

## LESSON PLAN:

# A Walk Across the Bottom of Seneca Lake

## OVERVIEW:

Students will examine research from the Seneca Lake Archaeological & Bathymetric Survey to understand the Erie Canal artifacts and the invasive quagga mussels found in the lake.

**Grade Level:** 6-8

**Class Periods:** Three to five 45-minute lessons with an optional project

## ESSENTIAL QUESTIONS:

- What are invasive species?
- What are quagga mussels?
- What impact do quagga mussels have on shipwrecks discovered in Seneca Lake?

## OBJECTIVES:

- Students will be introduced to the research done by the Seneca Lake Survey Project team.
- Students will understand invasive quagga mussels.
- Students will understand the impact invasive quagga mussels have on the deep-water artifacts in Seneca Lake.

## MATERIALS NEEDED:

- Computer with internet
- Student worksheets
- If you choose to have your students do the optional project, they will need a slide presentation application (Google Slides, Microsoft PowerPoint, etc.)

## LESSON PLAN ACTIVITIES:

- **Activity 1:** Picture Walk
- **Activity 2:** Investigate
- **Activity 3:** Packet Boats
- **Activity 4:** Quagga Mussels

## NEW YORK STATE EDUCATION STANDARDS:

### SCIENCE STANDARDS

- **MS. Matter and Energy in Organisms and Ecosystems**
  - **MS-LS2-1**—Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
  - **MS-LS2-4**—Construct an argument supported by empirical evidence that changes to physical and biological components of an ecosystem affect populations.

# Teacher Procedure & Answer Keys

## ► ACTIVITY 1: Picture Walk

### INFORMATION AND INSTRUCTIONS

Using images of artifacts on the bottom of Seneca Lake, take students on a “picture walk” to see what they find and record their discoveries.

1. Divide students into small groups.
2. Provide **Worksheet 1: Picture Walk** to students and have students discuss the images in a free form discussion.
3. Have students discuss and answer questions on the worksheet.

## ► KEY > WORKSHEET 1: Picture Walk

### KEY FOR IMAGES

- |  |   |
|--|---|
| A. ROV image of Target 7                 | B. Target 7, Pantry, Stern Cabin, Port Side           |
| C. Target 7, Looking AFT from Rear Cabin | D. Target 7, Passenger Cabin Interior                 |
| E. Target 7, Stern and Rudder            | F. Target 7, Woodstove Heavily Encrusted with Mussels |

*All Images Courtesy: Tim Caza & Dennis Gerber and the Seneca Lake Survey Project.*

1. What do you think these are pictures of?
  - *Shipwrecks*
2. Where do you think these pictures were taken?
  - *Seneca Lake*
3. How do you think these pictures were taken?
  - *Remote operated vehicles used during underwater archeological survey*
4. Who do you think took these pictures?
  - *Underwater archeologists*
5. What are your questions when you look at these pictures? What are you left wondering? What do you want to know?
  - *How old are the shipwrecks?*
  - *What types of boats were found?*
  - *How did the boats sink?*
6. Do you think there is anything in these pictures that might present a problem or concern? If so, explain.
  - *Something is covering the boats which might damage them*

SECTION 1: **TEACHER PROCEDURE & ANSWER KEYS**

---

**► ACTIVITY 2: Investigate****INFORMATION AND INSTRUCTIONS**

Students will create a hypothesis about artifacts found in Seneca Lake and conduct independent research about the Erie Canal.

1. Provide students with this clue about the pictures:  
*The pictures were taken on the bottom of Seneca Lake in New York State.*
  2. Have students write a hypothesis about what they see covering the shipwrecks in the pictures on **Worksheet 2: Investigate, Part 1 Hypothesis.**
  3. Instruct students to conduct online research to determine what the pictures are and try to figure out why the artifacts are covered in clusters of objects. Tell them to think like detectives and investigate. Along with queries using words from the previous clue, direct students to research *invasive species in Seneca Lake.*
  4. Have students complete **Worksheet 2: Investigate, Part 1 Hypothesis and Part 2 Vocabulary and Research.** Review answers as a class after students complete.
- 

**► KEY > WORKSHEET 2: Investigate****HYPOTHESIS:**

**What do you think is covering the objects seen in the images from the Picture Walk?**

- *They are covered by quagga mussels which are an invasive species*

**Was your hypothesis correct?**

- *yes or no based on individual student responses*

**What new information did you discover?**

- *What the Erie Canal is*
- *What packet boats were*
- *What invasive species and quagga mussels are*
- *Quagga mussels are damaging to shipwrecks*



