, owner, or navigator of any boat, or raft, to the penalty of ten dollars.

An early view of Corning, from Harper Brothers' *New York and Erie Railroad* guide book in 1855. Note the log raft in the Chemung River.

Native Peoples were the first to use the forests to hunt game and clear areas for living spaces and agricultural activity. Wood was used for houses, tools, cooking and watercraft. With the arrival of Europeans, forests became a potent source of wealth and power. In the shipbuilding world, the Northern forests filled with pine and oak were viewed by Europeans as key to their future prospects. In areas with natural waterways like Lake Champlain and the Finger Lakes, lumbermen cut large quantities of timber during the winter. They lashed the timber together at the shoreline collecting place into huge rafts. When spring came, the rafts were pushed off in a favorable wind to propel them to the marketplace.

For early settlers, the forests were a source of both building materials and income. Settlers built log cabins for shelter and cleared trees to create agricultural land. The trees from these cleared lands were often burned to produce potash and pearl ash, which could be shipped to market for cash or goods. Potash and pearl ash were important early crops for the new settlers, and often were the only cash crops available to them. Packed in wooden barrels, the ash was shipped to market for use in the manufacture of woolen textiles.

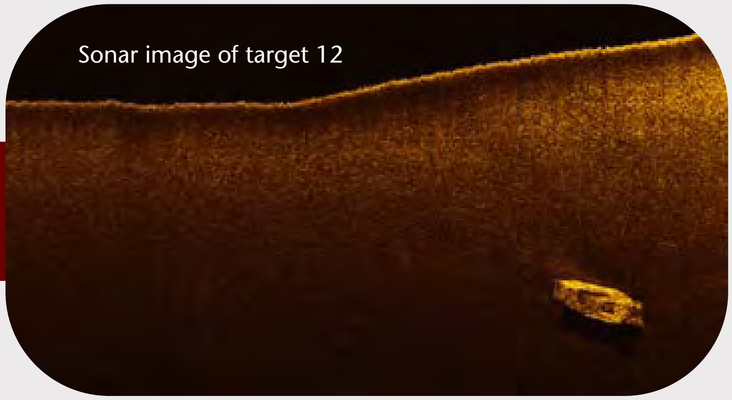
While the forest extended throughout the region, getting logs and timber to market was a challenge. Once again, the interconnected waterways proved indispensable and in spring, when the water was high, the rivers and lakes of the region were often busy with raft traffic. On Seneca Lake, rafts were assembled into cribs along the shore and when conditions were favorable, pushed off to reach Geneva at the north end of the lake. Geneva was also the entrance to the Cayuga and Seneca Canal, which connected it to the marketplaces along the Erie Canal. A Geneva newspaper reported on June 1, 1814 that such a raft had arrived "*…which was 150 feet long and 50 feet wide. It consisted of 7500 feet of squared timbers, 227 large pine longs and several thousand feet of boards.*

Despite concern that the log rafts might cause damage to the canal itself, when the canal first opened, they were also allowed to transit the waterway. On an early packet boat trip, Reverend Jedidiah Morse, father of the inventor of the telegraph, described a log raft on the new canal: "*We passed a raft of four hundred and forty six tons of timber coming down the canal, drawn by three horses at the rate of eighteen miles in a day and a half. The expense was estimated at fifty dollars, while transportation of the same quantity on land would be twelve hundred dollars…*"

Log rafts were essentially vessels built for a one-way trip to the marketplace. They would typically be built with the more buoyant wood on the bottom and lashed into cribs. The cribs would be secured together to form the full raft. Once the raft was formed then the hardwood logs could be loaded on top of the cribs, along with barrels of potash or any other products the raftsmen wanted to get to the market. Temporary huts for the crew could be added. If the raft was going to sail for a portion of the journey, then masts and sails were also added.

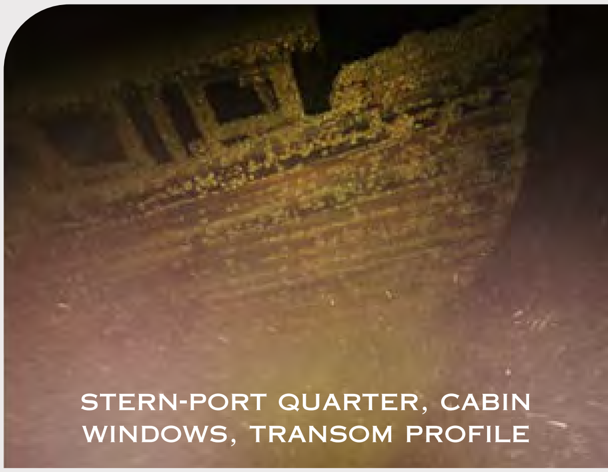
Log raft on the Chemung Canal (detail).
Canal Society of New York State

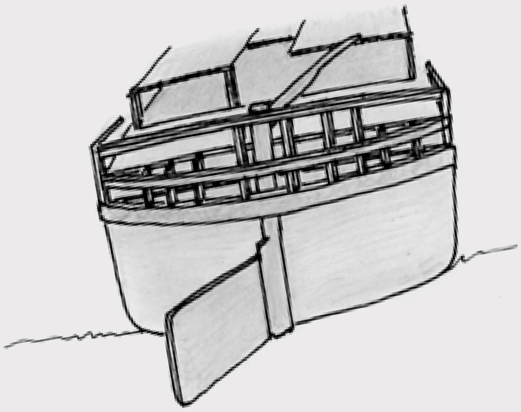
Target 12


Sonar image of target 12

Target 12 appears to be a remarkably intact "Enlarged Erie" canal boat.

- **Three cargo hatches,** with raised-hatch coamings and a fourth opening just aft of the bow stable of unknown purpose, as it has no apparent hatch coaming and has a deck beam running athwartships across the opening.
- The **cargo hold** appears to be loaded with a cargo, presumably coal.
- The **horse stable** and the **stern cabin** are intact.
- The canal boat is **tiller steered,** has its rudder present and an intact transom with bitt-posts on either side of the stern-deck.
- A **pump well** is visible on the deck just forward of the star-board-side corner of the rear cabin.
- The hulls **scow-shaped bow and stern** is unusual, with curved planking running athwartships and no evidence of an external stem or stern post.

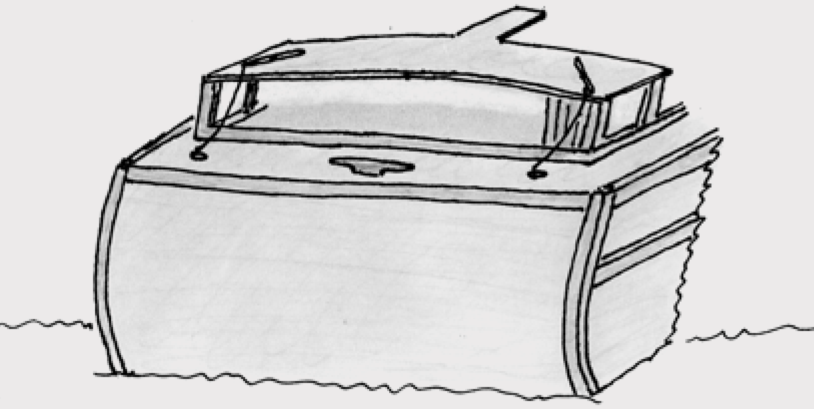

STERN-PORT QUARTER, CABIN WINDOWS, TRANSOM PROFILE



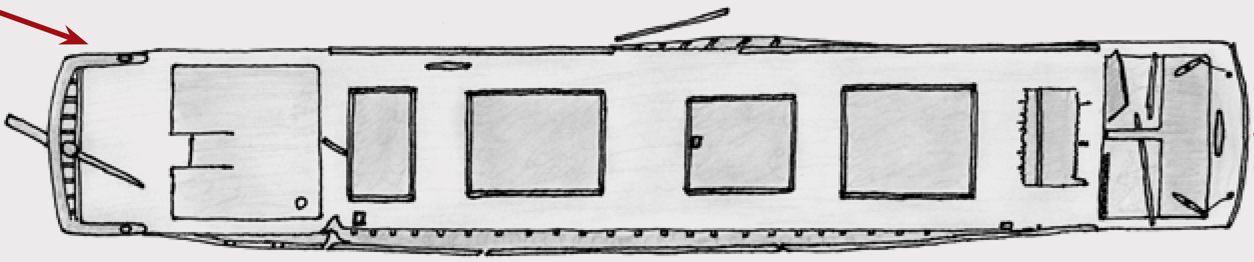
- On a **small bow deck,** forward of the stable, a **large cleat** is located in the middle of the deck, possibly for the towline.
- On either forward corners of the horse-cabin a **curved piece of wood** runs from foredeck to stable-cabin top. The function of this curved feature is not known, but may be a guard to protect the horse-cabin from tow rope damage.

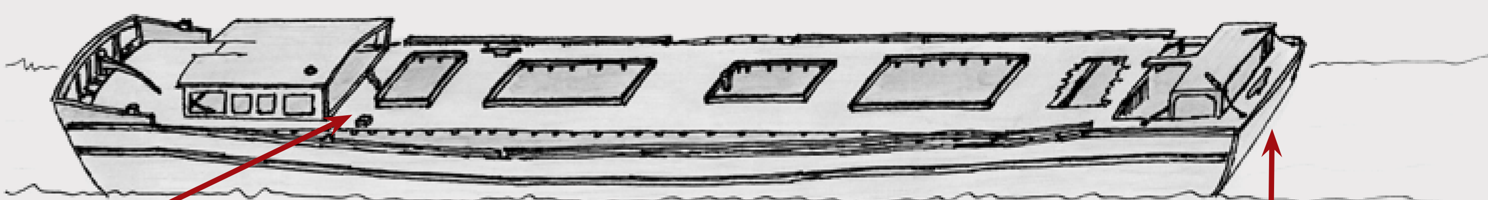

STERN SHOWING RUDDER AND TRANSOM


PORT SIDE LOOKING AFT TO CABIN TOP



BOW VIEW WITH HORSE STABLE



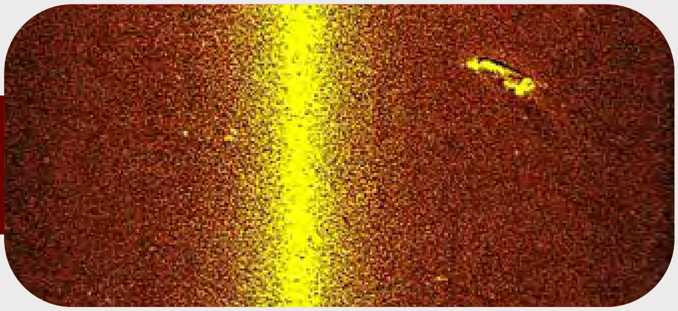


Drawings by Tim Caza

STERN CABIN (LEFT), BILGE PUMP,
REARMOST CARGO HATCH

BOW VIEW WITH HORSE STABLE

Target 13



Sonar image, target 13

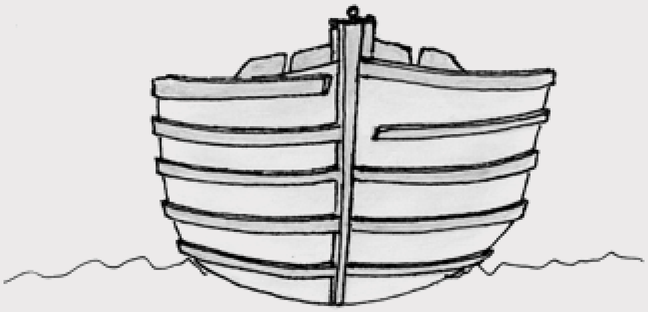
Target 13 is an "Original Erie" sized canal boat

with a damaged stern and intact bow, suggesting it sank by the stern. Stern cabin top and much of the stern section is missing.

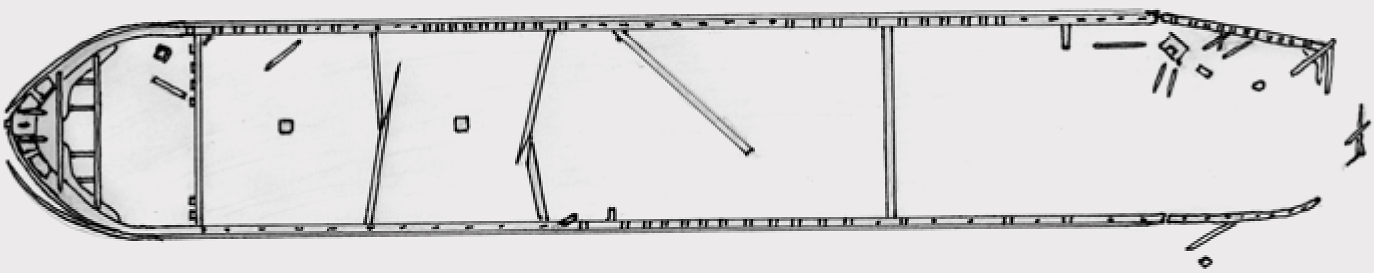
- The **caprail** has ~2″x 2″ framing approximately 16″ tall and 12″ apart, suggesting a raised extension to the side of the cargo hatch.
- **Vertical stanchions** located down centerline between deck beams may have been to support a ridgepole suggesting the cargo hatch was roofed.
- **Deck beams** have a small hanging knee on the outboard end.
- **Structural X-framed hogging trusses** mounted over ceiling planking with upper ends converge at the deck beams.
- **Bow is intact** and well preserved, with wooden fairleads either side of the stem.
- **Rope locker** and tool. A rigging hardware box is located just aft of stempost.
- **Stempost** has multiple iron rings to secure the towline.
- **Woodstove** on starboard side is visible.
- A **shifting cargo of coal** may be what broke the vessel.
- The **stern section** is framed until it reaches the vessels straight sides at forward end of the rear cabin.

PORT SIDE BOW PROFILE

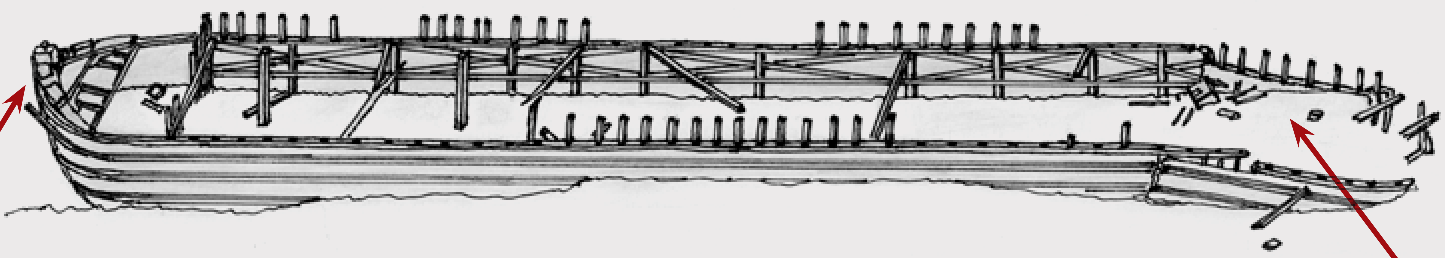
STEM PROFILE WITH IRON RING HARDWARE



BOW



Drawings by Tim Caza



INTERIOR, STARBOARD SIDE
NOTE INTERNAL BRACING AND CAPRAIL FRAMING

STERN CABIN
NOTE WOODSTOVE CENTER-RIGHT

Target 16

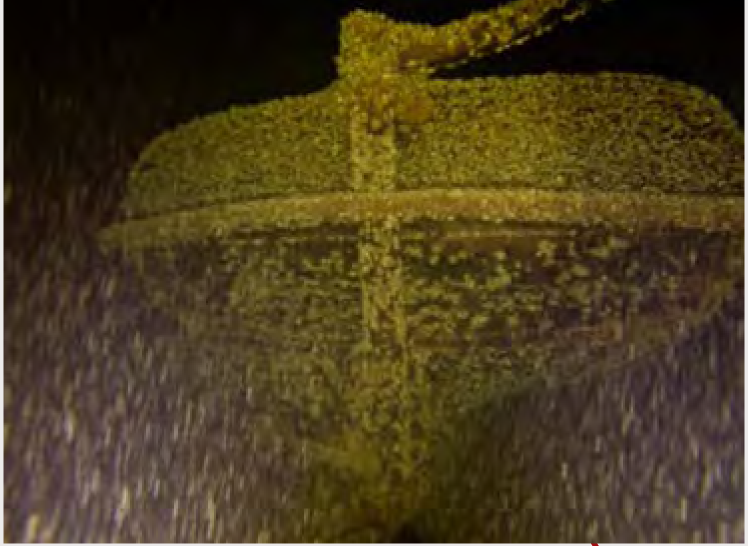

Sonar image, target 16


BOW SECTION


BOW SECTION. NOTE PROMINENT STEM, INTACT HORSE STABLE & CURVED FEATURE

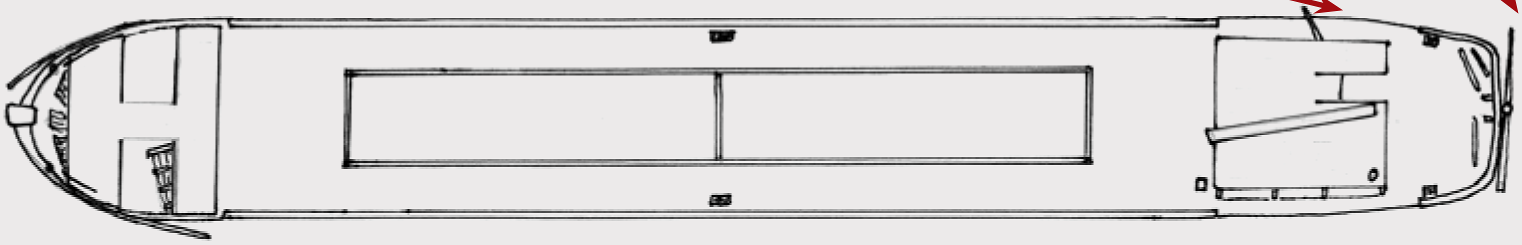
Target 16 is a stunning, remarkably intact "Original Erie" canal cargo boat.

- An **intact bow stable** showing the position of the companionway openings to the sides to facilitate transferring the horses or mules to and from boat and shore via a "horse bridge."
- An **interior ramp** to facilitate the horse or mule walking out of or into the cabin may be present inside the stable.
- A single large **cargo hatch** runs fore and aft and is surrounded by a coaming which rises ~2″ inches above the deck. A single deck beam runs athwartships through the hatch and connects to the midship bitts on either side.
- **Cargo of coal** present, which has shifted slightly towards the forward end.
- A low **bulwark,** ~3″ high present with regular scupper openings.
- Significant **sediment** collected along starboard side, almost to the deck level. This sediment disappears toward the stern, revealing an **intact stern** with a beautifully-shaped **transom, tiller, rudder post and rudder.**
- Possible sheets of **roofing debris** off starboard quarter.
- The **stern cabin** is intact, with **three windows** on each side and also across the forward end. Cabin windows expand as the cabin extends forward.
- The **companionway hatch** is offset to the starboard side.
- A **woodstove stovepipe hole** is visible in aft-port corner of the cabin top.
- The **companionway stairway,** unattached, can be seen inside the cabin.
- The **woodstove** has tumbled to the forward end of the cabin and can be seen on its side.
- An opening in the rear of the cabin to the under-stern deck area is visible. This area may have been sleeping quarters.
- A **pump-well with pump** just forward of the port-side corner of the crew cabin.
- **Bow is remarkably intact.** Heavy-built stem.
- The **curved feature** on the forward corners of the stable first observed on target 12 suggest they are there to protect the stable from a towrope.



