

MILITARY GEOLOGY OF THE BATTLE OF SACKETT'S HARBOUR (28 MAY 1813), LAKE ONTARIO, NY

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INTRODUCTION

Geology has shaped warfare since its inception; however, it was not until the end of the 18th century that geologists shaped warfare (cf., Guth, 1998; Kiersch and Underwood, 1998). For thousands of years, the idea that a hilltop position or fortification would provide the tactical advantage was considered “common sense.” Those who held the high ground were more likely to survive the fight and promulgate their ideals and to prosper. With the inception of the discipline of geology, these common-sense notions were turned into well-thought and planned military-geology strategies. There are many examples of the science of geology dictating tactical and strategic outcomes in war, from Napoleon’s invasion of Egypt (1798) to recent counterinsurgency operations in Afghanistan (Stewart, 2014).

For the Battle of Sackett’s Harbour (1813), engineer siting of Fort Tompkins and anticipated defense of the mainland by Brigadier General Brown, New York Militia were “common-sense” approaches to dealing with the tactics of the day. For this field trip, we propose to highlight these “common-sense” notions as geological controls on the battle. If it were not for the inadvertent recognition of geological processes at the main naval base on Lake Ontario, this United States tactical victory would have allowed the United Kingdom complete control of Lake Ontario and their primary supply route, the St. Lawrence River.

Portions of this field trip are the result of Ross Klepetkos’ senior project (2011) at St. Lawrence University where he synthesized his love of history with geology. The purpose of this trip is to provide an enjoyable recounting of the Battle of Sackett’s Harbour (1813) by following the path of the advancing British Regulars while highlighting the local geology and its unintended controls on the battle. Had the geology of Sackett’s Harbour been different, there would have been no rebounded cliff, spit and protected harbor, tombolo and island—no naval stronghold and no battles—no Sackett’s Harbour.

WAR OF 1812

In the short, but rich history of the United States of America, the War of 1812 (1812-1815) is often a forgotten conflict in the midst of the American Revolutionary War (1775-1783) and the War Between the States (1861-1865). Considering the wide geographic reach of the War of 1812, from the Battle of New Orleans to the burning of the White House and naval skirmishes off the coast of South America, it is odd that it would be “forgotten.”

President James Madison signed Congress’ official declaration of war against the United Kingdom on June 18th, 1812 as the result of 1) imposed trade restrictions with France (the UK was involved in the Napoleonic Wars), 2) UK impressment of US sailors, 3) UK support of native tribes against US westward expansion and 4) possible insults to national honor on the high seas and potential annexation of Canada to the USA (Latimer, 2010). Politicians in Washington City were of the mind that the USA could win a quick victory by an easy capture of British Canada; thereby, making British acquiesce to demands before she could send troops to take action (Katcher and Fosten, 1990). This, of course, was not the case. Instead, the war was fought on both sides with military incompetence and internal dissent leading to over 6,700 US casualties and over 5,200 UK casualties at the cost of approximately \$105 million (£25 million) or, in today’s values, approximately \$1.4 trillion (£1.4 trillion).

After almost three years of land and sea warfare, the peace Treaty of Ghent (Belgium) was signed December 24th, 1814 with the final US victory occurring at the Battle of New Orleans, thanks to the speed of news, on January 8th, 1815. The result of nearly three years of fighting was a *status quo antebellum* where impressment was a moot point after the defeat of Napoleon (1815). A significant US gain was the Treaty of Rush-Bagot (1818), which initiated the longest (chronologically and spatially) peaceful border in the world between the USA and Canada.

BATTLE OF SACKETT'S HARBOUR (29 MAY 1813)

The history of Sackett's Harbour (currently spelled Sackets Harbor) is what defines the town and provides its character (Figure 1). Driving around modern day Sackett's Harbour, one can see that history lives on, from the battlefield memorials to the numerous buildings that date back to the earliest parts of the 19th century. These buildings are a reminder of when this summer lake town was *the* major naval and military outpost on Lake Ontario; responsible for controlling its treacherous waters, as well as the supply lines to Upper Canada via the St. Lawrence River. Twice, the Americans were required to fight for its protection, first a naval battle on July 19th, 1812 where American sailors repulsed a British attack and second, the focus of this trip, on May 29th, 1813, the amphibious assault, land and naval battle.



Figure 1. Regional map and Lake Ontario blowout map. Black polygon represents approximate area of subsequent Sackett's Harbour figures.

This second Battle of Sackett's Harbour was a result of local anxieties, as well as the tensions that led to the War of 1812. In the years before the war, the British were engaged with their enemies in the Napoleonic Wars. During this time, Americans took advantage of both the British and French need for American goods and services by trading with both. The British, upset by this, embargoed American trade with the French by a blockade and boarded American merchant ships looking for Royal Navy deserters who had signed on with the merchant ships for better pay. One such instance occurred when the Royal Navy fired upon the merchant ship USS *Chesapeake* off the coast of Virginia, killing and wounding members of the crew in order to board the ship and search for British deserters. International incidents like this one, as well as political pressure from a group of congressmen known as the "War Hawks," led to a declaration of war on June 1st, 1812.