## SECTION 1: TEACHER PROCEDURE & ANSWER KEYS

### VOCABULARY:

**Artifact**—objects that are made, used, or modified by humans and give us information about life in the past.

**Erie Canal**—an artificial, or human-made, waterway in New York connecting the Hudson River to Lake Erie.

**Invasive Species**—an organism that causes ecological or economic harm in a new environment where it is not native.

**Packet Boat**—passenger boats which traveled on the Erie Canal and could accommodate 40 to 60 people.

**Quagga Mussels**—filter-feeding, freshwater, bivalve mollusks.

### RESEARCH:

**1. Where is the Erie Canal?**

- *Upstate New York. The original canal ran from the Hudson River at Albany to Lake Erie at Buffalo*

**2. What year did the New York State Legislature authorize construction of the Erie Canal?**

- *1817*

**3. What year did the Erie Canal fully open to traffic?**

- *1825*

**4. What was the name of the New York Governor who promoted the construction of the Erie Canal?**

- *DeWitt Clinton*

SECTION 1: **TEACHER PROCEDURE & ANSWER KEYS****► ACTIVITY 3: Packet Boats****INFORMATION AND INSTRUCTIONS**

Using information from the Seneca Lake Survey project, students will learn about Erie Canal packet boats and the significant findings made by the Survey team.

1. Introduce and explain the following:  
The Seneca Lake Archaeological & Bathymetric Survey Project is a geological study of the landscape at the bottom of Seneca Lake, as well as an investigation of any discovered artifacts that lie beneath the water. In 2018 the project was organized, and as of the date of this writing, the investigation continues. The team has discovered many shipwrecks dating back to the 1800s that were used for travel and commerce on the New York State Canal System. One of the most significant finds is of an Erie Canal packet boat, which is believed to be the first archaeological example of this type of boat to be discovered.
2. As a class, read the excerpt "Packet Boats" from page 76 of the *Seneca Lake Archaeological & Bathymetric Survey*, 2019 Final Report on **Worksheet 3: Packet Boats**. Students may also want to read about the Buffalo Maritime Center's Packet Boat Project <https://buffalomaritimecenter.org/packetboat/>.
3. After reading the excerpt, have students answer the corresponding questions on **Worksheet 3: Packet Boats**. Discuss answers as a class.

**► KEY > WORKSHEET 3: Packet Boats**

1. What were packet boats?
  - *Passenger boats which carried travelers on the Erie Canal*
2. What was the name of the packet boat used in October 1825 to celebrate the opening of the Erie Canal?
  - *Seneca Chief*
3. How many passengers could a packet boat typically carry?
  - *40-60*
4. How fast did packet boats travel on the Erie Canal?
  - *4 mph*
5. Why do you think the discovery of a packet boat by the Seneca Lake Survey team is important?
  - *Only one known to have been discovered*
  - *Tells us about how people traveled on the Erie Canal in the 1800s*

SECTION 1: **TEACHER PROCEDURE & ANSWER KEYS**

---

**► ACTIVITY 4: Quagga Mussels****INFORMATION AND INSTRUCTIONS**

Students will learn about invasive quagga mussels in Seneca Lake and the impacts they have on historic shipwrecks.

1. Introduce and explain the following:  
Quagga mussels are an invasive species which were first observed in Seneca Lake in the 1990s. They are considered invasive because of their potential to cause economic and ecological damage to Seneca Lake.
  2. Have students read the fact sheet [http://fingerlakesinvasives.org/wp-content/uploads/2014/01/Factsheets\\_Quagga.pdf](http://fingerlakesinvasives.org/wp-content/uploads/2014/01/Factsheets_Quagga.pdf) about quagga mussels and answer corresponding questions on **Worksheet 4: Quagga Mussels, Part 1 Fact Sheet.**
  3. Introduce and explain the following:  
Quagga mussels have been observed on all shipwrecks discovered by the Seneca Lake Survey team. Previous studies of shipwrecks in other lakes show that quagga mussels damage the iron fastenings which hold the wooden boats together.
  4. Have students analyze the images and answer corresponding questions on **Worksheet 4: Quagga Mussels, Part 2 Quagga Mussels and Shipwrecks.**
  5. At the conclusion of the lesson, have students return to their hypothesis on **Worksheet 2: Investigate** and answer the final questions.
- 