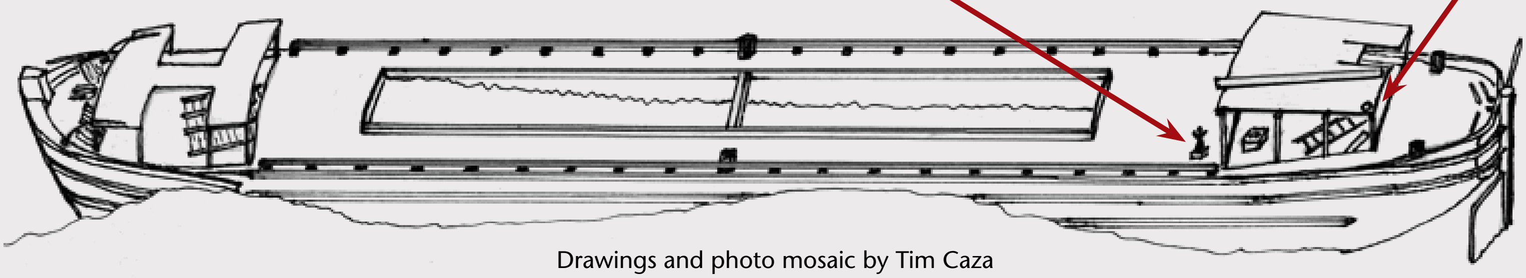
STERN SECTION PORT QUARTER, LEFT, CABIN TOP, STERN DECK, TILLER

STERN ASSEMBLY



PUMP WELL ASSEMBLY, PORT SIDE

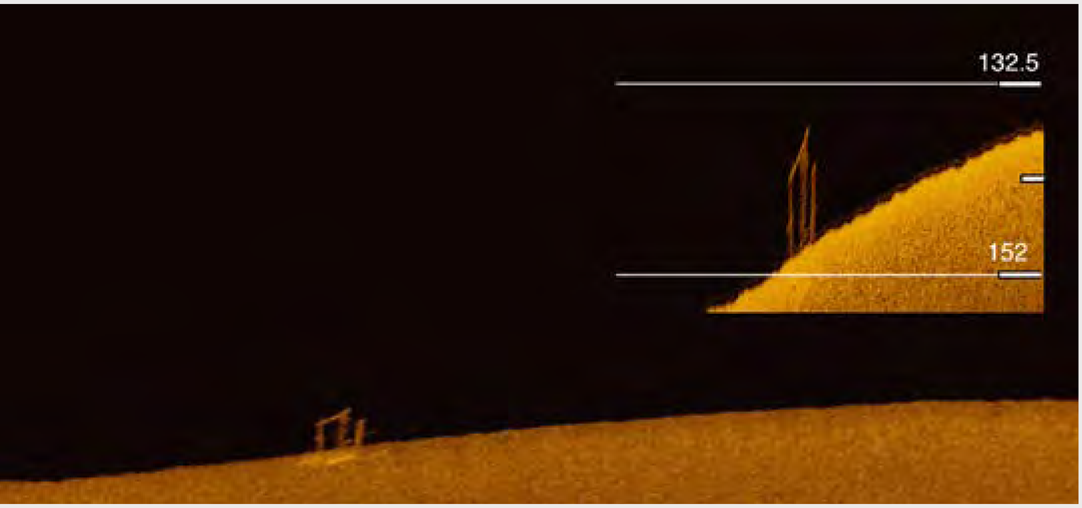
INTERIOR OF REAR CABIN SHOWING ACCESS STAIRS AND WOODSTOVE



Drawings and photo mosaic by Tim Caza

PHOTO MOSAIC OF TARGET 16 STERN QUARTER, STARBOARD SIDE

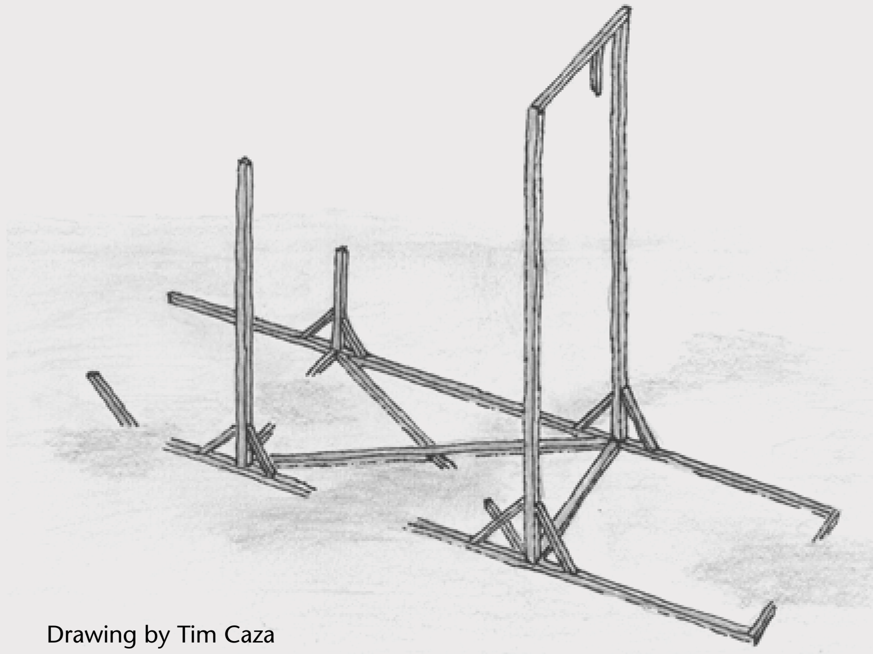
Target 6 Revisited



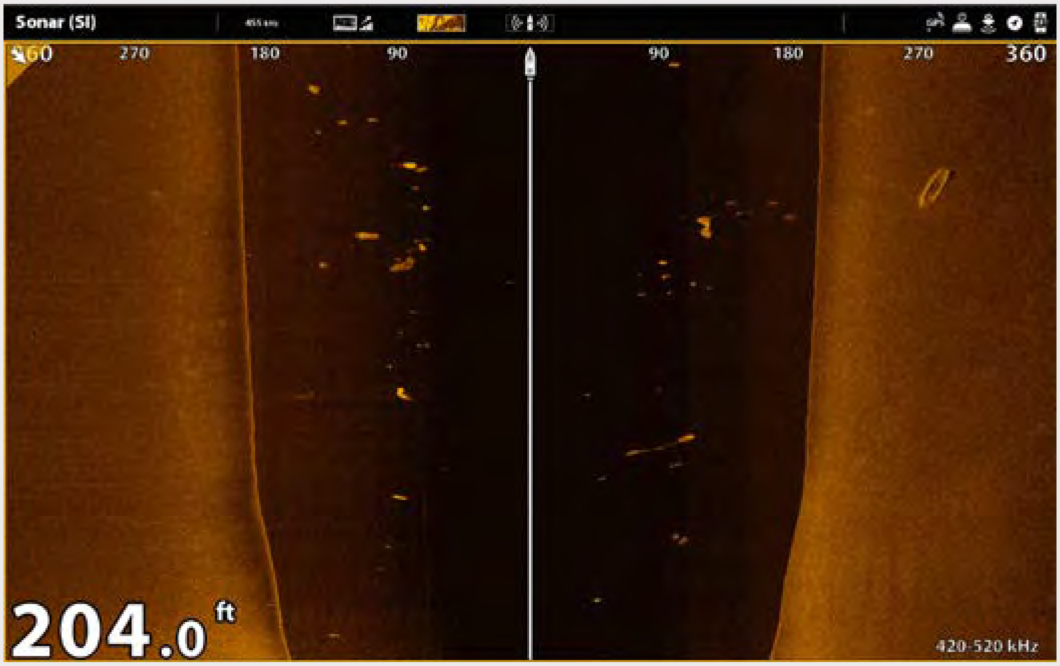
Target 6 is a framework of unknown origin, but does bear a resemblance to a framework used at the Sampson Naval Base to lift longboats for service and repair. Research will be able to determine if this type of lifting-frame might have been in wide-use around Seneca and other Finger Lakes.

In 2019, this target was verified by ROV and is believed to be a frame used to lift small watercraft.

Target 6 is believed to be a discarded boat hoist similar to the one pictured on the left from Samson Naval Base during the World War II era.



Drawing by Tim Caza



This underwater target appeared to be a canal-era shipwreck, but time and weather did not permit us to examine the site in 2018. We returned to target 7 in 2019 to document the vessel and add it to the inventory list. We were not disappointed.

Target 7 Revisited

At the start of the Seneca Lake Survey in 2018, while many historic canal boats had already been located and studied, no example of a packet boat had ever been located or archaeologically examined.

In 2018, because of its depth, the survey team was unable to document target 7, and examination of this presumed canal boat target was added to the 2019 "to-do" list. When the ROV team began the examination of target 7, they became immediately aware that the hull shape and superstructure were different than the freight carriers they had been examining. As they continued to examine the target, they wondered if they had finally located an example of a packet boat. The team is working diligently to determine if target 7, located in 2018 but not examined until 2019 might be an elusive archaeological example of this once common way of traveling in the earliest days of the canal.

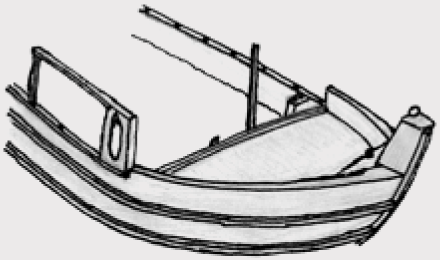
Target 7's construction presents a vessel design not previously studied and the archaeological examination of this shipwreck will add much to the interpretation and technical design of this early transitional river-to-canal passenger vessel at the dawn of a new era of inland transportation.

Detail from "Junction of the Western and Northern Canals," *Colden Memoir,* 1825. Canal Society of New York State

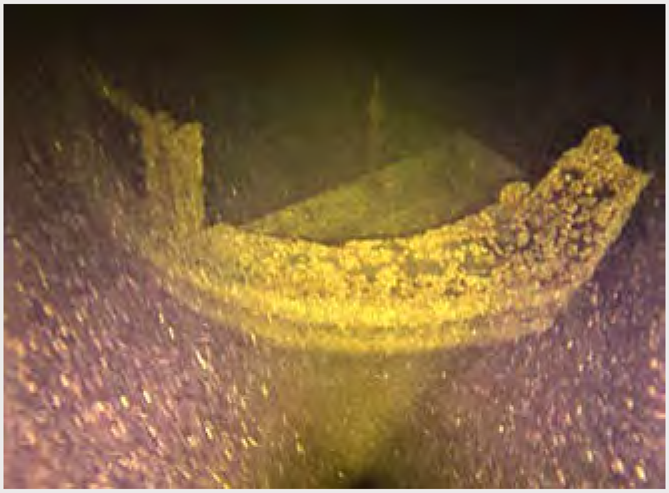
Target 7


Sonar image, target 7

Target 7 is believed the first archaeological example of a packet boat ever located.



- The bow-stem is very prominent and heavy.
- A small foredeck permits modest access to secure towlines to the stem.
- The **cabin space** appears subdivided into three sections: a ladies' cabin forward, a larger men's dining area mid-ships, and a kitchen aft.
- A **woodstove** for cooking and heat, and a pantry with bowls, plates and bottles is present on the port side of the kitchen.
- **Stern** is intact with rudder, post and tiller bar.
- **Interior benches** suggest accommodations for passengers
- A **distinctively long cabin framework** rising from the gunwales are a unique feature of this shipwreck.
- **Shallow draft a**nd hull lines suggest a non-cargo vessel designed more for speed than tonnage.



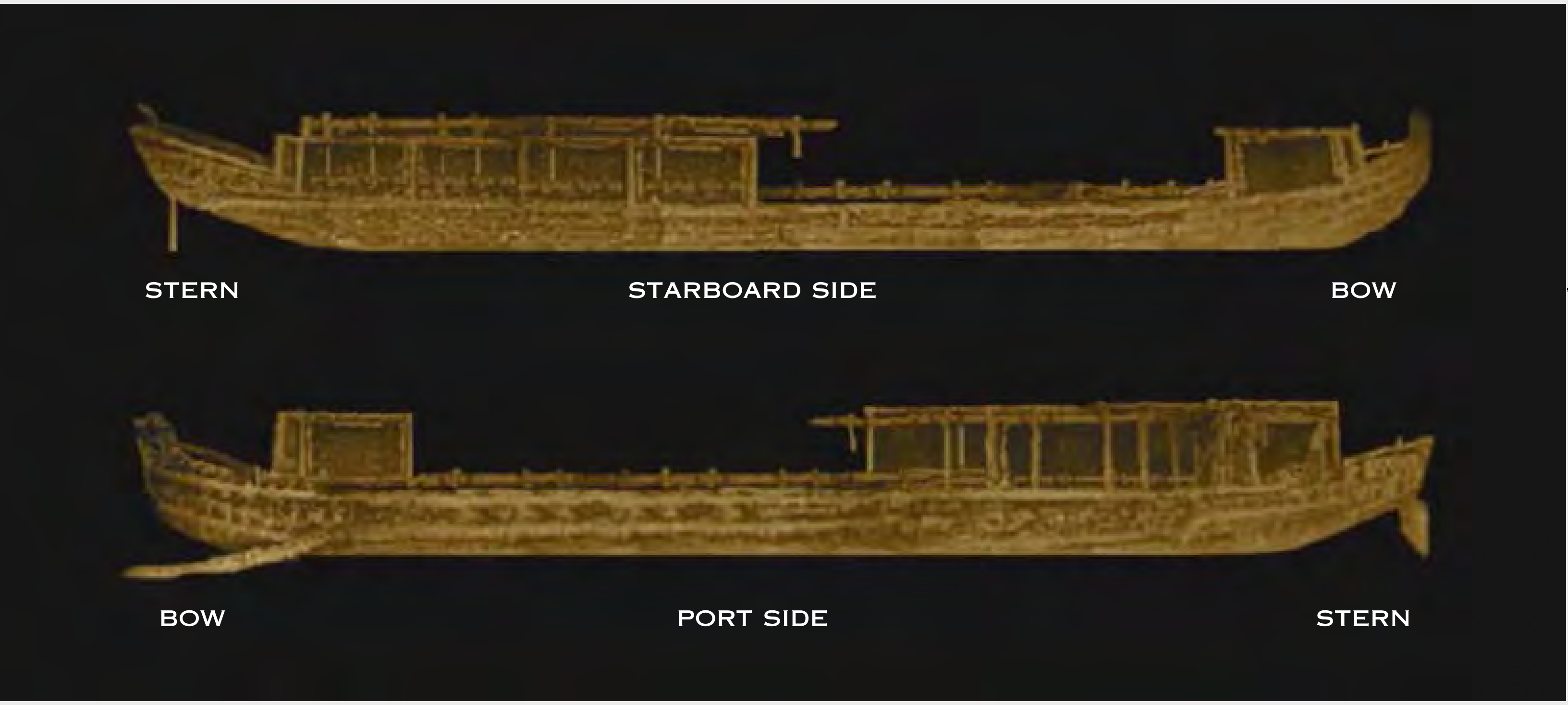
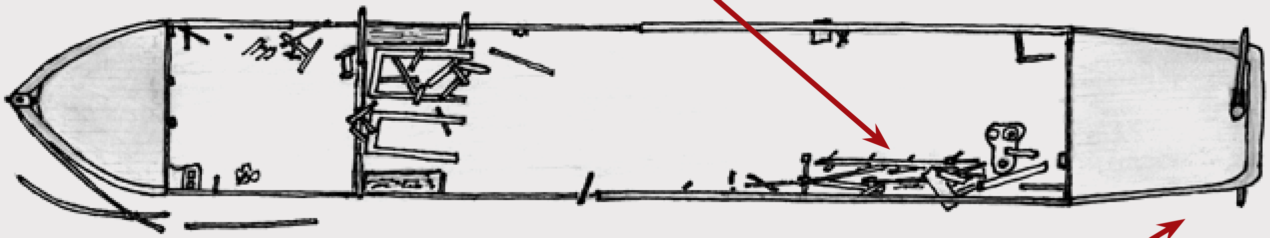


Photo mosaic by Tim Caza

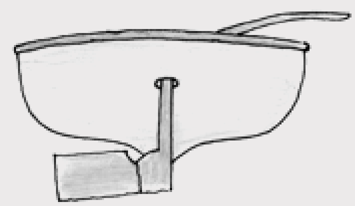
PANTRY, STERN CABIN, PORT SIDE

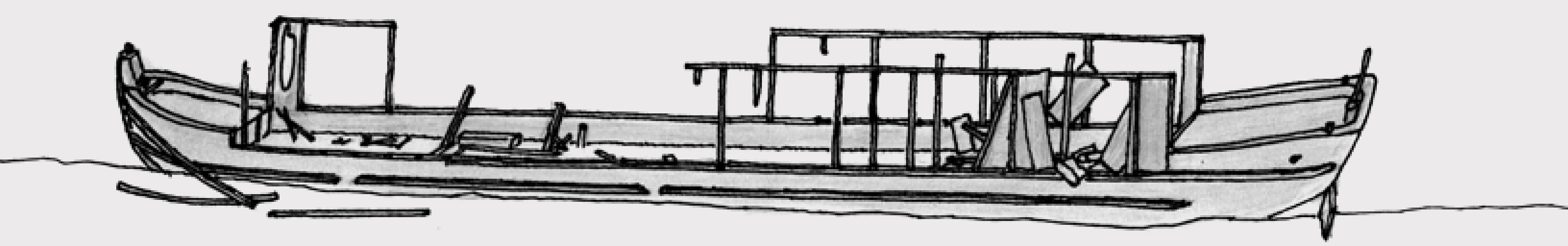
LOOKING AFT FROM REAR CABIN



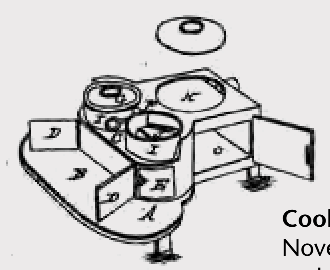
PASSENGER CABIN INTERIOR

STERN AND RUDDER





Drawings by Tim Caza



Cooking Stove. U.S. Patent No. 470, November 23, 1837. David Hastings and Solomon Sikes.

WOODSTOVE HEAVILY ENCRUSTED WITH MUSSELS

Packet Boats, a Brief History

Broadside, 1834 (detail). Canal Society of New York State

Packet boats were passenger carriers that operated on regular schedules over specified sections of canals. They traveled advertised routes and generally arrived at their intended destinations reasonably on-schedule. Packet boats operated as the canals' express bus system, and enjoyed a right-of-way through a canal and locks in preference to freight carriers. Almost overnight, packet boats offered a practical means of travel that stimulated a wave of migration from east to west.

Packet boats were the marvels of their age and as soon as sections of the canal were watered, they appeared, as if by magic to take advantage of new opportunities. On October 23, 1819, a packet boat, the *Chief Engineer,* traveled from Utica to Rome with Governor DeWitt Clinton and a boat full of dignitaries aboard as they initiated this new mode of transportation. These early packets appear to have been experimental in design and took on the appearance of Mohawk River boats adapted to the new canal. In 1830, a passenger described that:

> "The passenger boats are generally 80 feet in length and 14 feet in width, and drawn by three horses draw from 1 to 2 feet of water. The cabin occupies the whole length of the deck, excepting about 8 or 10 feet reserved at one end for the cook and 4 or 6 feet at the other end for the pilot. The intermediate space is occupied as a cabin constructed from the deck into a room with eight feet in height with single berths on each side, and calculated to accommodate 30 persons. The boats are drawn by three horses, one before the other and move day and night, at the rate of 4 miles an hour. Relays are furnished every 8 or 10 miles…. The price of conveyance in the packet boat is 3 cents per mile, meals extra."
>
> From: *The Fashionable Tour*, by G.M. Davidson, Saratoga Springs, 1830.