Prior to the War of 1812, Sackett's Harbour and the surrounding area were primarily supported by agriculture, with town residents actively engaged in trade with their Canadian neighbors across the St. Lawrence River.

Town founder, Augustus Sackett, came north from New York City as a land speculator, and found the area to be quite advantageous due to its relatively deep and protected harbor. Thus, the town grew from a small farming town into one of the more important towns on Lake Ontario. Close by in soon-to-be named Brownsville, NY, future militia commander Jacob Brown settled a community and emerged as a local leader. Brown was also known for taking advantage of the tensions between the Americans and the British across the lake and river, as he became an avid smuggler of potash. In fact, Brown became known as “Potash” Brown for his ability to smuggle the valuable fertilizer. When war broke out, however, this all changed when the military recognized the strategic value of Sackett’s and decided to make it the major base of operations on Lake Ontario.

The base of operations contained three groups, the U.S. Navy commanded by Commodore Issac Chauncey, the U.S. Army regulars commanded by Major General Henry Dearborn, and the New York Militia commanded by local Brigadier General Jacob Brown. Dearborn and Chauncey conferred and decided that there were too many British stationed at Kingston, British Canada and, therefore, decided to attack York. Chauncey and the U.S. Navy had recently outfitted local merchant boats with cannon, so they sailed to York, capturing it with some ease, for the American forces at Sackett’s Harbour outnumbered that of any British post on Lake Ontario. They burned York, and, riding high off their victory, decided to sail to the mouth of the Niagara River and attack Fort George in Ontario (Figure 1).

With Isaac Chauncey and General Dearborn engaged across the lake, a depleted force was left to protect Sackett’s Harbour. The ranking officer in the British Army, Sir George Prevost, recognized this weakness—thanks to information provided by a loyalist. Taking into account that the American ship, the USS *General Pike* was nearing completion, it would not be long before the British lost their advantage on the vicious waters of Lake Ontario and become more vulnerable to attack. Prevost consulted with the newly arrived and celebrated naval Commodore, James Lucas Yeo, and ultimately decided that the time was right to attack Sackett’s Harbour. They did not want to risk Chauncey and Dearborn returning from their attack on Fort George, and also recognized that, given the weather and unpredictable waters of Lake Ontario, a good opportunity for an attack could not be wasted.

After Yeo and the Prevost decided to attack, the newly appointed Commander Yeo sailed his fleet the short distance across the lake from Kingston stopping on the far side of the concealing Horse Island on the night of May 28th 1813 (Figures 1 and 2). Yeo and the Prevost decided that, based on the less than ideal conditions, they would hold their attack until the next morning. By doing so, the British gave the Americans more than enough time to prepare and the next morning, May 29th, 1813, Americans fired on the British as they neared land and were close enough for effective shots. After this initial attack, the New York Militia (NYM) retreated to the beach opposite Horse Island. This gave the British time to gather and rearm. The British were then forced to cross the knee-deep water atop the slippery shoal rocks from Horse Island onto the small beach where the militiamen were stationed, as this was the only point the British could get onto the mainland. This forced the British advance into a kill zone, but the defending NYM had not been battle tested and were afraid of the much more advanced British regulars. At this point, one of the NYM stated, “I fear we shall be compelled to retreat.... I know we shall, and as I am a little lame, I’ll start now” (quoted in Wilder, 1994). The militia retreated into the woods against Brown’s orders. Still, Brown gathered as many of the fleeing men as possible and attempted to make one last stand (Figure 3). Again, the Americans withdrew, providing yet another opportunity for the British to reorganize and revise plans for their struggling main assault.