**► KEY > WORKSHEET 4: Quagga Mussels****PART 1—FACT SHEET**

1. **What are quagga mussels?**
  - *filter-feeding, freshwater, bivalve mollusks*
2. **What type of habitat do quagga mussels prefer?**
  - *freshwater habitats up to depths of 90 ft., attaching to most surfaces including sand, silt and hard substrates*
3. **How are quagga mussels commonly spread?**
  - *through fishing and boating equipment*
4. **What steps can be taken to help prevent quagga mussels from spreading?**
  - *cleaning, draining, and drying boats and other aquatic equipment before moving to another water body*

**SECTION 1: TEACHER PROCEDURE & ANSWER KEYS****PART 2—QUAGGA MUSSELS AND SHIPWRECKS**

These images were taken of the same shipwreck which sunk in Lake Ontario. The first image was photographed in 1982, before quagga mussels were observed in the lake. The second image was photographed in 2008.

**How did the condition of the shipwreck change from 1982 to 2008?**

- *Quagga mussels on the shipwreck increased significantly*

**This image was taken in 2019 by the Seneca Lake Survey team of an Erie Canal packet boat. Considering your observations from the previous images, how might the condition of the packet boat shipwreck be different if it were photographed again in 20 years?**

- *There would be more quagga mussels present*



## SECTION 1: TEACHER PROCEDURE & ANSWER KEYS

### ► EXTENSION ACTIVITY

#### **DIRECTIONS:**

Ask students to prepare a slide presentation about the content discussed and what they discovered. Students will present to the class once completed.

#### **Presentation Outline Guidelines:**

Students may find it helpful to follow the general guideline below while constructing their slide presentation.

#### **Slide #1—**

*Title Slide*—Title, student name, date, class name, picture of topic content.

#### **Slide #2**

*Introduction Slide*—Introduce the Seneca Lake Survey Project. What do you find most interesting about the work being done?

#### **Slide #3**

*The Erie Canal and Packet Boats*—What new information have you learned?

#### **Slide #4**

*Seneca Lake Survey Project shipwreck discoveries*—Why are these discoveries significant? What additional questions do you have about them?

#### **Slide #5**

*Quagga Mussels*—What information have you learned about quagga mussels and invasive species, in general? What are their impacts on the environment and shipwrecks? What are the best methods of preventing and managing the spread of invasive species?

#### **Slide #6**

*Preserving Shipwrecks*—Why is it important to study shipwrecks? What information have you learned by studying the findings from the Seneca Lake Survey? What additional information would you like to know?

#### **Slide #7**

*Sources Slide*—List all the sources used to make this slide presentation.





## SECTION 1: TEACHER PROCEDURE & ANSWER KEYS

### ► SOURCES

#### PUBLICATIONS:

Cohn, Art, Principal Investigator and Dr. Tom Manley, Chief Scientist. *Seneca Lake Archaeological & Bathymetric Survey*, 2019 Final Report. Published June 2020. [https://americancanalsociety.org/wp-content/uploads/2020/12/Seneca\\_Lake\\_Survey\\_2019\\_ONLINE\\_VERSION.pdf](https://americancanalsociety.org/wp-content/uploads/2020/12/Seneca_Lake_Survey_2019_ONLINE_VERSION.pdf)