The packet boat *Seneca Chief* figured prominently in the October 1825 official opening celebration of the Erie Canal. For the next twenty-five years, packet boats carried thousands of passengers in a vibrant and lucrative business model that changed the demographics of the United States and Canada. Packet boat companies cooperated with existing stage coach lines that had been operating in western New York for more than two decades. In addition to carrying passengers, packets often carried light freight and mail, but their principal business was always the transportation of people. Each boat had a kitchen, bar, dining room and sleeping accommodations and carried between 40–60 people.

While the freight boats required most of the four-foot of draft of the original canal to maximize their load capacity, packet boats typically drew half that depth. Freight boats were pulled by two draft animals and traveled at about one mph, while fully-loaded packets drew half that depth and traveled through the canal at a brisk four mph.

"Plans or drawings were never made or needed as everyone that built these boats knew exactly how they were put together. The only resources of records we have of these boats are the written descriptions, and the few drawings, sketches and paintings of them as produced by the artists of the time. Photographs from these early years do not exist."

Dr. Robert Hager, canal boat authority, unpublished manuscript,
Chittenango Landing Canal Boat Museum Library

Packet boat companies and stage lines made connections at Schenectady, Canajoharie, Utica, Chittenango, Syracuse, Montezuma, Lyons, Palmyra, Rochester and Lockport. At Buffalo there were excellent stage connections in all directions. It was a symbiotic relationship with each conveyance benefiting from the cooperation. Unlike Erie freight boats, the packets had no stables aboard and instead kept horse barns at regular intervals along the canal where fresh horses and drivers could be exchanged for tired teams. The drivers or "hoagies" were often young boys who were frequently taken advantage of by their employers.

(above) Towns blossomed into cities and new settlements sprang up along the banks of the Erie Canal even before it was completed end-to-end. In 1822, guests of the Canal House in Utica could watch new canal packets and older Mohawk River Durham boats pass by. Anon. *A Knickerbocker Tour of New York State.* Mss., 1822 New York State Library

The circumstances that caused target 7 to sink in Seneca Lake are not currently known. The broadside (right) "Arrangement for 1827" confirms packet boats were regularly operating near Geneva at the north end of Seneca Lake.

Arrangements for 1837.

Seneca and Cayuga Canal Packet Boats

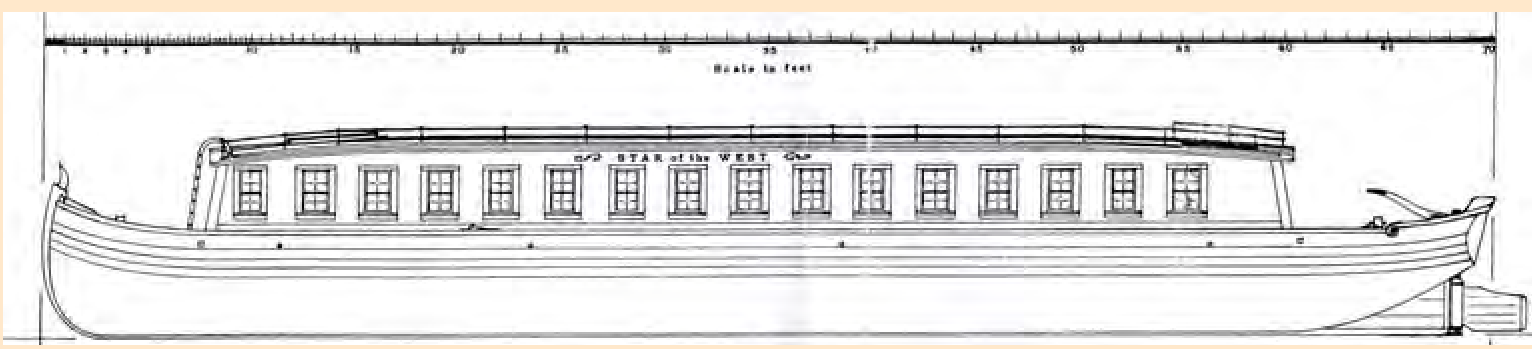
GENEVA AND EMBLEM.

THIS line of Packets will leave Montezuma every day at half past 6 A. M., and half past 1 P. M., arriving at Geneva at 11 A. M. and 6 P. M.

Returning, they will start from the foot of the Lake, near Densmore's Tavern, Geneva, every day one at 5 A. M., arriving at Montezuma at 10 A. M., in time for the Packet going East, which will arrive at Utica in season for the morning cars; the other at 2 P. M., arriving at Montezuma at half past 7 P. M., in time to meet the Packet for Utica.

For Passage, apply to I. PIERCE, Agent, three doors south of the Franklin House, Geneva, to the Captains on board, or to the Proprietor, Montezuma.

☞ Passengers and Baggage carried to the Boats free of charges, by applying at the office in Geneva.



Packet boat plans for *Star of the West.* Drawn by Dr. Robert Hagar. Chittenango Landing Canal Boat Museum

Montezuma the canal and the elevated tow path across the Cayuga Marsh, John Henry Hopkins, 1825. Hopkins illustrated the junction of the elevated tow path crossing the Seneca River. He painted the packet boat he was traveling on as well as a variety of craft undoubtedly drawn in from adjoining waterways.

"We passed several boats, rafts and scows on our passage. Some were built on the canal, and other transported to it from the Mohawk and Seneca Rivers." Governor DeWitt Clinton, writing as Hibernicus, May 26, 1820.

1846.

VERGENNES & BUFFALO LINE.

THE Boats of this Line will commence their regular trips, to and from Vergennes and Buffalo, running

DAY AND NIGHT,

(SUNDAYS EXCEPTED,) AS FOLLOWS:

PACKET GARLAND,

CAPT. P. M. SHAW,

Leaves Vergennes,		Leaves Buffalo,	
April	21,	May	2,
May	19,	May	30,
June	16,	June	27,
July	14,	July	25,
August	23,	September	5,
September	22,	October	3,
October	20,	October	31.

PACKET J. SHERMAN,

CAPT. E. B. TULLER,

Leaves Vergennes,		Leaves Buffalo,	
May	5,	May	16,
June	2,	June	13,
June	30,	July	11,
August	11,	August	22,
September	8,	September	19,
October	6,	October	13.

The Proprietors of these boats have spared no expense in fitting them up, and the travelling public may rest assured that they will be managed by a careful and experienced Crew, who will exert themselves to make their passengers comfortable and satisfied in every respect. There will be no detention after leaving Vergennes. The prices for Passage and Board, and also for Freight will be as low as can be expected with the conveniences and attention which will be given on these Boats.—Those choosing to Board themselves can have every facility for doing so.

For further particulars enquire of the Captain on Board.

R. CHAPMAN, Agent, Vergennes.
JOY & WEBSTER, WM. STIMSON, Esq., } Buffalo, N. Y.

Vergennes, Vt. March 19, 1846. 61

The Watchman, May 7, 1846

As sections of the canal opened, canal boats couldn't be built fast enough to accommodate the new opportunities. While new boats were laid down next to the canal, boats already operating on the Mohawk and Seneca Rivers were adapted for service.

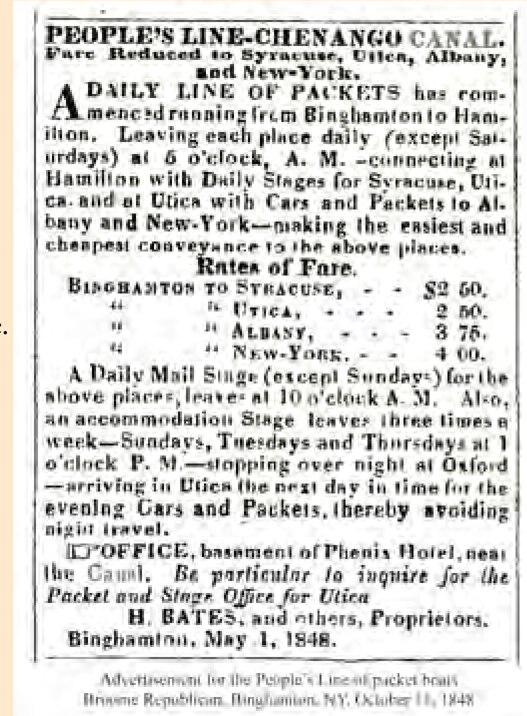
Reverend John Hopkins, traveling from Lockport to the Hudson River on a packet boat in October, 1825, created artwork and a journal documenting the Erie Canal at the time it was being officially opened. Rev. Hopkins visual record of the Erie Canal was created simultaneous to the official celebration culminating in New York City, was located at the Clements Library at the University of Michigan and is used here with their permission.

Long Distance Packet Boats

Packet boats traveled on a schedule that coordinated with stagecoach lines to offer a more predictable and reliable way to travel east and west or emigrate westward. Recently, we have located ads for the Vergennes [Vermont] & Buffalo Line of packet boats based in faraway Lake Champlain. This line was clearly meeting a demand for westward migration via Lake Champlain and the Champlain and Erie Canals.

Chenango Canal

As successful and popular as the packet boat were in the transportation system of 1820–1850, by 1860, the expanding railroads, able to operate year-round on a more precise schedule offered a competitive travel option. Although numerous illustrations and travel accounts exist, by this time the sleek packet boat drawn by three horses was essentially gone from the scene. One exception was on the lateral Chenango Canal that connected Utica to Binghamton, which officially opened in 1837. With the need to overcome significant elevation heading south from Utica to Hamilton, the canal had 80 locks over the first 30 miles! In the remaining 67 miles from Hamilton to Binghamton, there were only an additional 36 locks to navigate. This geographic reality made Hamilton the terminus of packet boat traffic and a junction point for stage coaches to Utica, Syracuse and Albany. These packets, because of their relative short run, could operate by day and did not need to deal with the complexity of sleeping accommodations. This continued until the railroad completed its tracks along the Chenango route at the end of 1870. Not surprisingly, this was the last year the packet boats ran on the Chenango Canal, and in 1876, the Chenango Canal suffered the fate of most lateral canals and closed forever.



PEOPLE'S LINE-CHENANGO CANAL.
Fare Reduced to Syracuse, Utica, Albany, and New-York.

A DAILY LINE OF PACKETS has commenced running from Binghamton to Hamilton. Leaving each place daily (except Saturdays) at 5 o'clock, A. M.—connecting at Hamilton with Daily Stages for Syracuse, Utica, and at Utica with Cars and Packets to Albany and New-York—making the easiest and cheapest conveyance to the above places.

Rates of Fare.

Binghamton to Syracuse,	- -	$2 50.
" " Utica,	- - -	2 50.
" " Albany,	- - -	3 75.
" " New-York,	- -	4 00.

A Daily Mail Stage (except Sundays) for the above places, leaves at 10 o'clock A. M. Also, an accommodation Stage leaves three times a week—Sundays, Tuesdays and Thursdays at 1 o'clock P. M.—stopping over night at Oxford—arriving in Utica the next day in time for the evening Cars and Packets, thereby avoiding night travel.

☞OFFICE, basement of Phenix Hotel, near the Canal. *Be particular to inquire for the Packet and Stage Office for Utica*

H. BATES, and others, Proprietors.
Binghamton, May 1, 1848.

Advertisement for the People's Line of packet boats
Broome Republican, Binghamton, NY, October 11, 1848

By the beginning of the age of photography, most packet boat operations had already ceased. However, the timing of the completion of the railroad line next to the Chenango Canal allowed packet boats to continue in service a decade or two longer than most operations. This rare photo was taken in Oxford in 1865, and provides a photographic glimpse of a packet boat. From *Packet Boats Along the Chenango Canal*, by Richard Palmer.

Packet Boat Line,
BETWEEN
Norwich & Binghamton

Fare, $1,50.

THE PACKET BOAT LILLIE will run between Norwich and Binghamton during the present season, as follows: Leave Norwich on Mondays, Wednesdays and Fridays; leave Binghamton on Tuesdays, Thursdays and Saturdays. Meals furnished to parties desiring, at reasonable rates.

Time Table.

GOING SOUTH.

Leave Norwich	6.00	A. M.
" Oxford	8.00	"
" East Greene	10.30	"
" Greene	12.00	M.
" Chenango Forks	2.00	P. M.
" Port Crane	4.00	"
Arrive at Binghamton	6.00	"

GOING NORTH

Leave Binghamton	6.00	A. M.
" Port Crane	8.00	"
" Chenango Forks	10.00	"
" Greene	12.00	M.
" East Greene	1.30	P. M.
" Oxford	4.00	"
Arrive at Norwich	6.30	"

May, 1870. WM. STEVER, Captain.

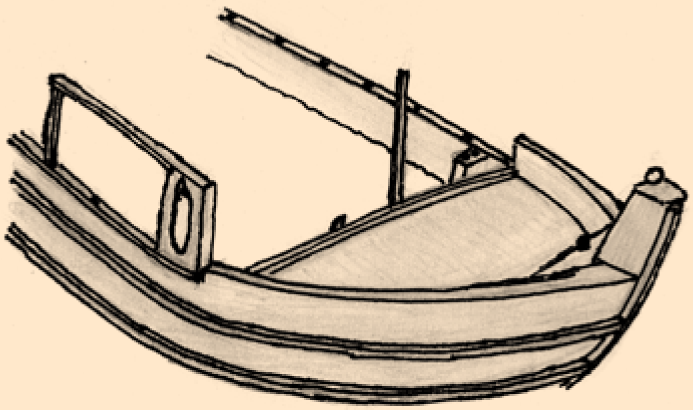
This 1870 packet boat line ad was the last gasp of an era which had begun half a century earlier. The packet boats had revolutionized canal passenger travel and moved thousands of people through the system. As the railroads provided a better alternative, the canal struggled to survive.

Detail of *View on the Erie Canal,* 1829. John William Hill. New York Public Library

Mohawk River Durham Boat Plans

When the New York canals were authorized, the most common vessel type being built along the Mohawk River route were the long, narrow and shallow draft for the Mohawk River Durham boat. It is not surprising that the first generation of boats built for use on the new Erie Canal would have some of the characteristics of this design. Examination of target 7 revealed a hull that was quite different from the many freight-carrying canal boats previously located and studied. Specifically, the hull looked like it was designed to be shallow draft with a sharp bow and a stem that rose up prominently. It also contained features along its sides that appear to be the framework for the distinctive cabin consistently shown in illustrations of packet boats from the era. Remnants of benches inside the hull add to the strong presumption of passenger use rather than of a heavy cargo carrier. Further examination of target 7 is planned.

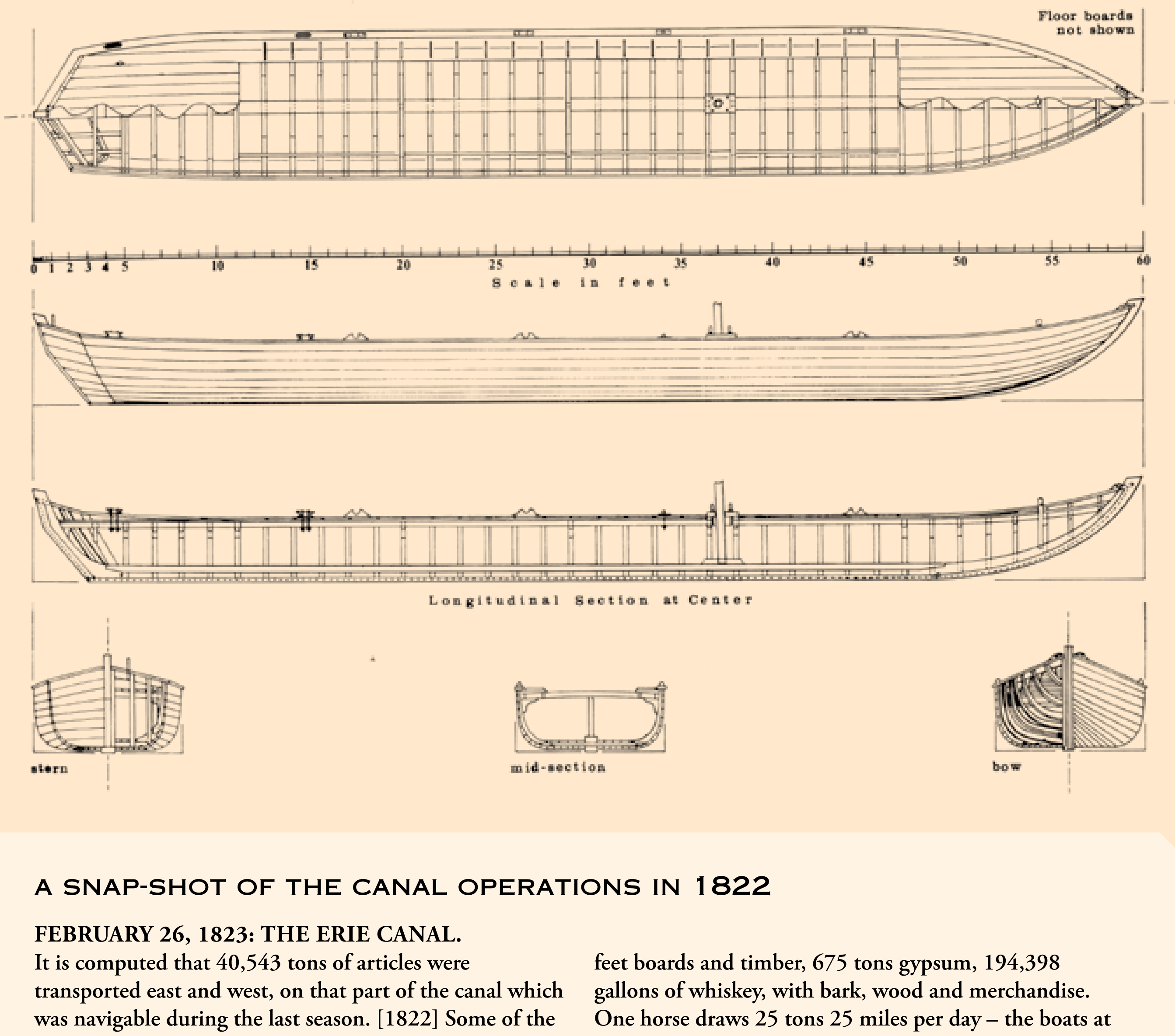
Detail of *Pittsford on the Erie Canal,* ca. 1840. George Harvey. From *The Course of Empire; The Erie Canal and the New York Landscape, 1825–1875.*



Note the distinctive shape of the packet boat's stem and the similar feature on the preliminary drawing of the bow section of target 7.

Target 7 and target 16 appear to be first-generation canal watercraft built for the new waterway. The canal formalized and standardized a navigation system that had been used for millennia by Native Peoples and then European explorers and settlers. By the time society had evolved to contemplate taming the natural rivers with engineered canals, large numbers of river boats, log rafts, arks and canoes had been built and refined to facilitate movement of cargo and people along the natural routes. Today, maritime archaeologists and historians are working to document the evolution of these early watercraft. The recent discovery and study of a Durham boat in Oneida Lake (see p. 99) and the work in Seneca Lake are beginning to fill in the story.

Mohawk River Durham boat. This drawing is based on illustrations published by Christian Schultz, who traveled the Mohawk River in 1807. It provides details of its probable construction. From *Mohawk River Boats and Navigation Before 1820*, by Robert Hagar, 1987.