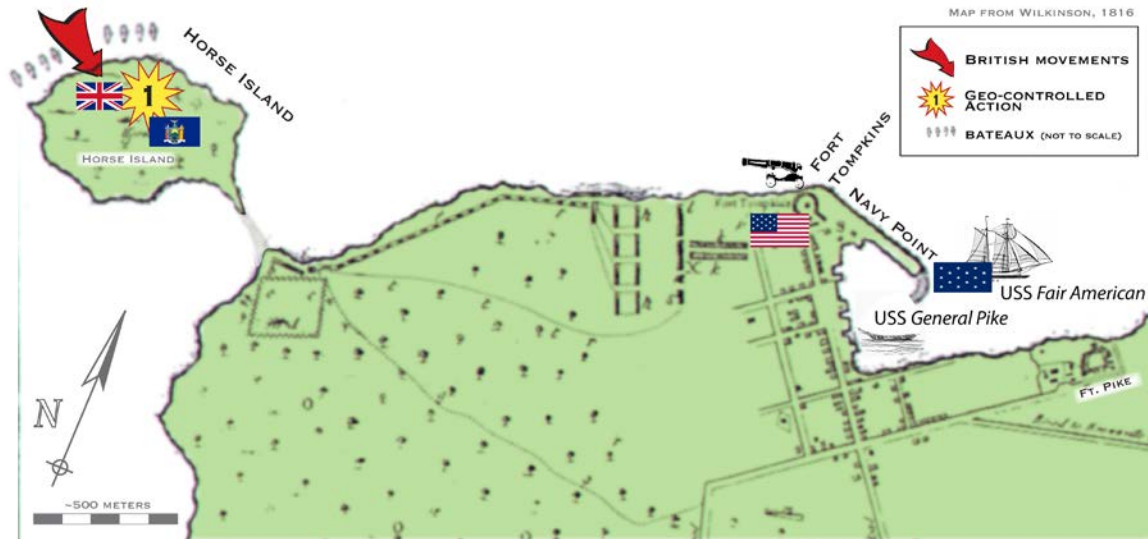


Figure 2. Reconstructed battle sequence highlighting the UK amphibious assault on the windward side of Horse Island. At this point, NY militia (NYM) were in defensive positions on the island; despite the British Regulars disembarking their bateaux and crossing knee-deep waters atop slippery limestone pavement, the NYM failed to repel the invasion.

Most of the British regulars marched down the road that ran along the shore toward the main fortifications near Fort Tompkins (Figure 4). The Voltigeurs (British Army) under the command of Captain Jacques Viger flanked right, trying to get around the American defenses. A remaining group of British forces, who had accompanied the assault, chased the retreating NYM into the forest that separated the village from the assault point (Figure 4). As the British marched down the road, an American marksman spotted Major Drummond (British Army) who was the second in command under Prevost, and waiting until he was in range, took a shot. Drummond dropped to the ground, but was only wounded. Earlier, at the encouragement of his men, Drummond had removed his epaulets, storing them inside of his shirt. When the marksmen fired his weapon, the bullet hit the epaulets, saving the major's life, and, unfortunately for the Americans, allowing him to resume his command.

As Major Drummond and the British marched forward, joined by the Voltigeurs, the British were again too much for the Americans. American military leaders Colonel Electus Backus, Major Jacint Laval, and Major Thomas Aspinwall retreated 200 meters toward Fort Tompkins and made their stand. It was the 32-pound gun inside Fort Tompkins, however, that was doing the most damage (Figure 5). Yet, the damage was mostly psychological because the British knew they stood little chance of success if they did not take or somehow dismantle the gun.

Patrick A. Wilder (1994) describes the scene in his book *The Battle of Sackett's Harbour*, "The American artillerists toiling in Fort Tompkins repeatedly discharged the 32-pounder into the woods toward the oncoming British. A deluge of cannon balls, grapeshot, and bullets lopped off treetops and branches, which flew in every direction. One nearly killed Captain Jacques Adhimar [British Army]." After seeing the significant damage the cannon was doing, Colonel Baynes of the Royal Army approached Prevost and said that his men would not be able to take the fort. British forces reorganized and made another attack on the American fortifications, yet by this time the British forces were reduced in number to approximately 300 men (Figure 6). In addition, Prevost received the news that all the other field officers, except for one, were wounded.