#### WEBSITES:

<https://buffalomaritimecenter.org/packetboat/>

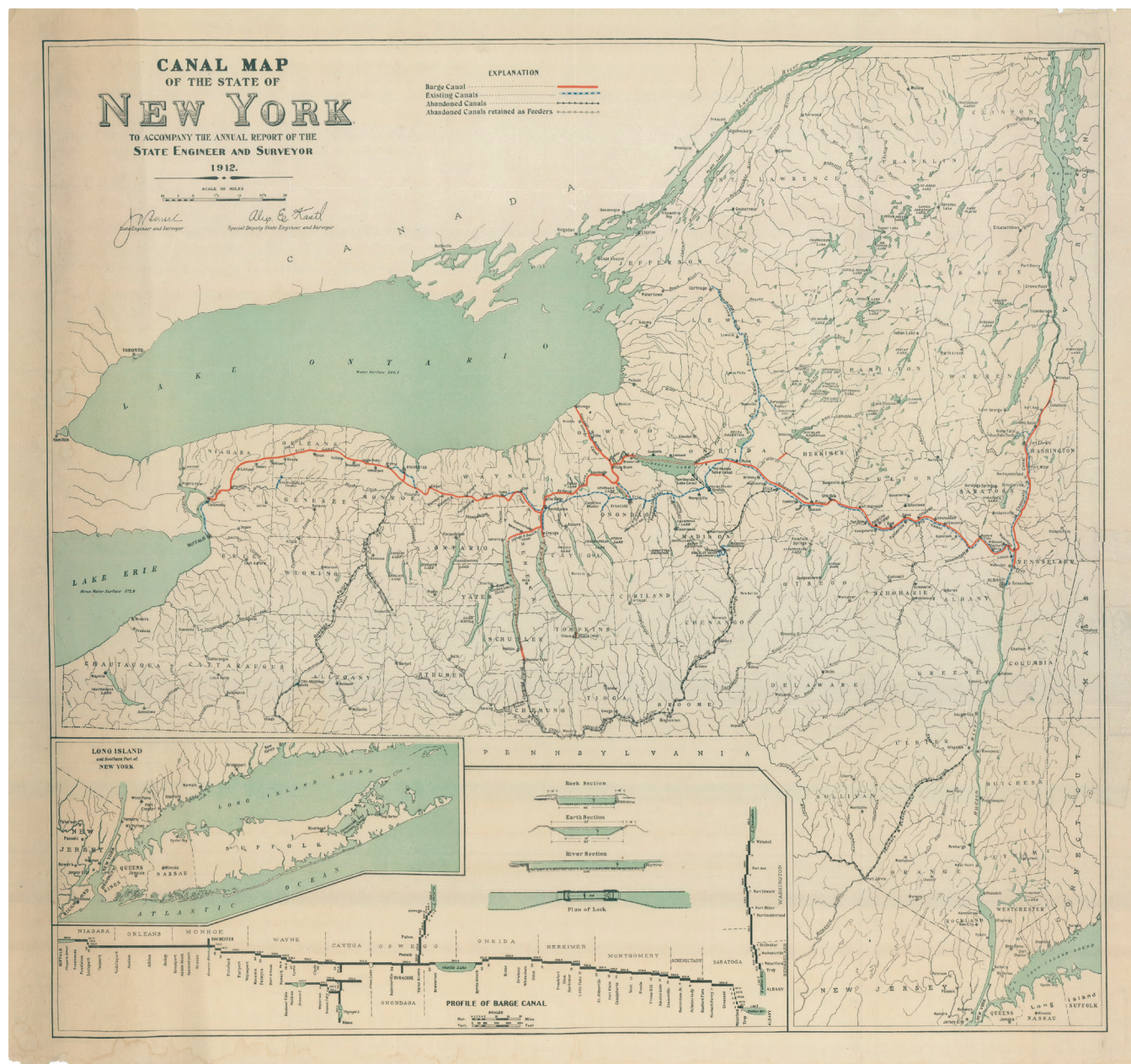
<https://hws.app.box.com/s/5k4z49wv21ntq6es5nliop8v0ewhh7pz>

<https://www.nwf.org/Educational-Resources/Wildlife-Guide/Threats-to-Wildlife/Invasive-Species>

[https://nyis.info/invasive\\_species/zebra-and-quagga-mussel/](https://nyis.info/invasive_species/zebra-and-quagga-mussel/)

[https://www.wnyprism.org/invasive\\_species/quagga-mussel/](https://www.wnyprism.org/invasive_species/quagga-mussel/)

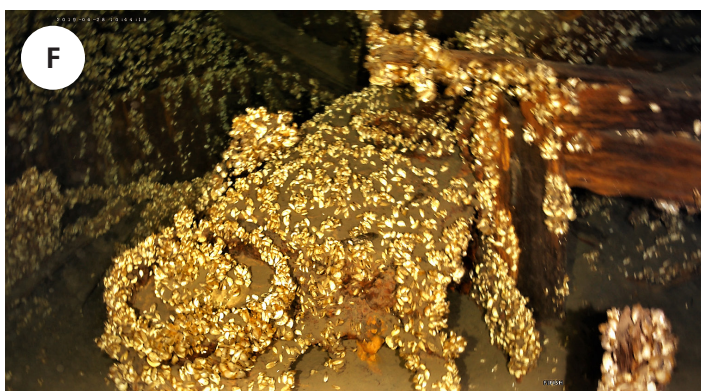
## Student Worksheets





NAME \_\_\_\_\_

## ► WORKSHEET 1: Picture Walk



All Images Courtesy: Tim Caza & Dennis Gerber and the Seneca Lake Survey Project.