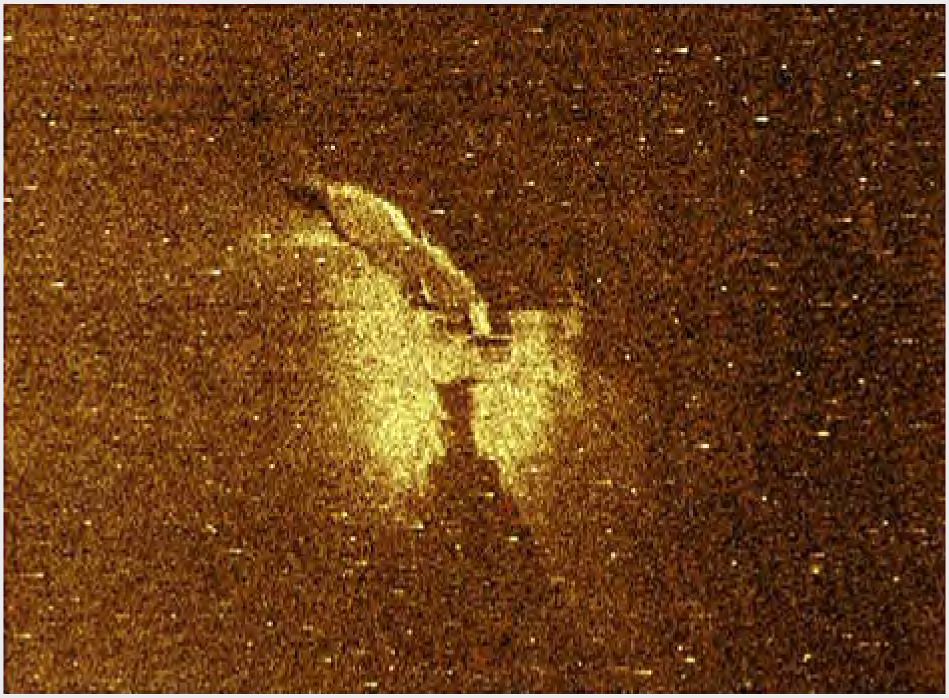
A SNAP-SHOT OF THE CANAL OPERATIONS IN 1822

FEBRUARY 26, 1823: THE ERIE CANAL.

It is computed that 40,543 tons of articles were transported east and west, on that part of the canal which was navigable during the last season. [1822] Some of the principal things were: 184,522 bbls. flour, 17,663 do. salt, 9,495 do. provisions, 4,372 do. ashes, 366 do. oil, 68,174 bush. wheat, 46,892 do. lime, about 1,500,000 feet boards and timber, 675 tons gypsum, 194,398 gallons of whiskey, with bark, wood and merchandise. One horse draws 25 tons 25 miles per day – the boats at present used are of the kind called Durham boats, but others, built specially for the canal, are preferable and coming into use. …"

— Geneva (New York) *Palladium*

TARGET 14



Target 14 gives all the appearances of an intact shipwreck in deep water and the survey team plans to examine her with a deep-water ROV. The target's shape is intriguing, and appears to be a canal-going vessel.

QUAGGA MUSSELS

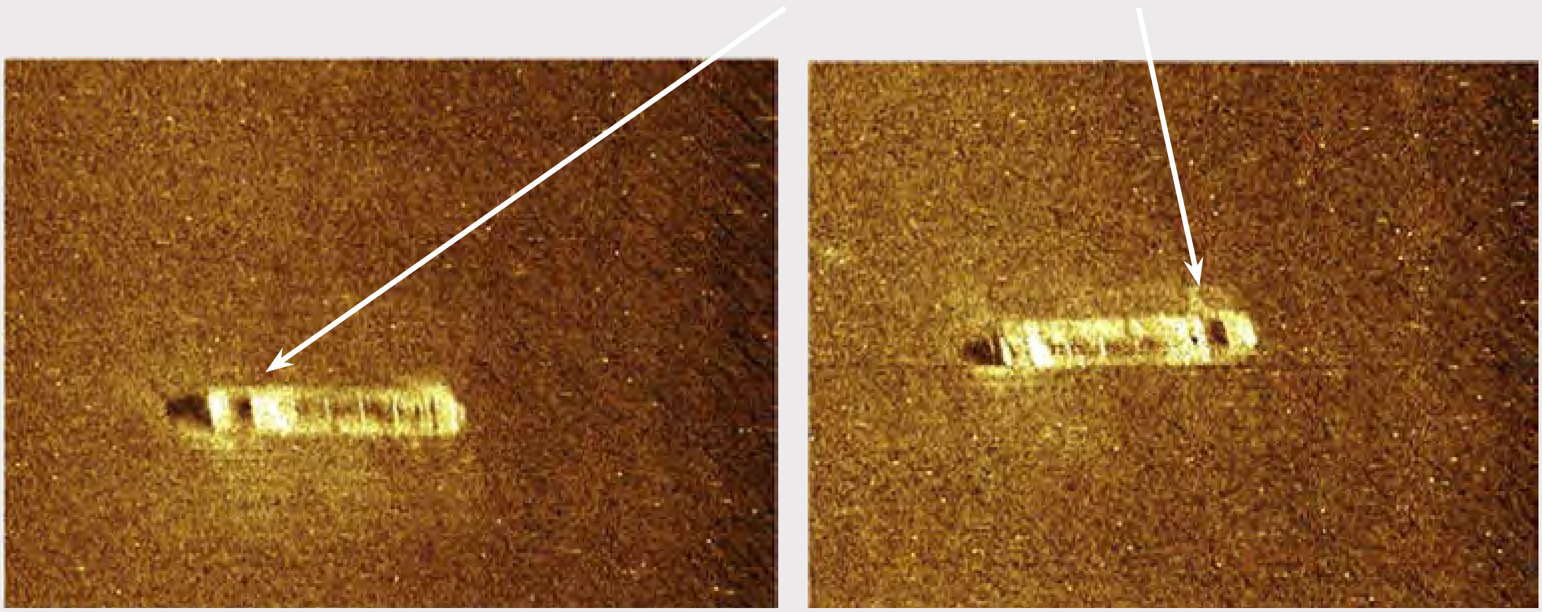
The presence of quagga mussels was observed on all the shipwrecks located in the 2018 and 2019 survey. Quagga mussels are an invasive species that were first observed in Seneca Lake in the 1990s and are predicted to eventually encrust all the lake's shipwrecks. Previous studies by the Lake Champlain Maritime Museum have determined that the presence of these mussels will have a significantly destabilizing effect on the iron fastenings that hold these wooden boats together.

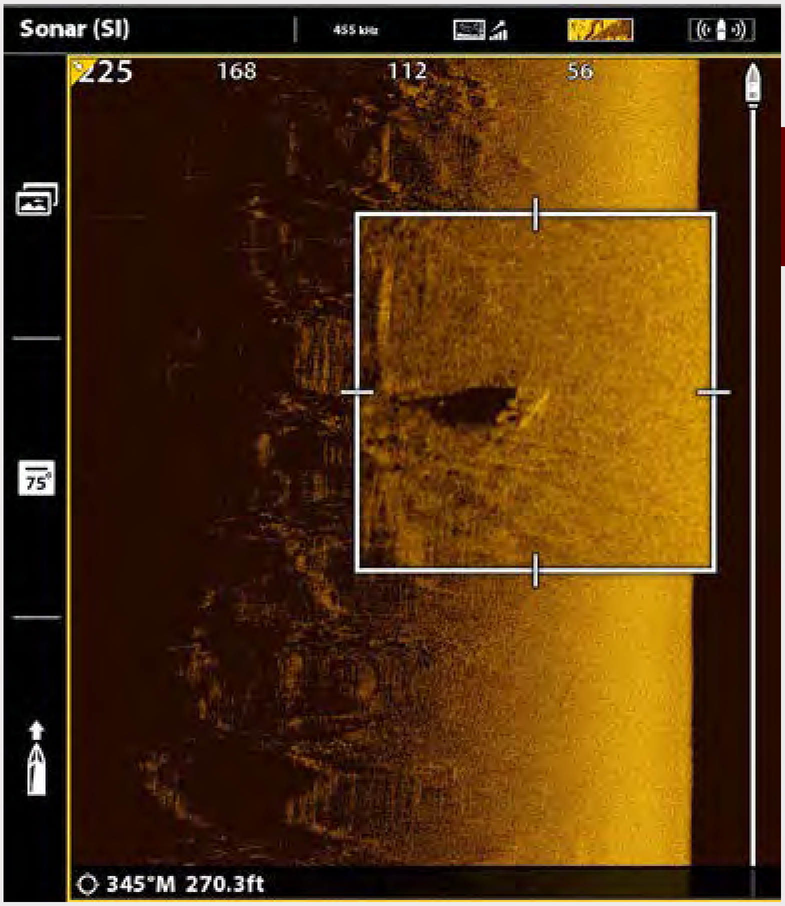
An anchor from the US Schooner *Hamilton*, sunk in Lake Ontario, photographed in 1982 and 2008. The change illustrates the zebra and quagga mussel threat to fresh water shipwrecks.
City of Hamilton

Target 15 is in very deep water, in contrast to target 14, and suggests the appearance of a canal-era vessel. The shipwreck appears to be in remarkably intact condition and should prove to be a valuable member of the tow-path era canal boat inventory. The bow stable and the stern cabin appear to be in undamaged condition.

Target 15

Sonar images from target 15. Shadows indicate cabins at both bow and stern.





Target 17

Target 17 appears to be an automobile in shallow water. Time did not permit examination in 2019, but this target will be further examined in the future.

The Bathymetry of Seneca Lake

Figure 1: Example of a lead-line observation in a lake. National Oceanographic and Atmospheric Administration

Section I: What Is Bathymetric Mapping?

Bathymetry is the study or measurement of the depth of water in the ocean, sea or lake. For the sake of this report, the term 'lake' will be used to encompass all bodies of water. The most important reason to study bathymetry is to keep ships from becoming shipwrecks by striking things in shallow water.

One of the most efficient ways to prevent the loss of ships in the old days was to create bathymetric maps and charts that were reliable and accessible to the nautical community. These first nautical charts were created during the mid-19th century from a technique known as lead-line observations or more simply, "lead-lining" **(Figure 1)**. The depth of the water was obtained using a marked cable with a moderately heavy lead weight at the end of the line. For the depth information to be useful, the location of this measurement also needed to be determined. Prior to 1945, a ship's location was primarily defined by triangulation to known points of land, celestial navigation, or dead reckoning. The farther away from shore and visible markers, the less precise the location.

In order to create a reliable lake chart, there was a balance between the number of observations and safe navigation for vessels, with more observations needed in shallow waters and less observations in deep water. In the NOAA chart of Seneca Lake **(Figure 2)**, the distance between observations range from a minimum of 200 meters (roughly the length of two football fields) in nearshore regions to 1100 meters (nearly ¾ mile) in the deeper, central portion of the lake. On average, the distances between most observations were in the 300–500 meter range.

Seneca Lake's aerial extent is a little more than 66 square miles, while Lake Champlain has a surface area of 490 square miles; nearly 7.5 times larger. With only 448 lead-line observations in Seneca, one would expect that Lake Champlain would have 3400 observations based on its greater surface area. In actuality, Lake

Champlain has almost three times as many lead-line observations as expected (9800) due to its very rugged bottom topography, numerous shoals, and rock-filled causeways that span significant distances across many segments of the lake. It is fed by numerous sediment-laden rivers that produce large and shallow deltas as well as larger extents of shallow water near the shoreline. NOAA lead-line based charts are still routinely used in many lakes in the United States even though they are 100–150 years out of date; Lake Champlain and Seneca Lake are perfect examples.

The larger size of ocean tankers and container ships with their increased drafts needed for international commerce drove a greater need for more detailed and more accurate bathymetric data for coasts, harbors and major rivers. Acoustic depth sounding, which was developed by the British during World War I as "acoustic ranging," was the next improvement in the methodology used to create bathymetric charts. After World War II, this technology took hold in the research and public sectors under various names, including acoustic depth sounders, precision depth recorders (PDRs), echo sounders, or the more commonly known "fish-finders."

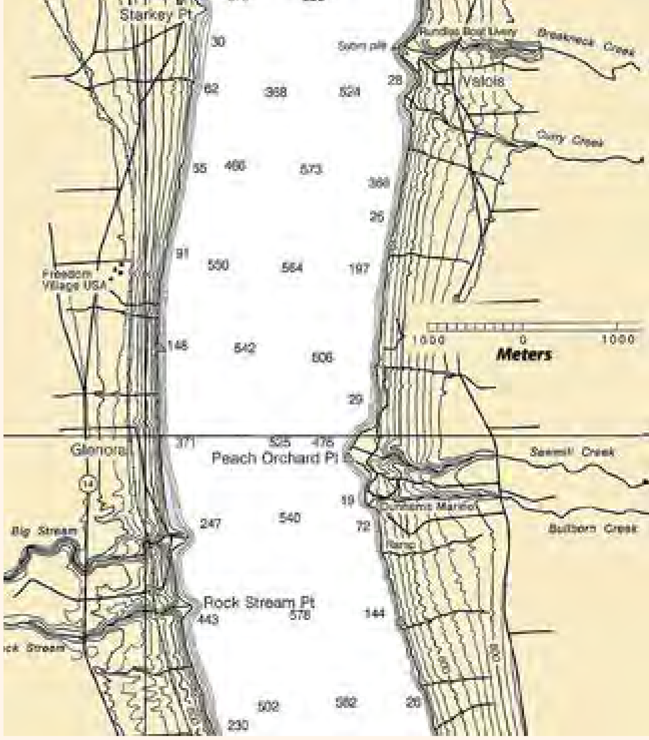


Figure 2. South central section of Seneca Lake showing the distance between lead-line observations. As an example, the distance between the depth value of 371 ft. at Glenora and the adjacent observation point to the northeast of 542 ft is 1.176 km (nearly ¾ of a mile).

This technology measures the time it takes for a downward-directed sound pulse (a ping) emitted by a transducer on a boat to go through the water column, be reflected off the lake bottom and be received back at the boat. The PDR swiftly became the instrument of choice for rapidly recording depth measurements since the vessel never had to stop or slow down in order to take a depth sounding. All that was required was continuous "pinging" of the bottom and recording the results. Prior to 1990, the most common way for recording and displaying depth information was on paper charts **(Figure 3A)**. Later, digital recording of depth made it vastly easier to assimilate all the acquired data.

Figure 3. Examples of **(A)** the older style paper chart echo sounders (Odom Mk3) that had no integrated positioning information and **(B)** the newer PDRs or "fish-finders" of today (Lowrance HOOK-7x) that use GNSS for precise positioning.

Another obstacle to creating accurate bathymetric charts was determining the position of the sounding. It wasn't until after World War II that electronic navigation became available. For mariners, this early electronic positioning system, known as LORAN, was land-based. In the 1970s, satellite-based navigation (US Global Positioning System or GPS) was launched for military use, with the public sector gaining access to it around 1983. The integration of satellite navigation capabilities of individual countries into a Global Navigation Satellite System (GNSS) is presently accepted as the most precise system and is the most widely used. As of today, GNSS is routinely incorporated into the positioning systems of modern day echosounders **(Figure 3B)**.

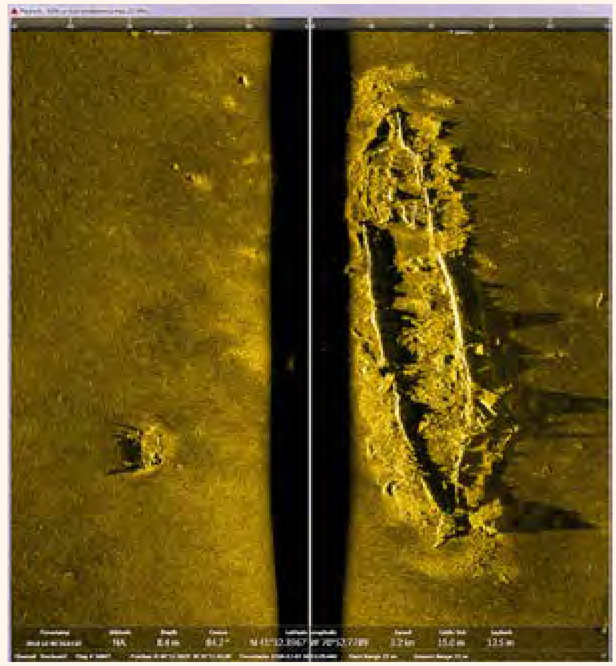


Figure 4. (above) Example of a side-scan sonar (the "fish") that would be towed behind the vessel and (right) the resulting image is of a shipwreck (not from Seneca Lake). From the EdgeTech 4205 system.

The integration of acoustic echo sounding, satellite-based navigation and the digital recording of information began the process of significantly improving bathymetric charts. One good example is the cooperative bottom-mapping program between Middlebury College and the Lake Champlain Maritime Museum (LCMM) from 1996–2002. The primary purpose of this seven-year project was to locate and identify all the major historical shipwrecks on the bottom of Lake Champlain using side-scan sonar; an acoustic swath-mapping device whose visual output is most closely associated with aerial photography. Side-scan is excellent at defining features that have a vertical relief higher than the local lake floor, such as rock outcrops, shipwrecks, fishing shanties, airplanes and construction debris.

In Lake Champlain, the underwater device or "fish," as it is commonly known, is towed behind the vessel at a height of approximately 10 meters above the bottom **(Figure 4)**. By using an appropriate spacing between ship tracks that are dependent on the swath coverage obtained by the system, the entire bottom of the lake can be mapped without any gaps. For example, in Lake Champlain the swath of the side-scan system was 200 meters (100 meters to the port and starboard of the ship). In order to create a 10% overlap of the data, separation between track lines was on the order of 175 meters. Unfortunately this system is not designed to provide depth information. That was obtained from a separate PDR which took a reading every two seconds.

Over the duration of the Lake Champlain survey this resulted in an amazing 735,000 observations along the ship track lines, compared to the 9800 lead-line observations **(Figure 5)**.

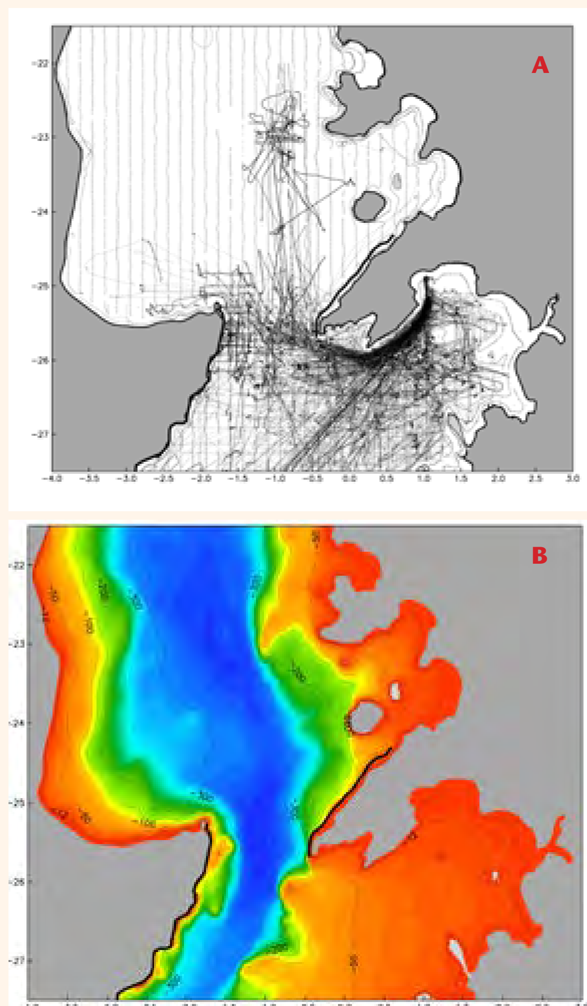


Figure 5. (A) An example of the number of ship tracks used during the 1996–2002 side-scan survey in Lake Champlain. The north-south track lines seen in the upper portion of the diagram were the typical horizontal spacing of 175 m. The dense pattern of ship tracks was a result of two vessels obtaining PDR data. **(B)** The resulting 10 m x 10 m computer-generated bathymetric map of the same region based on the calibrated PDR data.