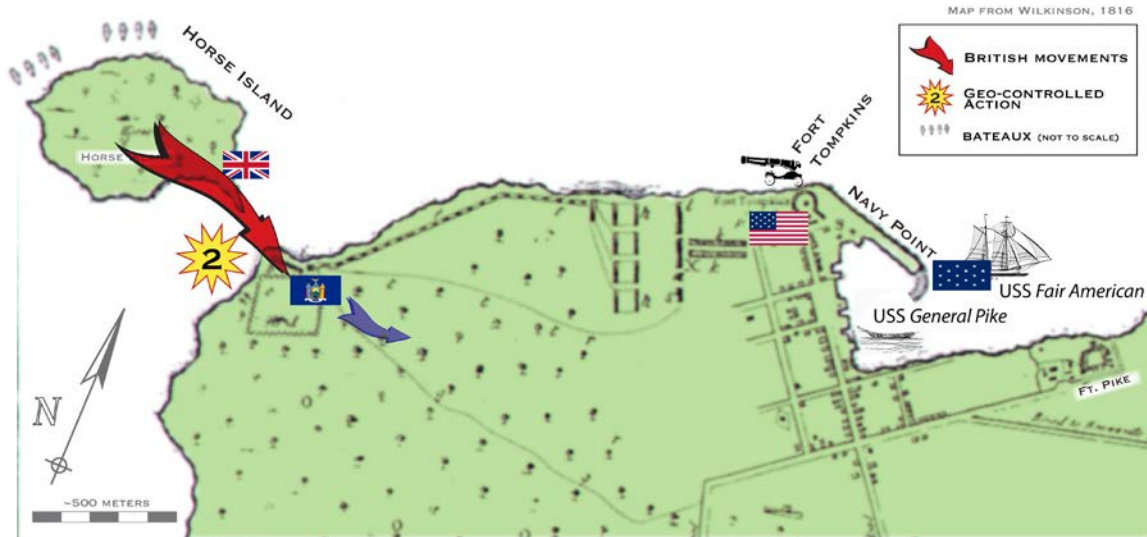


Figure 3. Reconstructed battle sequence highlighting the retreat of the NYM across the tombolo and their straggled defense behind the mainland beach berm. British regulars advanced across the same knee-deep, mossy-boulder-and-cobble tombolo toward the NYM defensive “kill zone.” This should have been (the second, see Figure 2) guaranteed end to the battle because the British would have only been five to ten abreast as they advanced across the tombolo, for the water depths increase to above waist deep just meters away from the tombolo’s centerline.

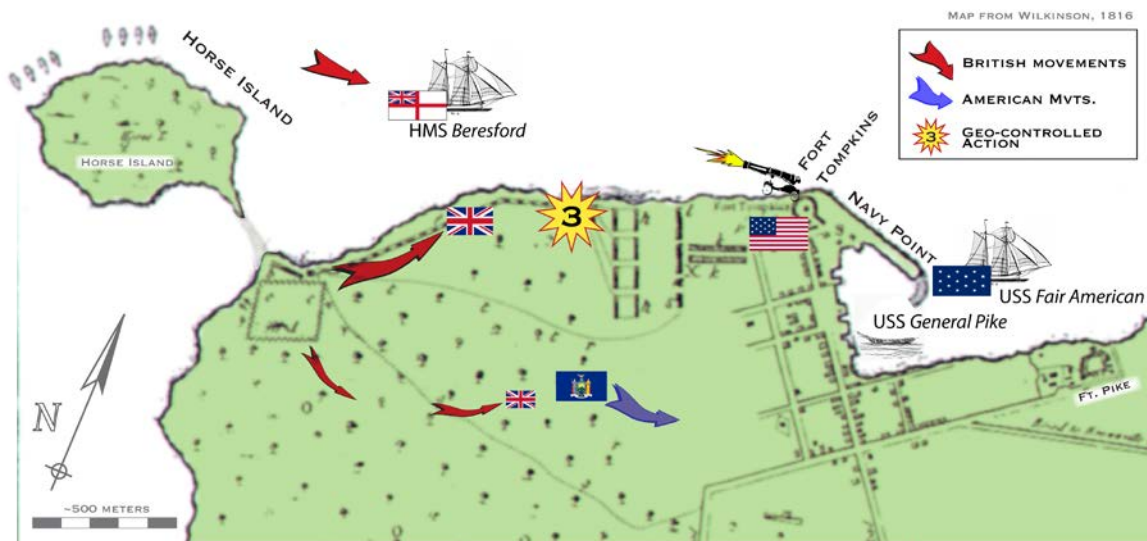


Figure 4. Reconstructed battle sequence highlighting the confused retreat of NYM back toward Forts Tompkins and Pike. After the main British force made the mainland, they continued along the lakeshore through abatis and direct fire from the 32# gun at Fort Tompkins. The British Voltigeurs split from the main group to follow some retreating NYM and to flank the cantonment. During this time, the HMS Beresford, the only British ship able to maneuver in these calm, shallow waters began rowing in to support her infantry.