► **WORKSHEET 1: PICTURE WALK**

1. What do you think these are pictures of?

---

---

2. Where do you think these pictures were taken?

---

---

3. How do you think these pictures were taken?

---

---

4. Who do you think took these pictures?

---

---

5. What are your questions when you look at these pictures? What are you left wondering?  
What do you want to know?

---

---

---

6. Do you think there is anything in these pictures that might present a problem or concern?  
If so, explain.

---

---

---

---



NAME \_\_\_\_\_

## ► WORKSHEET 2: Investigate

### PART 1—

**DIRECTIONS:** Read the definition of “hypothesis”. Write your answer to the prompt below. Discuss your thoughts with your group before writing your hypothesis. At the end of the lesson, you will return to the hypothesis that you have written on this page to determine if your hypothesis was correct.

**HYPOTHESIS**—a proposed explanation made based on limited evidence as a starting point for further investigation.

#### 1. Why do you think the artifacts in the pictures are covered with clusters of items?

---

---

(To be completed at the end of the lesson)

#### 2. Was your hypothesis correct?

---

#### 3. What new information did you discover?

---

---



► **WORKSHEET 2: INVESTIGATE**

**PART 2—VOCABULARY**

**DIRECTIONS:** Research the following terms and provide definition for each.

1. **Artifact** \_\_\_\_\_

\_\_\_\_\_

2. **Erie Canal** \_\_\_\_\_

\_\_\_\_\_

3. **Invasive Species** \_\_\_\_\_

\_\_\_\_\_

4. **Packet Boat** \_\_\_\_\_

\_\_\_\_\_

5. **Quagga Mussels** \_\_\_\_\_

\_\_\_\_\_



► **WORKSHEET 2: INVESTIGATE**

**PART 2—RESEARCH**

**DIRECTIONS:** Conduct research to answer the following questions.

**1. Where is the Erie Canal?**

---

---

**2. What year did the New York State Legislature authorize construction of the Erie Canal?**

---

**3. What year did the Erie Canal fully open to traffic?**

---

**4. What was the name of the New York State Governor who promoted the construction of the Erie Canal?**

---



NAME \_\_\_\_\_

## ► WORKSHEET 3: Packet Boats

### DIRECTIONS:

Read the following excerpt about packet boats from the *Seneca Lake Archaeology & Bathymetric Survey 2019* Final Report.

#### 1. What were packet boats?

---

---

---

---

---

#### 2. What was the name of the packet boat used in October 1825 to celebrate the opening of the Erie Canal?

---

---

---

### 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.

#### 3. How many passengers could a packet boat typically carry? \_\_\_\_\_

#### 4. How fast did packet boats travel on the Erie Canal? \_\_\_\_\_

#### 5. Why do you think the discovery of a packet boat by the Seneca Lake Survey team is important?

---





NAME \_\_\_\_\_

## ► WORKSHEET 4: Quagga Mussels

### DIRECTIONS:

Read the fact sheet [http://fingerlakesinvasives.org/invasive\\_species/quagga-mussel/](http://fingerlakesinvasives.org/invasive_species/quagga-mussel/) about quagga mussels to answer the questions.

### PART 1—FACT SHEET

1. What are quagga mussels?

---

---

2. What type of habitat do quagga mussels prefer?

---

---

3. How are quagga mussels commonly spread?

---

---

4. What steps can be taken to help prevent quagga mussels from spreading?

---

---

## ► WORKSHEET 4: QUAGGA MUSSELS

### PART 2—QUAGGA MUSSELS AND SHIPWRECKS

These images were taken of the same shipwreck which sunk in Lake Ontario. The first image was photographed in 1982, before quagga mussels were observed in the lake. The second image was photographed in 2008.



*An anchor from the Hamilton photographed in 1982.*

Courtesy: City of Hamilton, Ontario



*An anchor from the Hamilton photographed in 2008.*

Courtesy: City of Hamilton, Ontario

**How did the condition of the shipwreck change from 1982 to 2008?**

---



---

This image was taken in 2019 by the Seneca Lake Survey team. It is a compartment inside the sunken packet boat that the team discovered.



*Image of an Erie Canal packet boat photographed in 2019.*

Courtesy: Tim Caza & Dennis Gerber and the Seneca Lake Survey Project

**Considering your observations from the previous images, how might the condition of the packet boat shipwreck be different if it were photographed again in 20 years?**

---



---



---



---



---