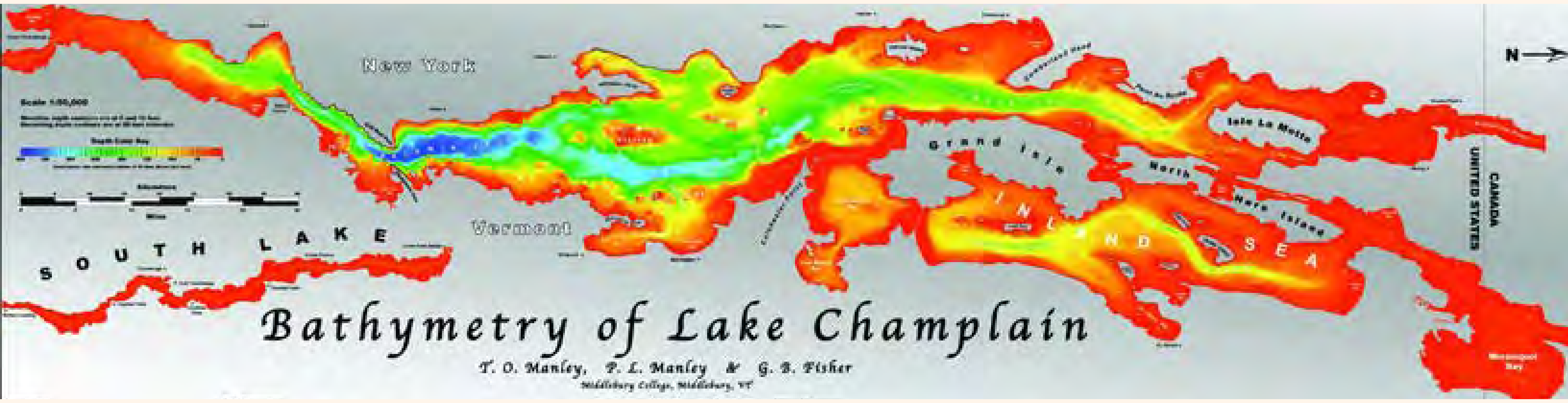


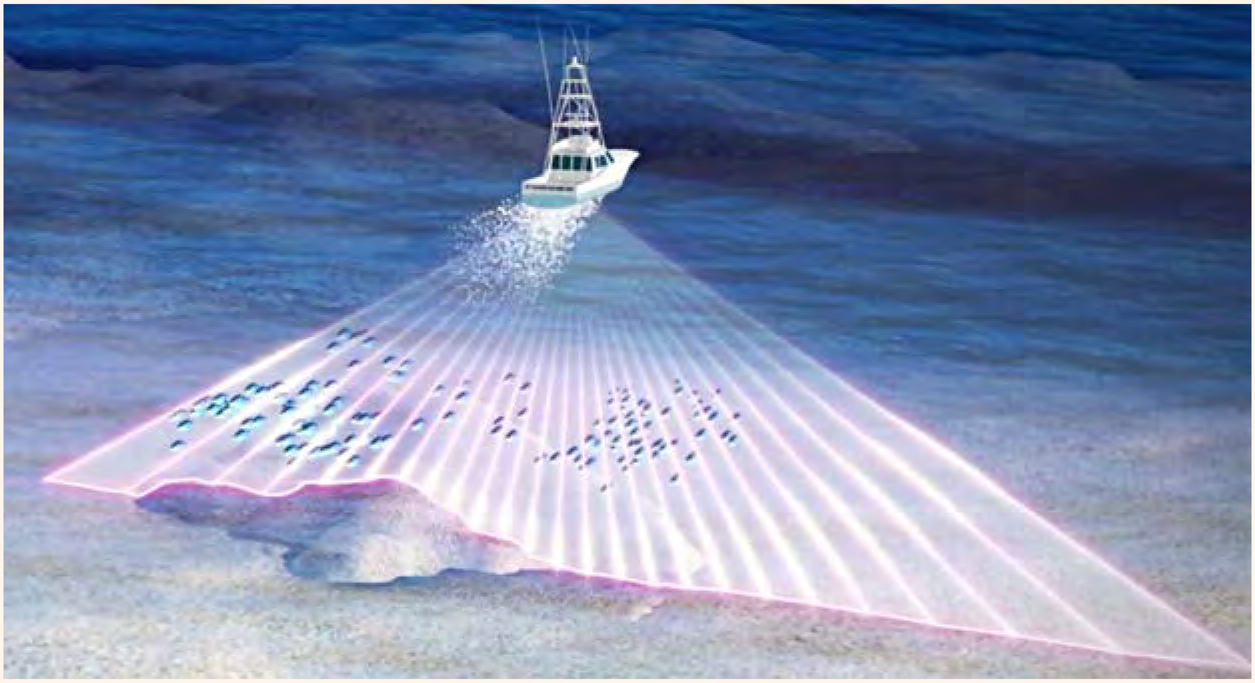
Figure 6. The 2005 map of Lake Champlain based on the PDR data collected from the 1996–2002 side-scan survey.

After two years of calibration and post-processing, computer modeling was used to create a mathematical "best fit" surface to the entire bathymetric data set. In 2005, this new bathymetric map of Lake Champlain was released **(Figure 6)**. This new bathymetric database represents a 75-fold increase in our knowledge of the bottom bathymetry of Lake Champlain over that of the original lead-line observations.

Multibeam Sonar

Side-scan mapping was improved again by an entirely new ship-based bathymetric observing system, known as multibeam sonar (MBES). The technology was secretly developed by the U.S. Navy in the early 1960s, but it wasn't until the 1970s that the system was eventually declassified and made available for commercial development. The concept is quite simple: place several single beam echo sounders on the boat pointed in different directions in relation to the ship's axis, that will take multiple simultaneous depth readings on either side of the ship, thereby creating a swath mapping system **(Figure 7)**. The difference between the swath created by a side-scan and that of MBES is that a multibeam system is designed for the acquisition of depth information while side-scan is designed to look for objects above the lake floor. They are similar in that they both swath map, yet different in the data they collect. While both systems are important to the success of the Seneca Lake program, the multibeam is truly at the heart of the program.

Figure 7. An example of how the various beams of a multibeam echo sounders system (MBES) are distributed to create a swath-mapping pattern on the ocean floor (Furuno MFF3D).



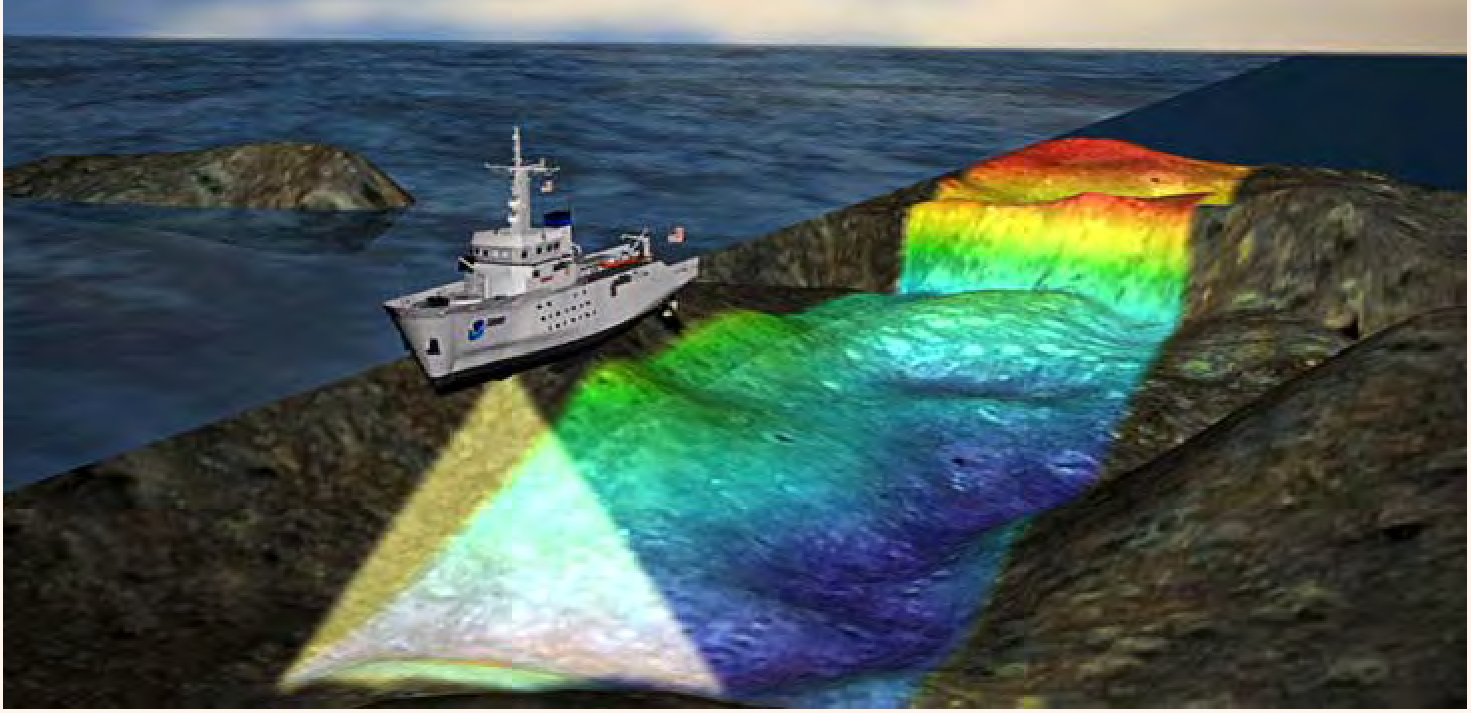


Figure 8. A simple image that shows how a MBES system can "paint" the bottom of the ocean floor in real-time after stabilizing all of the beams from ship roll, pitch, heave and yaw. (NOAA MBES, usgs.gov)

The MBES is designed to be highly accurate by providing depths that are typically within a 0.13 meter (approximately 6 inch) margin of error. To accomplish this, **sound velocity profile measurements** (i.e., from surface to bottom) must be repeatedly taken in the area that is being mapped to capture slight but important changes that can affect depth calculations. For Lakes Champlain and Seneca, profiles are usually repeated every two hours in order to capture changes in surface temperature due to daytime heating or evening cooling. Continual monitoring of sound velocity in the water column is extremely important for providing accurate depths and therefore was built into the 2019 Seneca Lake Survey protocol.

A hidden complexity of the MBES relates to how sound velocity changes vertically throughout the water. In single-beam echo sounders that point straight downwards, all one must know is the average sound velocity in the water column to determine an accurate depth. The more precise the sound velocity, the better the depth measurement. However, once the sonar beam is directed at any angle away from vertical, a different physical law of sound propagation in media becomes very important – that of diffraction or the "bending" of waves. A sound wave will be diffracted (bent) to a greater degree the farther off vertical it is. For example, a beam that is directed straight down will not bend but a beam that is directed away from the ship at 30 degrees from vertical will. A beam directed at 60 degrees will experience a greater diffraction than one at 45 degrees. The determination of where a beam will hit the lake floor is calculated in real time using mathematical equations based on **the law of diffraction** using the most recent sound velocity profile.

The last MBES complexity is defining the motion of the ship while it is taking these depth measurements. Unlike the side-scan sonar which is towed behind the survey vessel, MBES must be rigidly attached to the hull of the ship and setup in a way that has the downward-directed beam perpendicular to a calm lake surface. In that way, the motion of all the beams can be calibrated to the motion of the ship. For example, if there are wind-generated waves on the lake, the ship will respond to those waves by pitching, rolling, yawing and heaving. And since the MBES is rigidly attached to the ship, the beams will be experiencing the same motion, thereby creating a rather chaotic and random sampling of lake-floor depths. But with some additional mathematics and the installation of an **Inertial Motion Unit (IMU)** that provides very detailed information on the ship's motion several times per second, the MBES computer can "stabilize" all these ship motions into a very clean bathymetric rendering of the lake floor **(Figure 8)**. The IMU also provides extremely good positioning of the ship to less than 0.3 meter (about one foot) and after post-processing, less than a few inches.

All of the information, the sending and receiving of the pings of each beam, incorporating sound velocity and refraction calculations, high-quality position information, heave, pitch, roll and yaw from the IMU, is controlled, processed, stored and displayed in real time by the **multibeam computer.** The modern multibeam systems are far more sophisticated than the earliest systems that used a maximum of 16 beams. In contrast, newer MBES systems, like the one employed on the R/V *Folger,* employ an amazing 512 beams that continually ping the bottom 5–10 times every second.

When the MBES system is in operation aboard the R/V *Folger,* the most closely watched components are the two monitors in front of the operator **(Figure 9)**. The first monitor displays the raw, partially-processed view of the lake floor as captured by all 512 beams. An example of this output can be seen in **Figure 10** as a "waterfall" plot. The second monitor displays all the region's lake floor data acquired to-date, from the beginning of the survey to the last few seconds. It updates a color image of the lake floor with every ping. We often call this the "paint as you go" display. The displayed data represent only a small averaged subset of the complete data set but is still adequate to visualize all significant features on the lake floor. Post-processing at a later date improves best results.

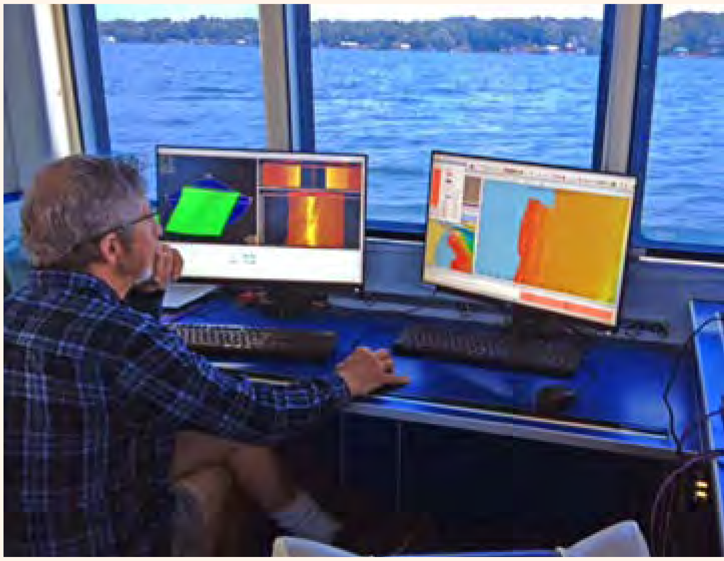


Figure 9. One of the sonar operators studies the MBES monitors aboard the R/V *Folger* during the 2019 Seneca Lake Survey.

Figure 10. Image capture of the raw data display that the sonar operator uses when mapping is underway. This display is known as a waterfall plot since the data scroll down from the top (where the most recent data are plotted). The length of the record is about 20 seconds. The bright green line at the top of the image, even though appearing to be a solid line, is comprised of all 512 tightly-packed individual beams. The image shows the detailed edge of what we believe to be the toe of a small ancient submarine landslide.

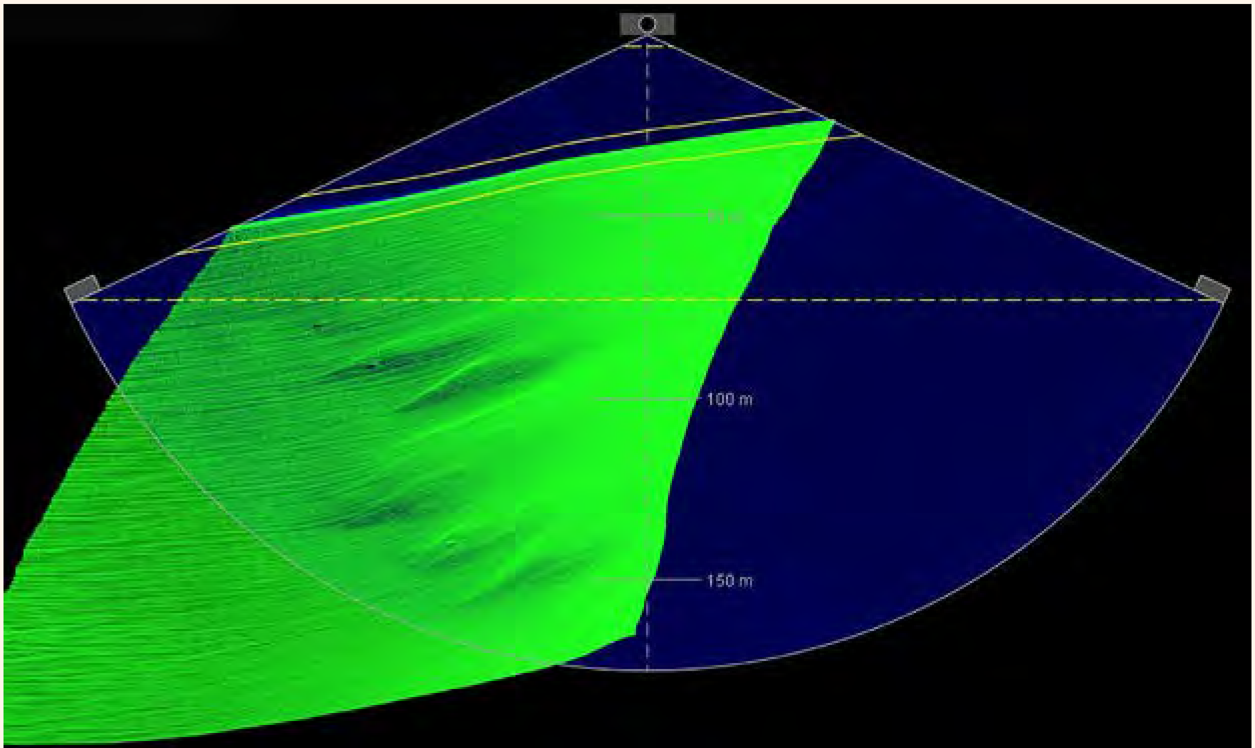


Figure 11. R/V *David Folger*, the 48-foot, Middlebury College research vessel, was the central platform used in 2019 to systematically survey the underwater bathymetry of Seneca Lake.

Section II: 2019 Preliminary Bathymetric Results

During the two-week Seneca survey in 2019, the MBES system on Middlebury College's R/V *Folger* **(Figure 11)** was used to map the northern third of Seneca Lake, except for the northernmost shallows, in remarkable detail. **Figure 12** provides a striking comparison between the 19th century lead-line observations and the newer multibeam data. MBES is rarely used in water of less than 10 meters deep (about 30 ft), because of the amount of time that would be required. Because of this, most of the northern lake was left unmapped. There are plans to later incorporate a LIDAR (Light Detection and Ranging) system, a very high-resolution laser-based airborne system that has the capability to map underwater surfaces shallower 10 meters. We estimate that LIDAR would only require 1–2 days of flight time to map all the shallow waters of the lake, compared to about 30 days with MBES. The combination of LIDAR and MBES data will produce the final bathymetric map of the lake.