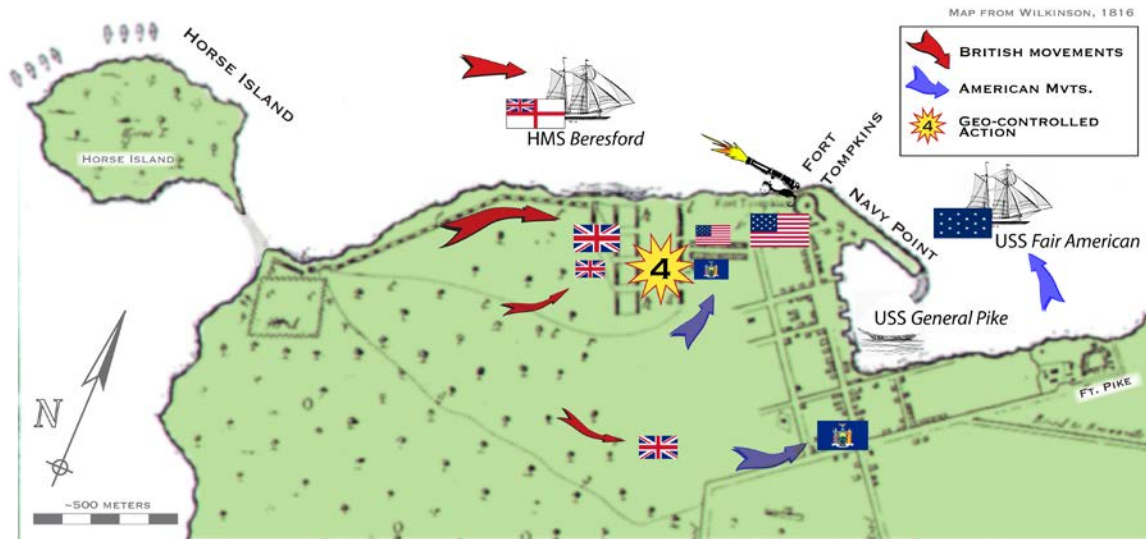


Figure 5. Reconstructed battle sequence highlighting the in-line, infantry firefight at the Smith (Basswood) Cantonment with the movement of the USS Fair American into position to ward off the HMS Beresford.

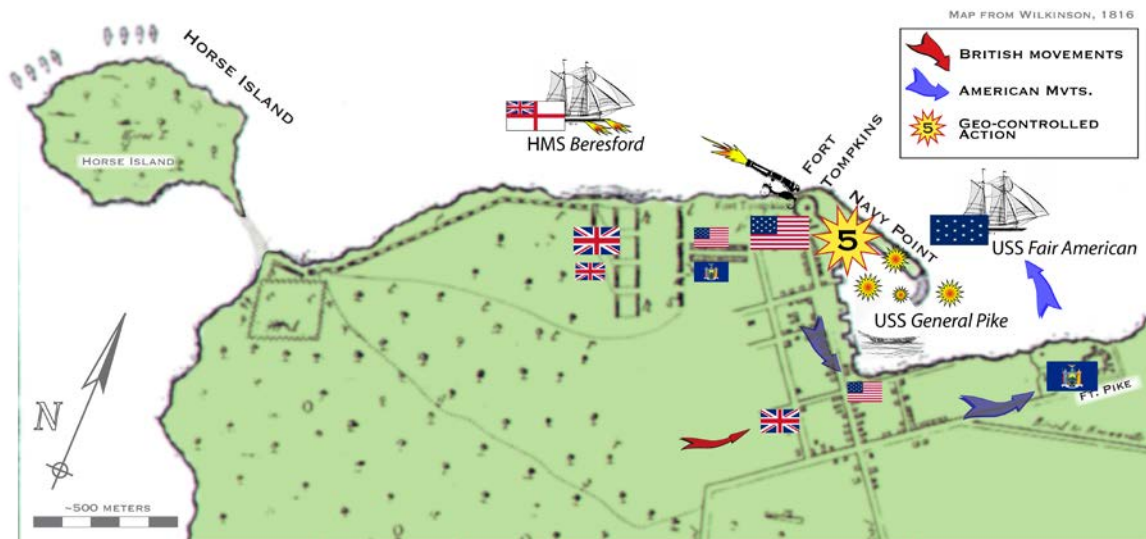


Figure 6. Reconstructed battle sequence highlighting the exchange of fire between the 32# cannon at Fort Tompkins and the HMS Beresford. Because of keen placement of Fort Tompkins, fire from the Beresford either smashed into the 7-meter cliff face below the fort, or overshot into and around the harbor. US sailors and soldiers on Navy Point misinterpreted this as fire from an over-run (British taken) Fort Tompkins (which was not the case). Because of confusion, the Americans set the USS General Pike and stores on Navy Point ablaze.

British Naval commander Yeo favored supporting the land attack by going ashore and leaving the naval support in the hands of the ships' various captains. Meanwhile, most of the ships remained in their positions, out of range and ineffective at providing naval support. The HMS *Beresford*, the only British ship outfitted with sweeps (long oars), zigzagged into the unknown depths to provide support (Figure 6), but was met by the USS *Fair American* commanded by LT Wolcott Chauncey, USN. The ships fired on each other until Chauncey cut his cables and retreated, leaving Navy Point and Fort Tompkins.

Chauncey's departure was a key event. He had been left in charge of the base's naval operations, while his senior officer and brother, along with portions of the army, were in the western part of the Lake, fighting at Fort Niagara. Earlier in the morning, before the start of the battle, LT Chauncey had given the order that if his ship was on fire and/or Fort Tompkins was taken, he would fly a red flag from his ship. This was the signal for the remaining men to set ablaze the stores at Navy Point and the recently laid-down USS *General Pike*, thus averting their capture by the British (Figure 7).

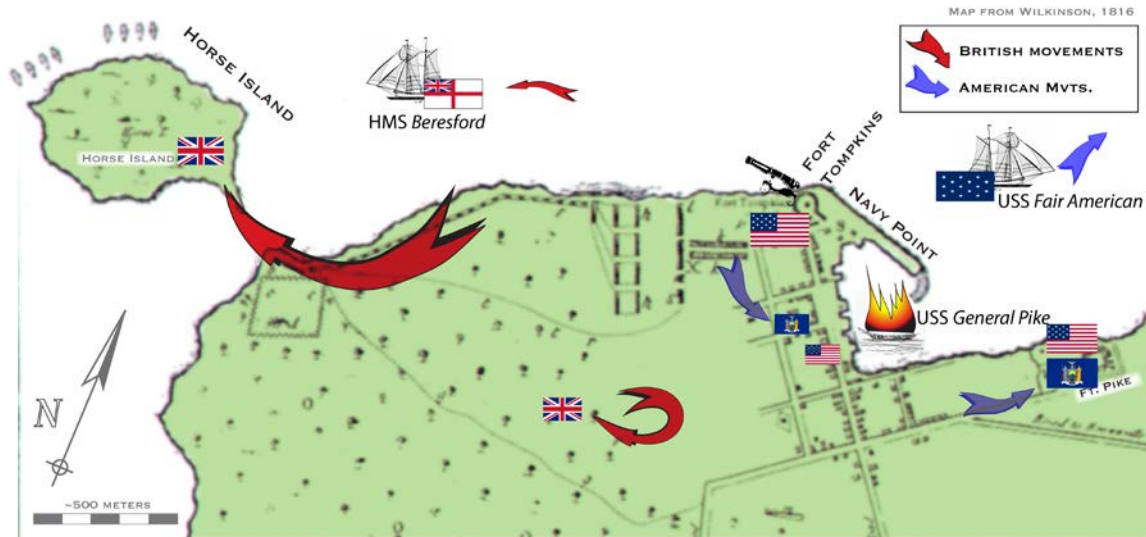


Figure 7. Reconstructed battle sequence highlighting the burning of the USS General Pike and the general retreat of both the USS Fair American, HMS Beresford and the US regulars, NYM and the British main assault. At this point, neither side was “winning,” but because the British force was retreating to their ships, the Americans held the day.

Confusion was running rampant at Navy Point because of mixed signals and general loss of command and control. For example, the Americans at Navy Point thought that the British took the 32-pound cannon at nearby Fort Tompkins. Instead, the firing from the HMS *Beresford* had forced the artillerists of the 32-pound, main gun at Fort Tompkins to take cover; it was these *Beresford* volleys that were overshooting the fort and hitting around the harbour. American sailors thought that this fire was coming from the “captured” Fort Tompkins, but in fact they were shots intended for Fort Tompkins from the *Beresford*. Because of the confusion and the insistence of some that Chauncey's order be followed, sailors decided to burn the USS *General Pike* and the stores and retreat to Fort Volunteer across the river from Navy Point and Fort Tompkins (Figure 7).

Simultaneously, the U.S. Army was also retreating to Fort Volunteer where Colonel Backus was mortally wounded, leaving Major Laval, USA of the Dragoons, in charge. Major Laval also sent his men back to Fort Volunteer, leaving Major Aspinwall and his men to protect Fort Tompkins (Figure 7).

It appeared the momentum was shifting. Major Aspinwall held Fort Tompkins, the burial site of General Pike, and repelled the British advance. By this time, the HMS *Beresford* continued firing on Fort Tompkins, but she was unable to communicate with her land forces, as Yeo had not set up any signals in advance. Aspinwall and his men took full advantage of the situation, continuing to successfully defend Fort Tompkins, and, in the process, killing many British troops.

Thinking he had a clear advantage, Major Drummond suggested the British approach the Americans, demanding their surrender. Major Laval refused, telling Drummond, “Then tell Sir George Prevost we will wait the issue of his [next] attack” (quoted in Wilder, 1994). It was decision time for Prevost and he chose retreat (Figure 7). Prevost feared that Isaac Chauncey and his fleet could return and cut them off at any minute, unaware that American troops, in fact, were quite fearful of the British and had low morale. Meanwhile, Viger

and the Voughts, unaware of the retreat, had made their way into the village and, as a result, were among the last ones to sail back to Kingston.

While the battle at Sackett's Harbour is an American victory, the British were able to accomplish something during their invasion. In the midst of the confusion on Navy Point, and the apparent signal by Wolcott Chauncey to burn the naval stores, the British were able to maintain superiority on the Lake as the USS *General Pike*'s construction was delayed by two months—keeping the U.S. Navy from ascending to power on Lake Ontario until much of the sailing season of 1813 was over.

After the battle, Sackett's Harbour increased its military strength, adding Fort Kentucky and by building up Fort Volunteer, now known as Fort Pike. The harbor held its key position until railroads became more commonplace and bypassed Sackett's Harbour. Still, Sackett's Harbour maintained a luster given that it was a posting for military luminaries, including Ulysses S. Grant before the start of the War Between the States.