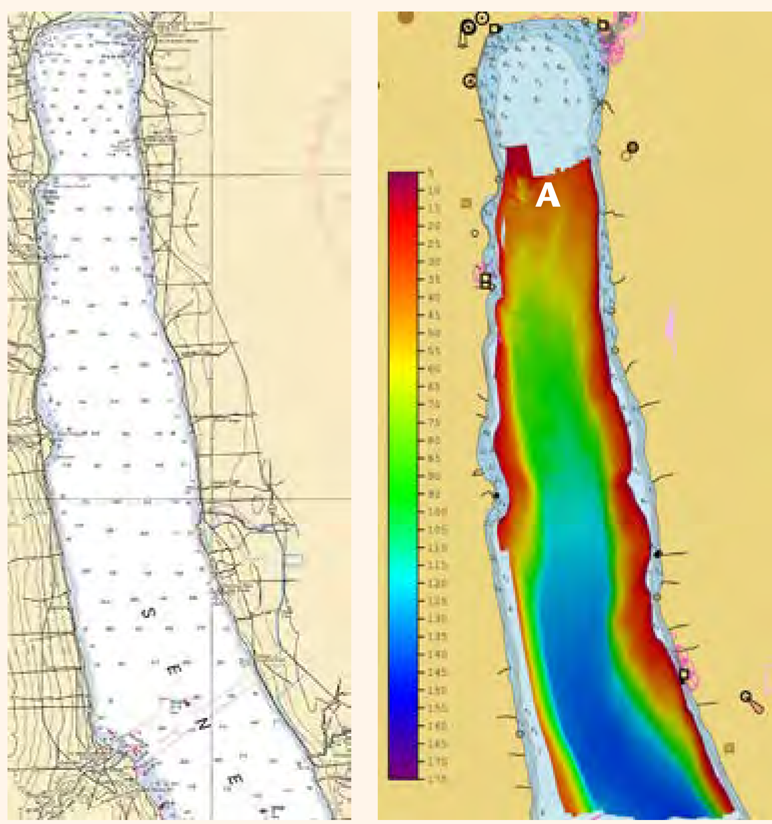


Figure 12. Comparison between the mid-1800s NOAA chart on the left and the two-week multibeam survey from Middlebury College's R/V *Folger.* The color key defines depth in meters. Total MBES data = 337 million pts; image = 55.1 million pixels.

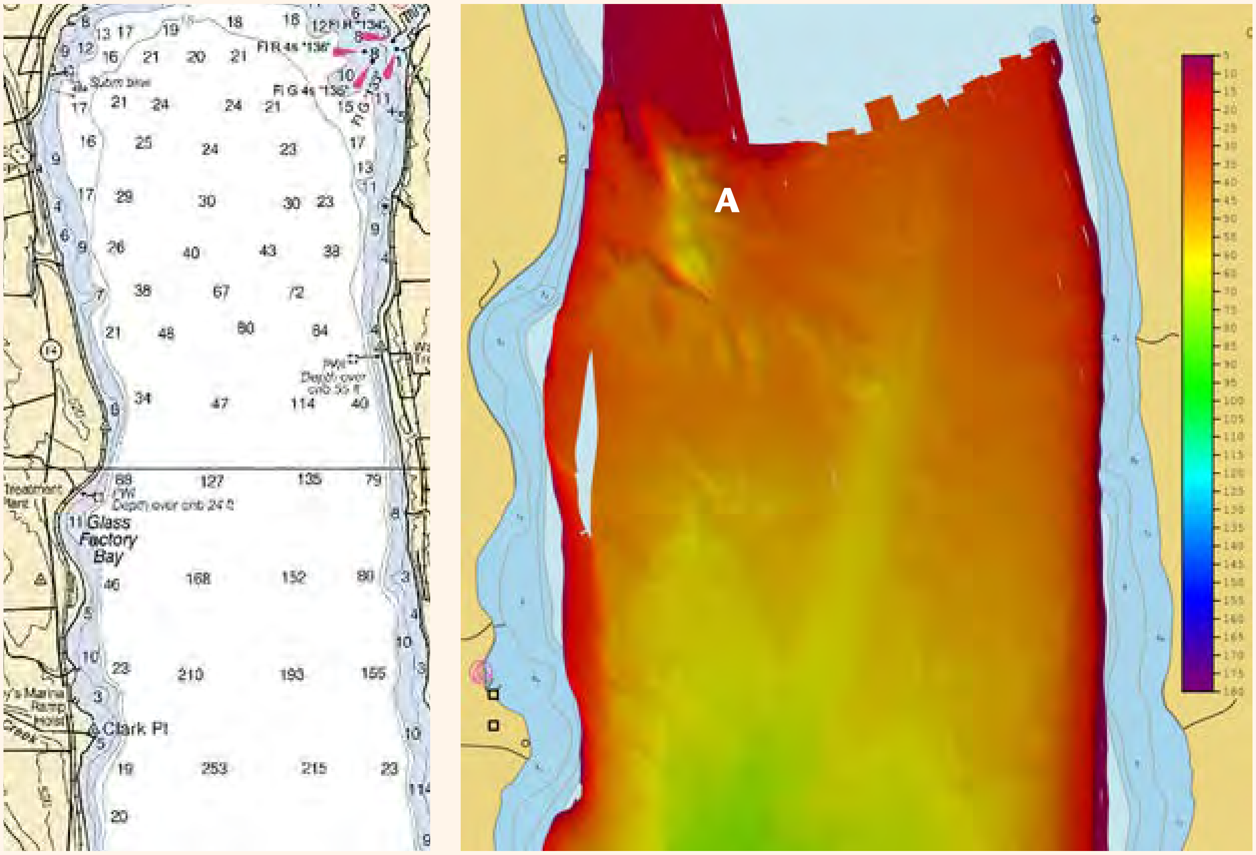


Figure 13. A more detailed comparison between the mid-1800s lead-line data (left) and the higher resolution multibeam data to the right. The increased detail the multibeam image is apparent. The deep "hole" found in the upper left (labeled A) of the multibeam diagram was missed during the NOAA survey. The total number of 1 m x 1 m pixels for this image is 9.1 million. Color key defines depth in meters.

Zooming in on the northern 20% of the data set collected in 2019 further illustrates the enhanced capabilities of MBES **(Figure 13)**. The feature labeled "A" was never observed in the lead-line data and it was only in the last twenty years that researchers discovered this deep depression that they often referred to as the "Hole." Over the last two decades, single-beam PDRs were consistently used to define its structure but even these maps were crude when compared to what is shown in Figure 13. Further enhancement of the northwest sector of this figure provides another level of detail available in the MBES data within the region of the "Hole." Querying the multibeam data set shows that this feature is 711 meters long and 380 meters wide, but instead of being one large depression within the shallow waters, it is actually composed of at least five separate depressions. The deepest (58.7 meters) is located at its most southern extent while the two directly north of it show a consistent shallowing at 57.2 meters and 53.5 meters.

Researchers have also shown that within the immediate region of the "Hole," the amount of dissolved salts (salinity) increases with depth. This also agrees with observations showing that the geologic layers beneath the lake tilt upwards to the north and downward to the south. The deep southern layers have commercially minable salt deposits while the northern layers are not commercially viable. The most widely accepted reason for this large depression is that groundwater or water from Seneca Lake (or both) is dissolving portions of this salt layer. These dissolved salts become mobile and move out of the region either through groundwater motion or through leakage into Seneca Lake. Over a significant amount of time, this loss of salt within the geologic strata created large subterranean caverns that could no longer support the overburden pressure of sediment and water within the lake and caved in, creating the "Hole" and explaining the presence of higher salinity at its deeper levels.

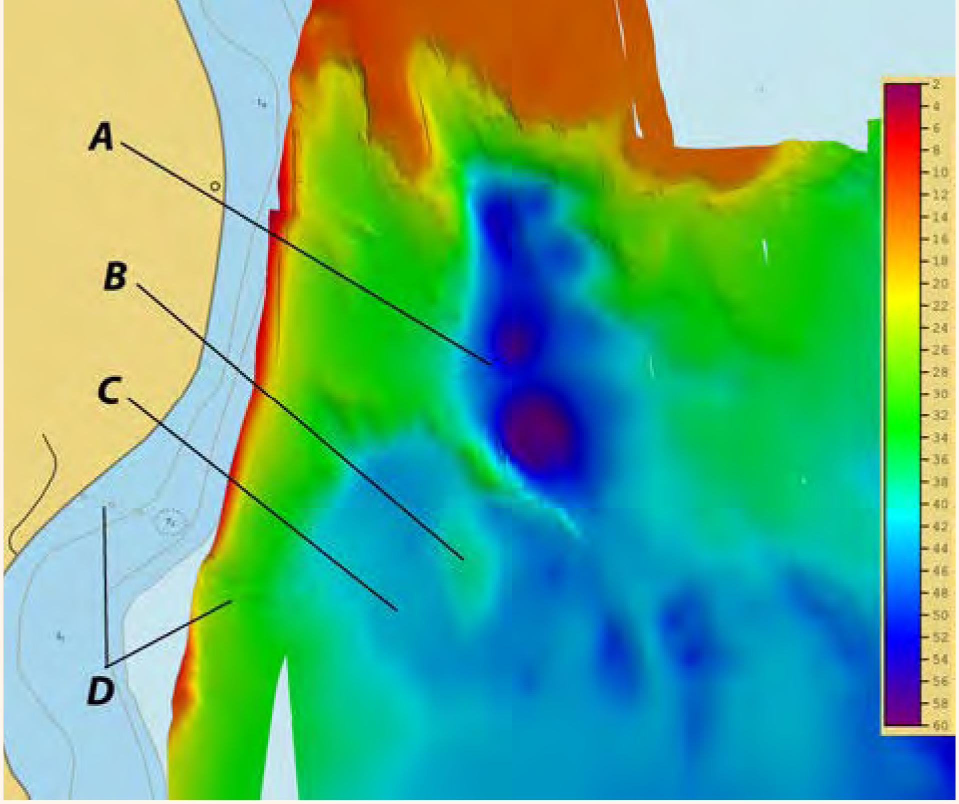


Figure 14. Color-enhanced view of the northwest portion of the survey. The color key was altered from full-depth (0-180 m) to one that accentuates depth variations in shallower water (0-60 m). Note the large depression (A) that is ~20 m (~70 ft) deeper than the local surroundings as well as the shallower, more circular depression (C) to the southwest that is only half as deep. There is also a shallow shoal in the middle of this feature (B). The color key defines depth in meters.

The multibeam data support the presence of at least five depressions within the larger feature. This might indicate that there were several (rather than one) cavern collapses that occurred to create the overall depression. Prior to the collapse, local depth was close to 37 meters as shown in the brighter green colors in **Figure 14**. The depths of each major depression from south to north of 58.7, 57.2 and 53.5 meters imply cavern collapses of approximately 22, 20 and 16 meters. In addition to the large depression, the multibeam data revealed another large, circular depression (500 meters x 430 meters) adjacent to and directly southwest of the "Hole" (labeled C). Also of note is an elongated shallow region (depth of 38.8 meters) near the center of the circular depression. There is a slight southeastward tilt to the bottom of the circular depression of approximately three meters with the western side being the shallowest at 42 meters and the eastern side being the deepest at 45 meters. Based on the previous discussion on the creation of the "Hole," it is also possible that this large circular depression was also created by another cavern collapse beneath the lake. However the average collapse would have been on the order of 10 meters, roughly half the distance of the collapses in the large depression. The shallow region within the center of the circular depression possibly represents a region within the salt layer that is still stable enough to support the overburden pressure.

Mis-registration or inaccurate positioning of specific features is also commonplace when comparing NOAA charts with the higher-resolution multibeam data. A good example of this is labeled D in Figure 14. On the NOAA chart, a buried pipe

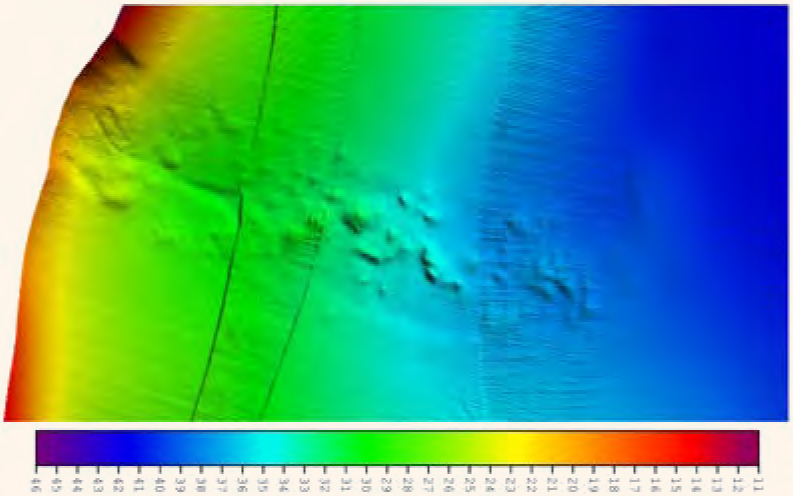


Figure 15. Tailings from the burial of an underground pipe that appears to be tied to the Geneva water treatment plant. Length and width of the excavation field is 209 m x 55 m (228 x 60 yards).

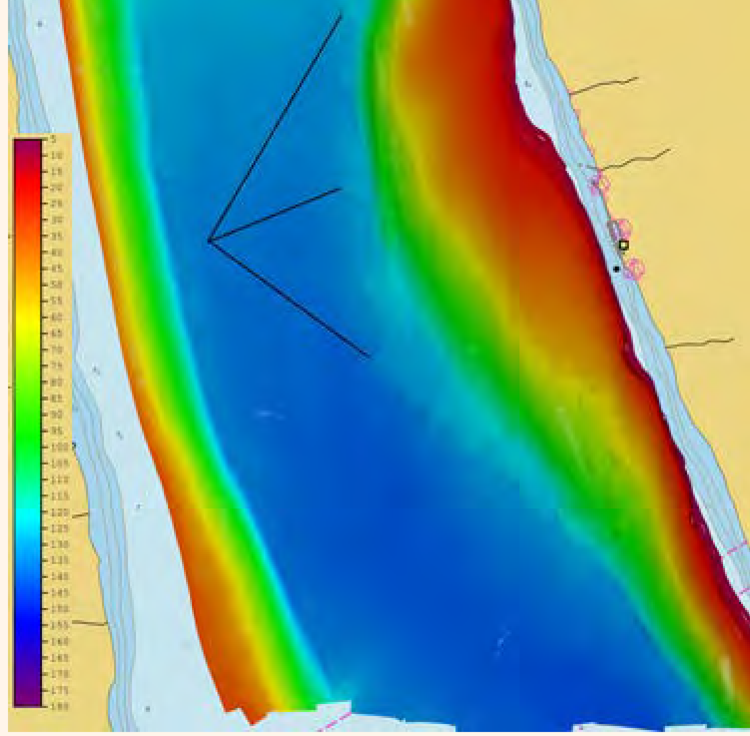


Figure 16. Submarine landslide "debris fans" found along the deep eastern side of the lake. These features are defined by the lighter blue "lobes" found at the base of the slope; several of them indicated by black lines. Total length along the shoreline possessing submarine landslides is ~7200 m.

with shallow cribbing at the end is well defined. However the newly-acquired multibeam data show it to be south of its defined location and extending much farther out into the lake itself. A more detailed view of this positioning is shown in **Figure 15**. In this image, the excavation region is quite evident with large, blocky tailings located throughout its boundaries. The maximum height of these large tailing blocks can be measured at nearly two meters.

Another geologic feature typically found in larger lakes is a submarine landslide. Submarine landslides are similar to surface landslides except that they tend to be more fluid in their nature. A close example on land would be a mud flow, which is a mixture of sediment and water. When the sediment in a submarine landslide moves from its original resting position at some higher elevation downslope, it will eventually encounter the flat, deep sections of the lake. When it encounters this significant change in slope, the sediment will fan out in all directions away from its origin. The resulting debris field on the bottom of the lake is something akin to a fan-shaped lobe, referred to as a debris fan. **Figure 16** shows many of these features located along the eastern side of the lake. The northern ones are much smaller and exhibit individual, lobe-like structure whereas to the south, multiple submarine landslides have merged to form a much larger and more dispersed sedimentary deposit. The largest excursion of sediment away from the more steeply-dipping slope (bottom line in Figure 16) is a little over 1/2 kilometer or just under 1/3 mile. From what we have observed so far, a majority of the submarine landslides are found on the eastern shoreline of Seneca Lake and very few on the west. With respect to the displaced volume of these features, it is impossible to provide this information without more detailed sediment thickness information from an instrument known as the **Sub-Bottom Profiler** (SBP). In Lake Champlain, some of the largest submarine landslides have exceeded 10 million cubic meters and were believed to create surface phenomena called "lake tsunamis."

A Tsunami in Seneca Lake in1888?

Between the periods of freezing over, another phenomenon made itself manifest. It was the appearance of a 'tidal' wave such as old settlers have observed at intervals of years. During the forenoon of Wednesday, March 21st [1888], in the slip at the Lembeek malt house, a wave came rolling in which raised the surface of the water fully two feet. It receded, returned but with less volume, and so continued until the water was again quiet. The [canal] boat *Capt. Henry Goss* was in the slip at the time loaded with 9500 bushels of barley. It was raised by the wave as if a shell, and dropped with such force on the recession of the water, that four ropes with which it was moored to the dock parted. It surged back with the wave over its length, grounding on the west bank of the slip, only to be sent forward far beyond where it had been tied by the second wave. The captain of the craft, Joseph Benson, has run on Seneca Lake for thirty years and never before had such an experience. The wave was witnessed by several men, connected with the malt house, and coal yard near by. It occurred at about the changing of the wind from south to north.

—Barbara Bell, Schuyler County Historian, 1982

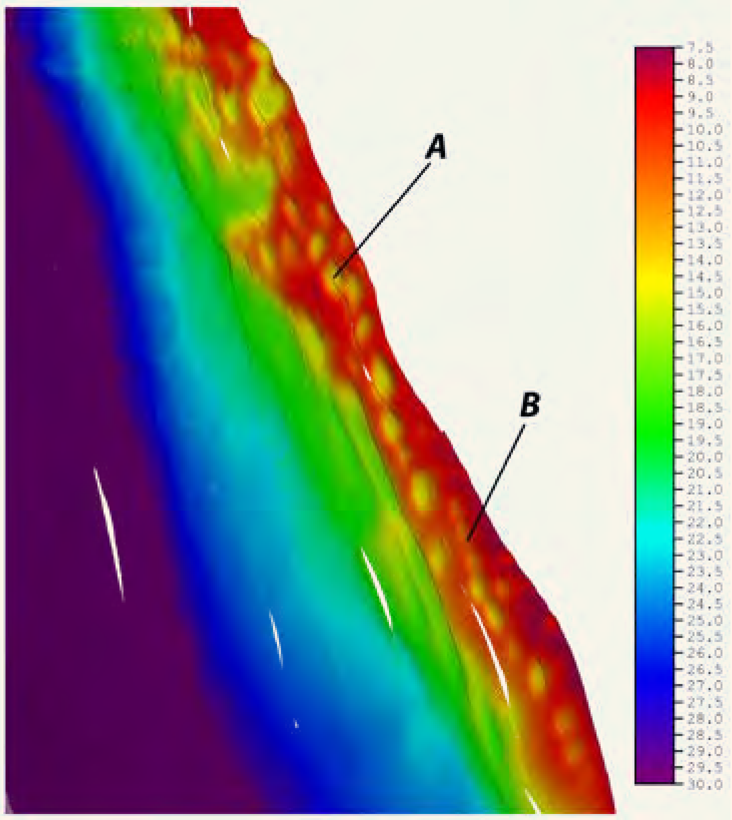


Figure 17. A string of pockmarks found along the southeastern portion of the survey. Image resolution is 0.5 m per pixel. The pockmarks have the appearance of several strings of beads. The depth of the shallow water (red) near the shore is 9.3 m (30 ft.) while the central depths of the pockmarks are reasonably consistent at 15.2 m (50 ft.) thereby providing an average depth of these features at 20 feet. For reference, the long and short axes of the pockmark labeled **A** are 41 m and 20m, respectively. Note the strong linear nature of these features as seen in the string of pockmarks defined by **B**.