Clearly, Sackett's Harbour was at its prime during the War of 1812 as American forces were able to fend off two British invasions. Thanks to several key victories, including those at Sackett's Harbour, the U.S. maintained a strong presence on the lake as the USS *General Pike* was eventually restored and completed. The U.S. also made a statement to the British about their strength in the war as a whole. Yet, as one drives through the modern day summer community of Sackett's Harbour and its colorful history is celebrated, it is hard to imagine its fields bloodied and its coastline bombarded with fire.

GEOLOGICAL OVERVIEW OF SACKETT'S HARBOUR

Sackets Harbor, New York is rich with history, evident by a drive down the main street; they have truly embraced their War-of-1812 history. There is a history, however, that predates any war or people on the land—the geologic history. From the building stones to the cliff that protects the historic battle site from the rough waters of Lake Ontario, geology plays an essential role in the village of Sackets Harbor. The geology of the area ties in with several geologic events, including an epeiric sea over 400 million years ago and a great ice sheet that covered the area “just” 15,000 years ago. The best way to get insight into that ancient ocean is through the limestone cliff that lines the shore of the lake; for evidence of the massive continental-sized glacier, you only have to look at that same cliff, the rolling topography and the lake.

The cliff along the eastern shore of Lake Ontario is comprised of up to seven meters of Ordovician-aged, shallow-ocean-water sedimentary rocks; part of the Lake Ontario Homocline (Kay, 1942) with a dip of approximately 8m/km to 222° (Wallach and Rheault, 2010). These limestones and shales are evidence of fluctuating sea levels, or eustatic changes, during a time when nascent North America was about 25° south of the equator. The shales were deposited in quiet, deeper water environments (10's of meters) while the interbedded limestones represent shallow-water carbonate factories. The deposition of these beds, along with the sea-level transgressions (local deepening) and regressions (local shallowing) would have taken many thousands of years, a long period of time, but relatively insignificant in geologic time. These limestones and shales have been identified as part of the Trenton Group's, “Shoreham interval.” These limestones are analogous to modern-day Bahamian environments—places where little ocean critters, such as foraminifera, multiply in shallow, warm, sun-rich ocean waters. These creatures live and die by the trillions, accumulating only millimeters every thousand years or so, turning to limestone over time. At varying times, mountain-building events on the eastern edge of the continent affected the local depth of ocean water (by raising/lowering the land). When the land was depressed, deeper water sediments prevailed. In these deep, dark regions, forams are not able to proliferate; as a result, fine-grained sediments settle in this quiet environment—one way of making shaly units.

There are several prominent features associated with this cliff. First, while walking atop the cliff, one notices the jagged nature of the cliff edge and numerous depressions next to it. These features are places where the cliff has been weathered and eroded underneath, causing subsidence and cliff-face retreat. This erosion is caused by wave action constantly beating the cliffs until eventually the cliff is weakened to the point that it falls into the lake. The reason the waves are so effective at eroding the cliff is because wave action is concordant to the joints in the rock. These joints are weaknesses, allowing the waves to be more successful with their weathering and erosion, causing faster cliff retreat. In fact, there are multiple instances where the cliff face has already been

sapped, separated and tilted toward the lake. In another instance, wave action has worked antithetic joint sets making a small cavern beneath the cliff edge. This erosion has caused the cliff to retreat over time; possibly, two to five meters since the battle.

The surrounding area was also impacted by the Quaternary continental glaciers, which advanced and retreated multiple times in the past two million years. While the last glaciation maxed out around 15,000 years ago, evidence of the advance and retreat of these glaciers can be found in the area. There are numerous glacial features, including drumlins and moraines, which can be seen to the east in Watertown. Also, the area that Lake Ontario currently occupies was once covered by another, larger lake known as glacial Lake Iroquois. This lake formed as meltwater from the Laurentide Ice Sheet was prevented from flowing out the St. Lawrence River Valley by the retreating ice to the north, and geographic boundaries like the Adirondack Mountains to the east. Eventually however, the ice melted farther north and the water from the lake drained through the St. Lawrence River.

Wave refraction also played a part in shaping not just the cliff, but Horse Island. Horse Island is an island in Lake Ontario adjacent to mainland Sackets Harbor and nearby Gilmore Point. Before it was an island, however, it was likely an extension of Gilmore Point. Today, Horse Island is probably a “lake stack.” The bathymetry of the lake near Horse Island helped focus wave-refracted energy, which eventually cut Horse Island off from the mainland. This same process is responsible for maintaining the thin tendril that connects Horse Island to the mainland—a tombolo. The tombolo, currently known as Gilmore Shoal, is covered with shallow water and was the route taken by the British invasion force when attacking Sackets.

Several lake-coast, geologic processes, including longshore drift and wave refraction, are the modern modifiers of the Sackets Harbor area. Longshore drift is the process by which sediment is transported along the coast. Depending on the prevailing wind direction, sediment is eroded and deposited continuously along the coast by swash and backwash. At Sackets Harbor, westerly winds generate waves that move sediment from the Horse Island area towards the village of Sackets Harbor. These drifting particles are carried to the harbor and then deposited as a spit of land, which projects from the mainland and protects the harbor. This spit is known as Navy Point, where the U.S. Navy was stationed during the War of 1812 and after. These protected harbor waters were crucial for ship building operations as well as stationing naval vessels. Today, these same protected waters are used for the same protective purpose, but only for pleasure craft.