Features known as pockmarks were also found in Seneca Lake. Pockmarks are circular to slightly oblate features that indicate the presence of either upwelling gases, water or both. If water or gas percolates upwards through the top sediment layers, the water/gas will carry some of the fine silts and clays into the water column. Once these particles are in the water column, they will be carried away from the upwelling zone by currents. After repeated upwelling episodes, the continual loss of sediment creates a localized depression. In Lake Champlain, these pockmarks range in diameters from just a few meters to over 30 meters and depths of a few centimeters to about six meters. Figure 17 provides an amazing example of a pockmark field discovered within a 1100-meter segment along the eastern shore of Lake Seneca. By using a color key that is specifically designed to enhance shallow water features, these pockmarks resemble strands of beads. Some of these are aligned linearly (B in Figure 17) while others tend to be aligned in a slightly curvilinear fashion. The linear alignment of pockmarks suggests the presence of geologic control such as a fracture or fault in the underlying strata. If true, water/gas would find a preferred pathway to escape to the surface.

Historically, bathymetric charts were important to prevent ships from colliding with shallow water outcrops or shoals. Figure 18 shows a newly-discovered shoaling of the waters on the eastern side of the lake as a rather long and sinuous (610 meter) ridge of a more resistant geologic layer. The composition of this layer is unknown at this time since no samples were taken from this ridge. Based on our current knowledge of the geologic strata in this region however, it may be composed of marl, a calcium carbonate or

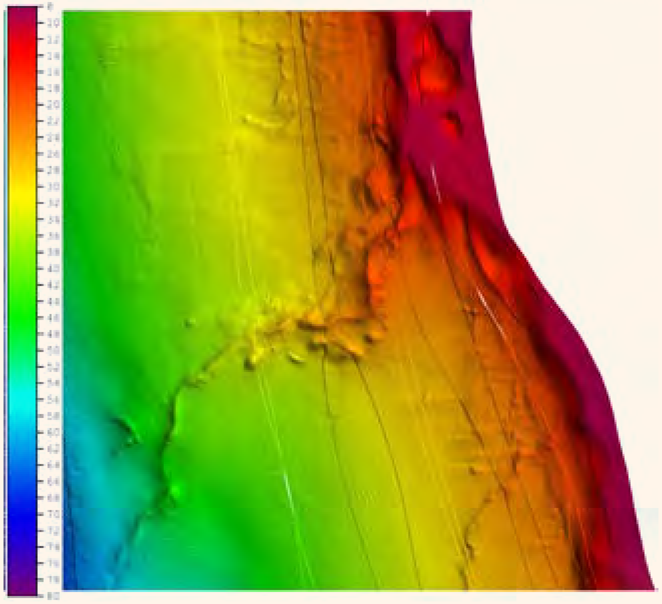


Figure 18. Subsurface ridge of more resistant material along the eastern shoreline. The length of the ridge is 610 m (nearly 0.4 mile). The image resolution is 0.6 m per pixel.

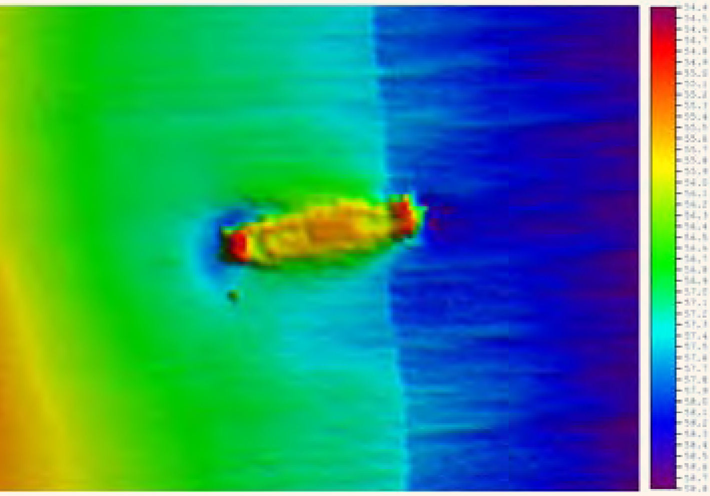


Figure 19. Target 4 at a depth of ~56 m. Image resolution is 0.5m per pixel. For scale the wreck is 24.5 m (~80 ft) long.

chalk-like rock with varying amounts of silt and clay within it. This would definitely be capable of inflicting damage to a ship if such an encounter occurred. Fortunately, in this observation, the maximum rise of this ridge above the local surrounding lake floor is 5.3 meters (17.4 feet), which is still too deep to affect ship traffic.

Multibeam systems have proven to be quite effective in finding underwater cultural heritage artifacts such as shipwrecks. **Figure 19** shows a shipwreck at a depth of approximately 56 meters (184 feet) with an object just south of its western edge that was most likely dislodged from the deck as it sank. Over time, currents can also scour and deposit sediments around shipwrecks, shown here as scouring on the top and left side of the wreck (blue colors) as well as the deposition of sediment along the bottom of the image (green colors). A small feature below the left end of the wreck could be dislodged cargo or a portion of the ship. **Figure 20** reveals a more intact shipwreck at 67 meters (220 ft) with its presumed bow at the top of the image and stern at the bottom. The wreck is closely aligned to bottom contours and while scouring and deposition of sediment is evident, it is to a lesser degree than shown in **Figure 19**.

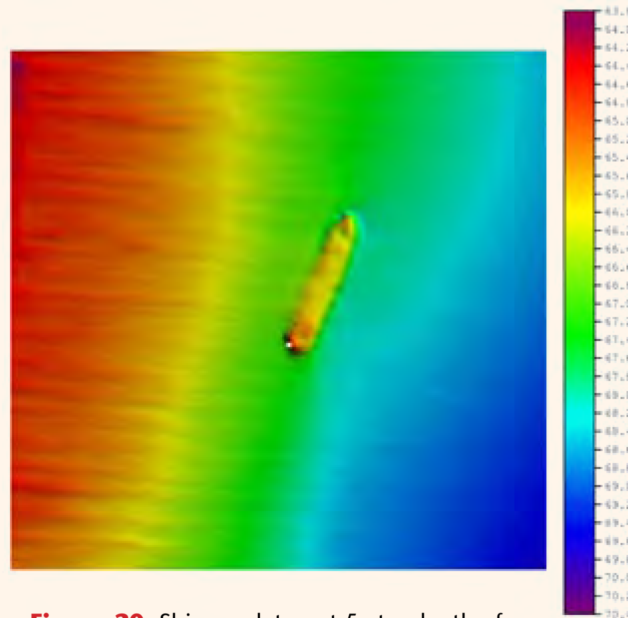


Figure 20. Shipwreck target 5 at a depth of 67m (220 ft). Image resolution if 0.75m per pixel. For scale the wreck is 24.6 m (~81 ft) long.

Located at a depth of nearly 80 meters (262 feet) is a pristine wreck of one of the longest (30 meters or 100 feet) canal barges yet observed in Seneca Lake **(Figure 21).** The large amount of small-scale and slightly elevated features around the wreck suggests that a significant amount of its cargo was dislodged as it sank. A slight depression on the top deck might indicate the presence of hatches, places where the cargo was dislodged or both. As with almost all other shipwrecks, sediment scouring is evident.

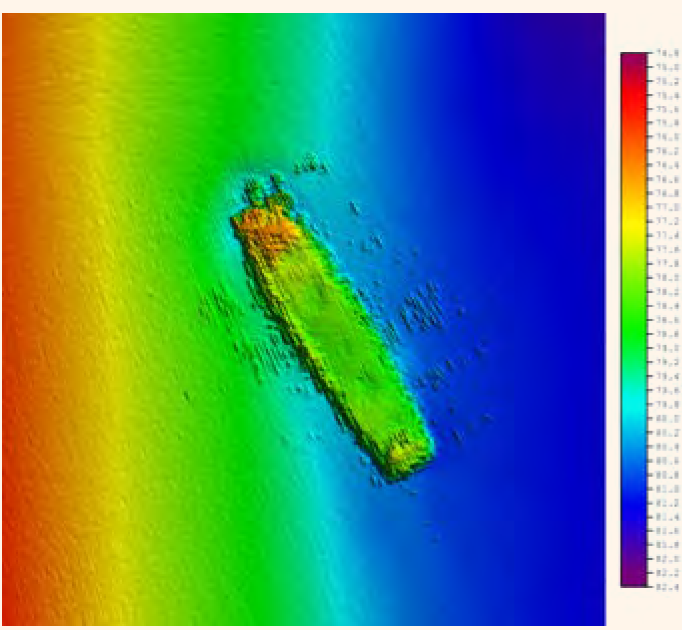


Figure 21. Wreck of an Enlarged Erie barge, target 12, along the western slope of the lake. Image resolution is much higher at 0.1 m per pixel. For scale the barge is 30.0 m (~100 ft) long.

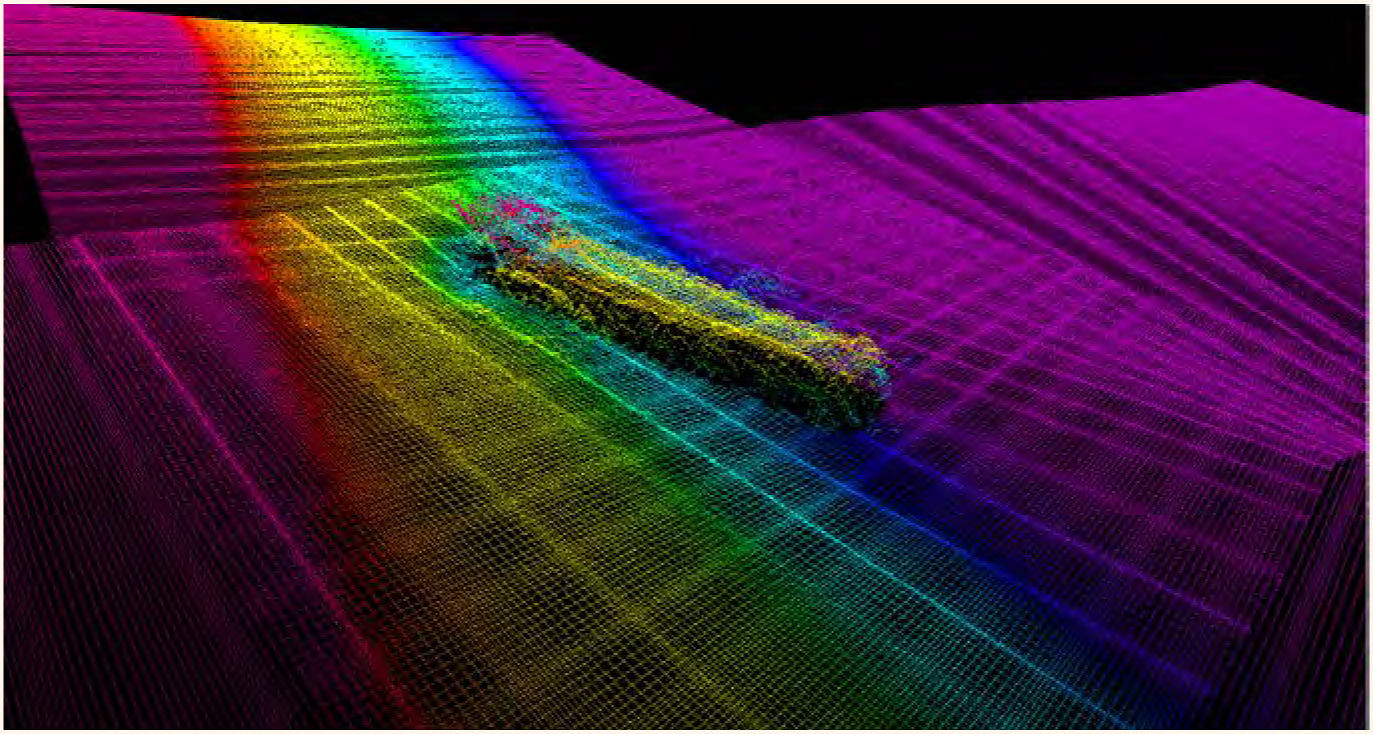


Figure 22. 3-D point-cloud view of the large barge, target 12, shown in Figure 21. Colors represent depth.

Figure 22 shows the same shipwreck in 3-D point-cloud representation. The point-cloud is an amalgamation of every depth point captured by the MBES while at this feature. In this case, the view is created from two orthogonal track lines that are each approximately one minute in duration. The total number of points in this image is well over 100,000. The beauty of this type of display is that it can provide significant additional information by being rotated, tilted and vertically exaggerated by the operator to gain a variety of perspectives of all sides of the target.

Figure 23 shows another long 29.2 meter (96 foot) shipwreck that is laying approximately 60° to the local bathymetric contours with its presumed bow pointing into deeper water. Strong scouring and deposition are evident along its perimeter and indicate the presence of relatively strong currents. The vessel is located at a depth of approximately 34 meters (112 feet). The rudder at the stern of the vessel also appears to be visible. The elevations along the deck of the ship show the raised sections of the stern and bow but also a drop of approximately one meter in a significant portion in its midship deck (i.e., going from red to green). While it is difficult to state exactly what this depicts without further investigation with an ROV, it could suggest that a portion of its cargo was dislodged when it sank or

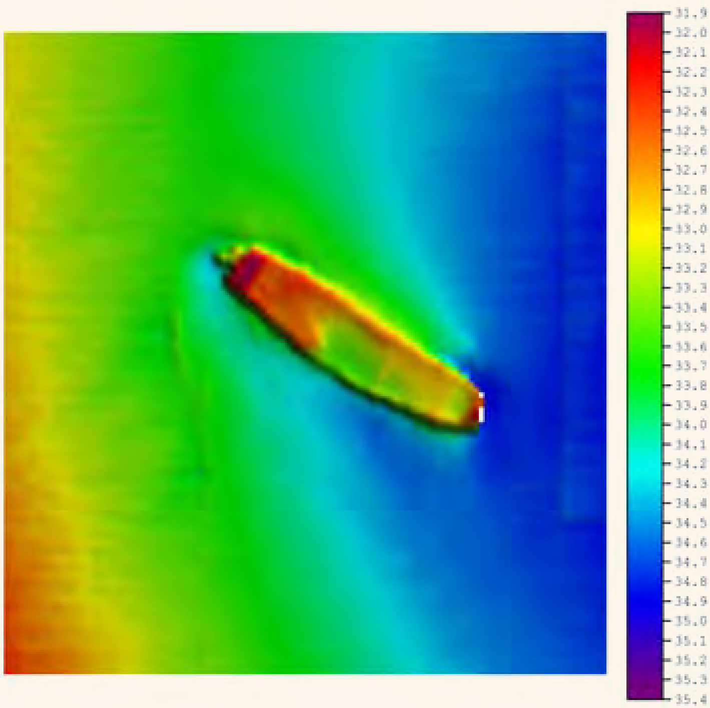


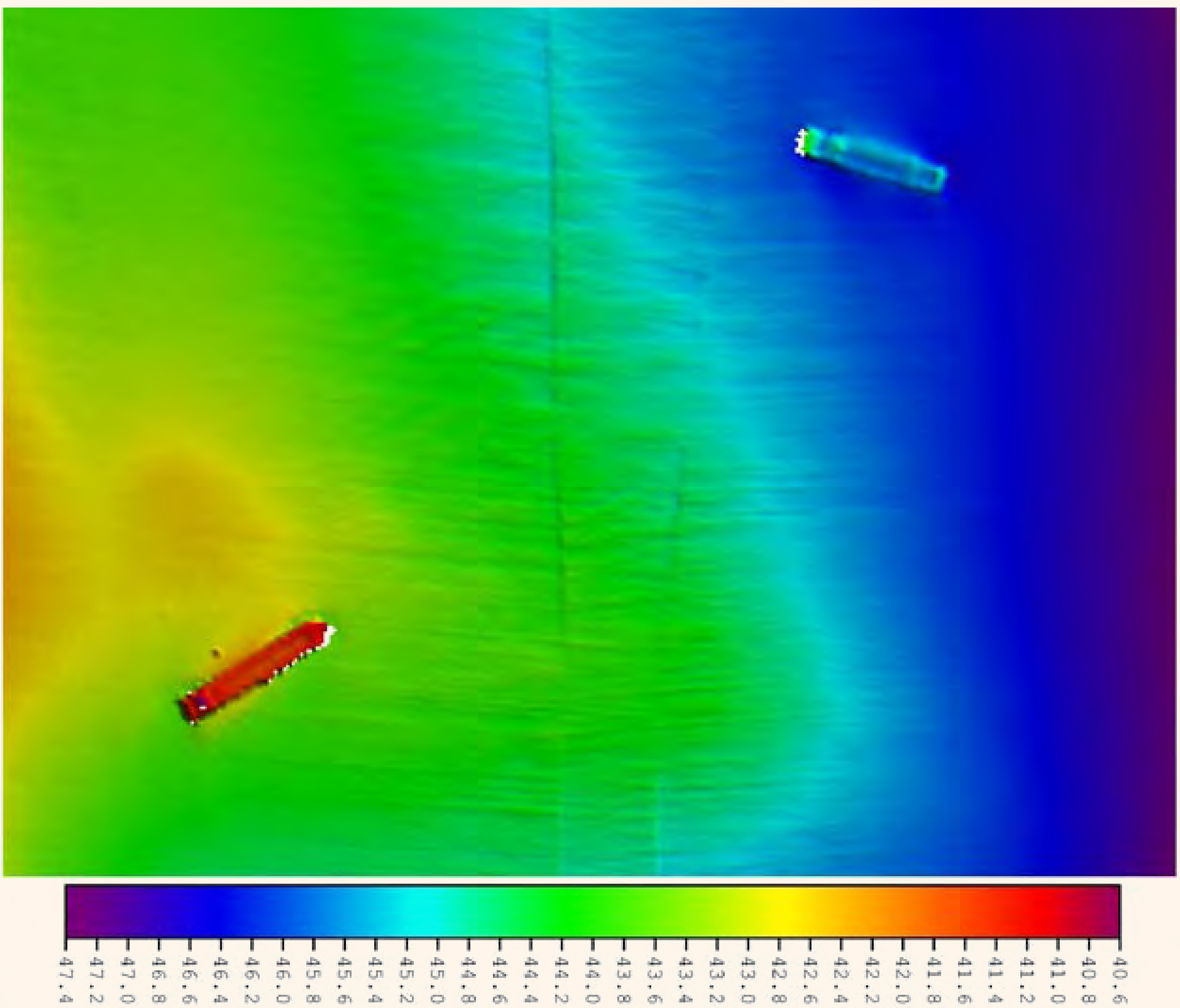
Figure 23. Shipwreck of target 9, a large, intact barge along the western side of the lake but in much shallower water (33 m or 112 ft). Image resolution is 0.5 m per pixel.

that there was no cargo there in the first place. The absence of debris around the wreck suggests the latter.

The last figure **(Figure 24)**, provides a view of two shipwrecks that are in close proximity to each other. The lower one, located at a depth of 43.2 meters (142 feet), is 28.2 meters long (93 feet) and intact. The indication that the wreck's elevation is consistent over the entire length of its main deck suggest that the shipwreck is in very good condition. The sonar image suggests that one small object (instead of many) is lying on the lake floor to the north side of the wreck. The shipwreck in the upper right is located in water that is three meters (about 10 ft.) deeper than its southern companion. It is also shorter by about four meters (13 feet) and appears to have no dispersed cargo lying on the lake floor. It does however appear to have been built with scow-shaped barge-ends rather than the traditional canal boat shape.

The use of modern multibeam sonar provides a state-of-the-art tool that with the same surveying effort can examine the deep, glacial Seneca Lake to create an inventory of underwater cultural resources, gather bathymetric data and gain basic knowledge of the geological processes. Working with the experienced Seneca Lake geologist Dr. John Halfman from Hobart and William Smith Colleges and Dr. Lewis McCaffrey from New York State's Department of Environmental Conservation, each season's survey effort will add to our understanding of Seneca Lake.

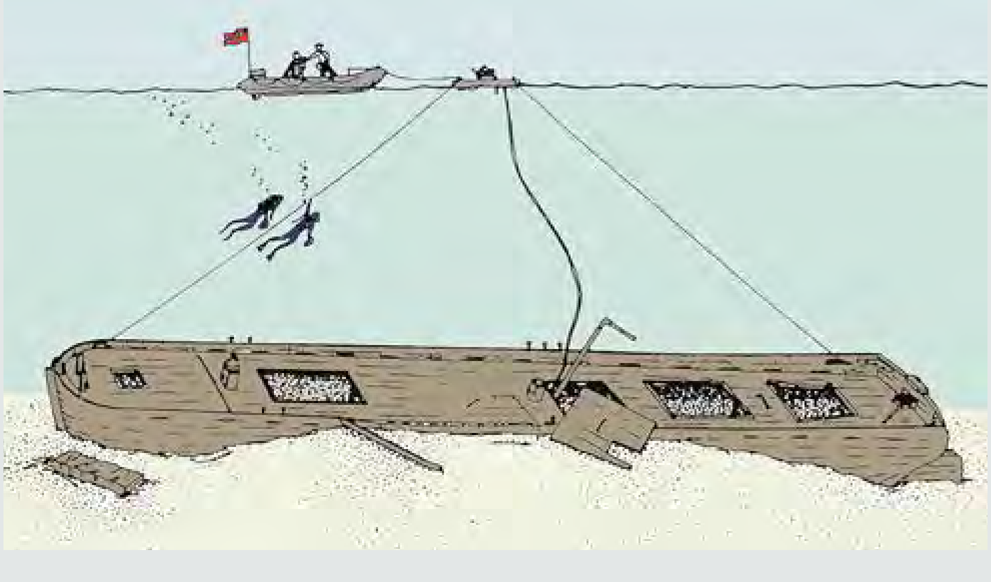
Figure 24. Two wrecks, target 2 below, and target 3 above, that are in close proximity with each other along the western side of the lake. Image resolution is 0.45 m per pixel.



CANAL SCHOONER *LOIS MCCLURE* ON SENECA LAKE

The canal schooner *Lois McClure* under sail on Seneca Lake and getting ready to host the public at the dock in Geneva in September 2018.

The Lake Champlain Maritime Museum (LCMM) research team has been studying canal boats in Lake Champlain for more than 30 years and has located and documented many examples. LCMM re-discovered the Lake Champlain sailing canal boat which resulted in a decade-long documentation and research effort that led to the publication of *Lake Champlain's Sailing Canal Boats* (2004). It also led to the construction of an exact replica of an 1862-class canal schooner which has traveled the still vibrant Erie Canal system and its interconnected waterways. Since the *Lois McClure's* launching in 2004, she and her companion tugboat *C.L. Churchill* have logged thousands of miles visiting hundreds of maritime communities, and hosted tens of thousands of visitors in a step back in time.



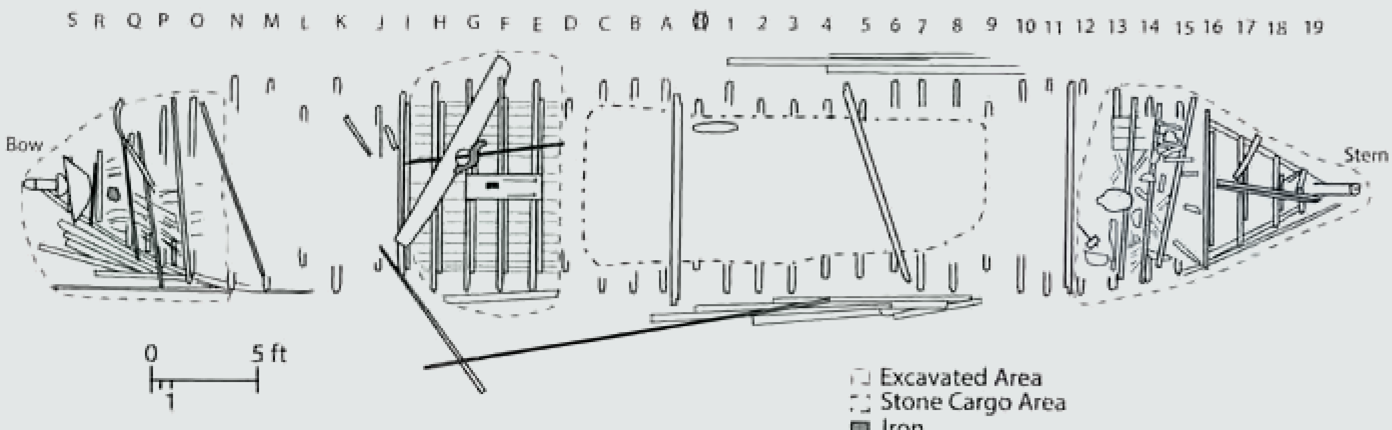
The *General Butler,* Lake Champlain. The principal model for the *Lois McClure* rests in 40 feet of water in Burlington Harbor and is part of the Lake Champlain Underwater Historic Preserve. Drawing by Kevin Crisman, LCMM

Durham Boat: Defining a Vernacular Watercraft Type

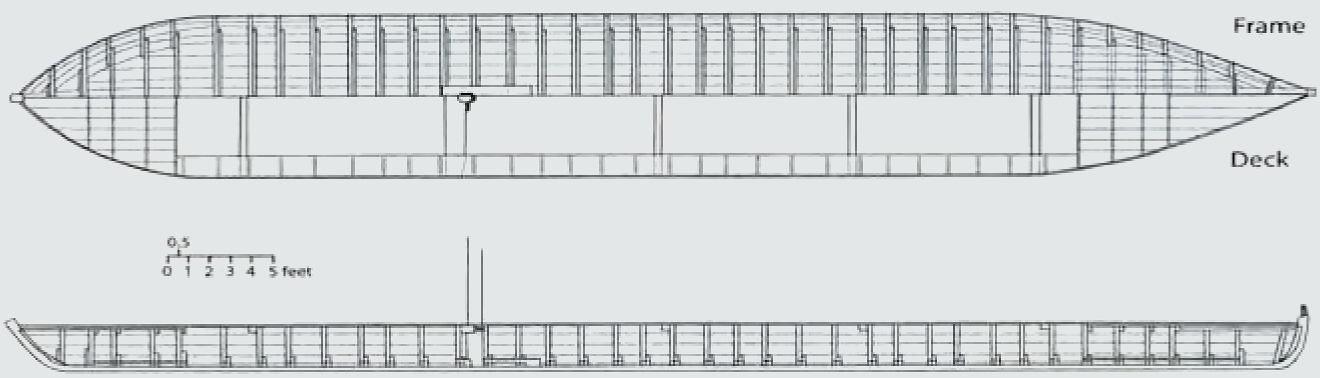
Durham boat on the Mohawk River, by J. Riley, 1810.

Durham boats were a vital part of eastern North American inland transportation during the 18th and 19th centuries and were instrumental in the economic development of the region. They were essentially unknown in the archaeological record until 2011 when Tim Caza discovered the remains of a 19th century shipwreck in Oneida Lake, NY, that closely resembled historical Durham boat descriptions. This discovery allowed for an archaeological analysis of this little known, pre-canal era watercraft. Tim Caza is also a principal contributor to the Seneca Lake Survey Project. The results were published in *Historical Archaeology,* September 12, 2018 by authors Ben Ford, Timothy Caza, Christopher Martin and Timothy Downing.

The freight-carrying vessels were long and narrow in order to navigate the shallow rivers of New York, Pennsylvania, New Jersey, Delaware, Ontario and even Wisconsin, allowing the development of iron, salt and agricultural industries. They are believed to have had a capacity of perhaps 20 tons, and are the type of boat that George Washington used to cross the Delaware River.



Site plan, Oneida Lake Durham boat. Drawing by Ben Ford, 2016



Reconstruction of the Oneida Lake Durham boat. The upper half of the upper image shows the boat at the level of the frames, the lower half shows the deck level. The lower image illustrates the boat as it would appear from the centerline looking toward starboard, Light gray lines indicate hull structure obscured by planks. Drawing by Ben Ford, 2016

Buffalo From the Lighthouse, 1825. Buffalo, on the eastern end of Lake Erie, was chosen as the intersection of the new canal and the Great Lakes. Here, larger sail and steam vessels from Lake Erie could exchange passengers and freight with the canal craft operating on the new canal. *Cadwallader Colden Memoir*, 1825. Clements Library

2017–2025 New York State Canal Bicentennial

The New York State Canal system Bicentennial Era officially began on July 4, 2017 and reflected back 200 years to when the first shovels of dirt were turned in Rome, NY. A gathering of canal enthusiasts met in Rome to signal the start of the celebration of the biggest and most successful public works project the state and nation had ever attempted. The ensuing eight years will offer canal advocates, interested communities and the public an opportunity to explore this remarkable accomplishment and the impact of the completed canal on the world of 1825. In Governor DeWitt Clinton's time, the completion of the new canal was celebrated with a public journey of the packet boat *Seneca Chief* carrying the Governor and dignitaries from Buffalo to New York City. The celebration culminated with the "Wedding of the Waters," the symbolic mixing of water brought from Lake Erie to the ocean. Vessel parades, numerous balls, parties and fireworks over City Hall signaled to 1825 society that a new era in travel had begun.

As the Bicentennial of this landmark event approached, many concepts on how best to commemorate the anniversary were discussed. One idea with broad support was the creation of a replica packet vessel that in 2025 will recreate the historic journey from Buffalo to New York City. As of this writing, it can be reported that the Buffalo Maritime Center, which has been engaged in maritime projects reflecting Buffalo's maritime heritage, has embarked on a project to build a replica packet boat in time for public programming in 2025.

Entrance to the Harbor, Lockport,1825, by George Catlin. The five double locks at Lockport were considered a marvel of engineering. This image captures that triumph while also presenting a three-horse powered packet boat heading west. *Cadwallader Colden Memoir*, 1825. Clements Library

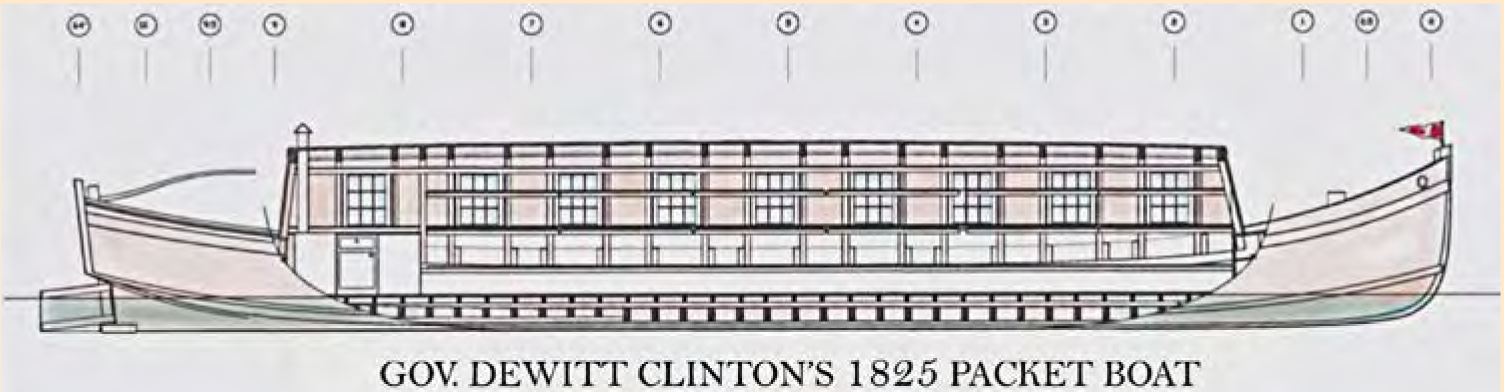
Lock Restoration at Lockport. One of the signature canal legacy projects has been the partial restoration of the flight of five locks at Lockport. As this report is being written, three of the five locks have been restored to operation. Some years ago, the Buffalo Maritime Center built a period boat to demonstrate how the locks were used to raise and lower vessels transiting the canal.

Exterior and interior architect's rendering of the "Longshed" that will house the Packet Boat Project. Erie Canal Harbor Development Corporation

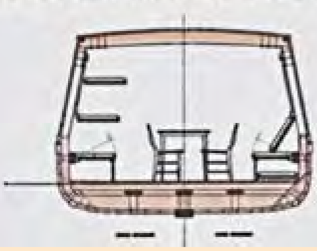
THE BUFFALO PACKET BOAT PROJECT

Buffalo's Canalside Waterfront Project has re-energized and transformed Buffalo Harbor into a vibrant public venue. Perhaps the most dynamic project to commemorate the 2025 formal culmination of the Canal Bicentennial calls for a "Longshed" to be built at Canalside near the previously restored entrance to the old Erie Canal. Here, in this five million dollar permanent structure, the Buffalo Maritime Center will construct a replica packet boat. The new vessel will be a focal point of interpreting the canal bicentennial and canal heritage to the public for years to come.

Envisioning the future of Canalside at Buffalo's Harbor (right).
Erie Canal Harbor Development Corporation



The Buffalo Maritime Center has embarked on an ambitious project to build a replica 1825 packet boat to interpret and commemorate the culmination of the New York State Canal Bicentennial in 2025. The ongoing Seneca Lake survey and research can assist in developing plans for the replica.

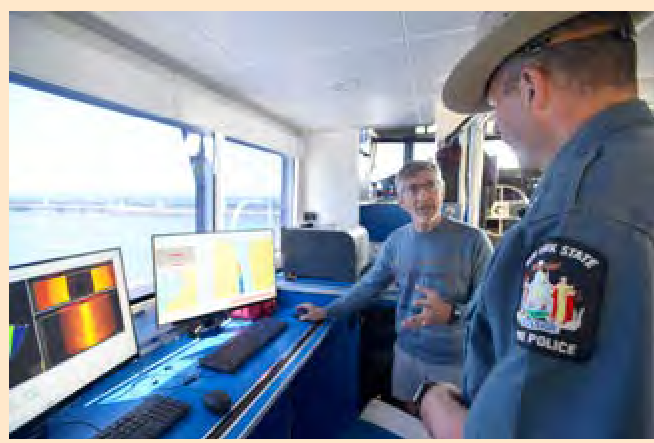


BUFFALO MARITIME CENTER

Tom Manley and Art Cohn and the rest of the survey crew providing a progress report for the community at the Romulus Town Office, July 2, 2019.

2019 Seneca Lake Survey Community Outreach Lectures

Schuyler County Historical Society Annual Meeting, April 25.
Canal Society of New York, Annual Meeting, Rochester, March 1.
Sampson State Park Marina Dedication, June 26.
Romulus Historical Society, July 2.
Seneca Lake Pure Waters Annual Meeting, August 3.
Finger Lakes Boating Museum, August 15.
Hudson River Maritime Museum, August 22.
Waterford Tugboat Roundup, September 7.
Schoharie Crossing NYS Park, September 24.
Chittenango Landing Canal Boat Museum, October 23.
Yates County Historical Society Annual Meeting, October 24.
Canal Society of NY Fall Meeting, Fayetteville, November 2.



Chief Scientist Tom Manley provides a technical orientation of the survey data-gathering equipment to a NYS Park Police officer.

Who Gets Access to Historic Shipwrecks?

Seneca Lake divers are being oriented to preserve and protect these public resources. Rob Parker, Finger Lakes Underwater Preservation Association

In recent years, states have followed the Abandoned Shipwreck Act of 1987 guidelines to provide reasonable access to selected underwater sites by opening "underwater parks" for recreational divers. Divers are encouraged to dive safely and to enjoy and learn from selected historic shipwrecks. Seneca Lake has experimented with several dive sites at its southern end and the NYS Underwater Blueway Trail initiative is exploring the feasibility of expanding this access. Recent developments in technology have also permitted some jurisdictions, like Lake Champlain, to provide the non-diving public with access to historic shipwrecks in real-time through the use of ROVs.

1837.

NEW-YORK AND HAMMONDSPORT

LINE OF LAKE BOATS.

The Proprietor of this line will commence running regularly on the opening of navigation between the cities of New-York and Hammondsport, a Line consisting of LAKE BOATS.

The Boats will be towed on the Hudson by steam boats [illegible] first capacity, and by relays of horses on the Canal.

The [illegible]vantage [illegible] having a line of Lake Boats [illegible] of public [illegible] [illegible]ave the delay and other inconv[illegible] iences of a re-sh[illegible] [illegible]bany.

The utmost exer[illegible] [illegible] used by the proprietor and agents of the line to meri[illegible] [illegible]blic patronage.

Experienced and [illegible] [illegible]asters w[illegible] [illegible]ved to run the boats.

A. M. ADSIT, *Proprietor*

For Freight or Passage, apply to [illegible] [illegible]lowing Agents:
M. L. KEITH, *No. 8 South st., New-York;*
LYMAN ROOT, *Albany;*
Or [illegible] the Proprietor at *Hammondsport.*

1837. NEW-YORK AND HAMMONDSPORT LINE OF LAKE BOATS. Courtesy of Mr. Craddoch and the Steuben County Historical Society

All of the Finger Lakes have Archaeological Potential

While the Seneca Lake Survey was focused on the largest and deepest of the eleven lakes collectively known as the Finger Lakes, it is clear that this survey could be repeated in all of these lakes. The survey has, we believe, effectively demonstrated that the resulting inventory of submerged historic watercraft used in central New York would add significant information to the region's historical record. The submerged cultural resources also enhance of knowledge of regional economics, social networks and technology. The Erie Canal bicentennial period adds incentive to our timely understanding of our heritage.

Related efforts involving underwater cultural heritage:

- A Finger Lakes Region National Heritage Corridor Feasibility Study has recently begun.
- The National Oceanographic and Atmospheric Administration is studying the establishment of a new National Maritime Sanctuary program on Lake Ontario.

Acknowledgments

The 2019 Survey Team Members
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Matt Harrison, Chris Sabick, Craig Williams, Peg Ellsworth, Jonathan Eddy and Art Cohn.

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The Canal Society of New York State, Schuyler County Historical Society, Geneva Historical Society,
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Special Thanks
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Special recognition is due the late Dr. Robert Hagar, a tireless student of canal boats.
His manuscript in the collection of Chittenango Landing Canal Boat Museum was an invaluable resource.

Significant contributions to this report were made by
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Kirk House, Steuben Historical Society; Mark Peckham, New Baltimore; Duncan Hay, Waterford;
John Callaghan, Waterford; Paul Schneider, Jr., Saratoga Springs; Derrick Pratt, Erie Canal Museum, Syracuse;
Ole Varmer, NOAA Office of General Counsel; and my special friends and research partners,
Jean Belisle, Montreal, PQ; Kevin Crisman, Institute of Nautical Archaeology;
and J. Kevin Graffagnino, Director, William L. Clements Library.

(above and previous page)
Detail from Cadwallader D. Colden, *Memoirs* *prepared at the Request of the Committee of Common Council of the City of New York, 1825.*
William L. Clements Library, University of Michigan

1825 - 2025

In the fall of 1825, the Erie Canal officially opened. Its ability to move people and goods was so superior to existing transportation systems, it surprised even its more ardent supporters and triggered an explosion of commerce, migration and societal growth.

As we approach the 200th anniversary of the Erie Canal's completion in 2025, the discovery of a remarkable collection of intact, "Original Erie" canal boats on the bottom of Seneca Lake reveals a new understanding of a time when bold visions and tireless problem solving overcame seemingly insurmountable challenges. 2025 provides an opportunity for celebration and reflection about the past, present, and future of the living legacy that is the Erie Canal.

Art Cohn, Principal Investigator ⚓ arthurbcohn@gmail.com ⚓ May 29, 2020

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