Wave refraction is the process by which the limestone cliff that lines the coast is weathered and eroded. Waves are altered by the bathymetry of the lake floor. As a linear wave crest makes its way toward the shore, the shore end will encounter a shallowing bathymetry before elsewhere along its crest length (due to the angle of impingement). As this portion of the wave enters the shallower water, it slows down while the deeper, farther removed portion along the same crest continues at a now, relatively faster rate causing the wave crest to “bend” toward the shore. This process is undercutting the cliff along the joints, causing the weathering and, ultimately, the cliff erosion and retreat. This is an important process relative to the battle, for the cliff provided natural protection to the American fortifications at Sackets Harbor.

WALKING TOUR LOG AND NOTES FOR TRIP A-2

This tour will leave from the Bonnie Castle Resort, 31 Holland Street, Alexandria Bay, NY 13607 at 1100hrs taking about 45 minutes to arrive at the Sacket's Harbor Battlefield State Historic Site (SHB), 500 W. Main Street, Sacket's Harbor, NY 13685 and return to Bonnie Castle Resort by 1700hrs.

NOTE 1. If you are driving separately, please plan to arrive at the SHB (start, see below) by 1145hrs; we will be taking NY12 south from Bonnie Castle Resort to I-81 south to NY3 (Arsenal Street) west to the SHB.

NOTE 2. This is a walking tour of approximately 4.5 kilometers in length (Figure 8). The first portion of this trip will be a visit to Horse Island (private), which is connected to the mainland by a 250-meter, narrow strip of mossy cobbles and boulders submerged in upto 0.5 meters of water. Access to the island will require knee-deep wading with sandals (and dry shoes to change, if you choose). There will be a gazebo available on the island to change sandals/shoes (and vehicles on the mainland).

NOTE 3. The formal portion of this trip will terminate at the SHB proper, hopefully, allowing approximately 30 minutes to follow the official signed trail of the battlefield or visit the village.

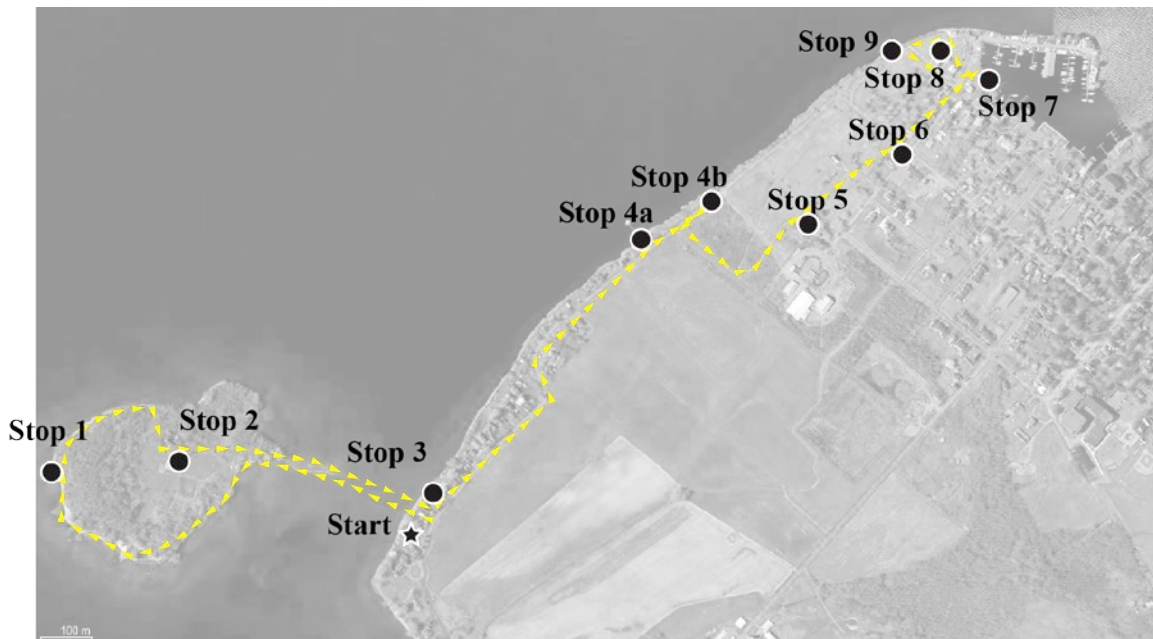


Figure 8. Overview map of the Sackets Harbor area showing the walking tour and stops. Start to Stop #3 is private property (see Table 1 for stop details).

CUMULATIVE KM (MILES)	KM (MILES) FROM LAST POINT	ROUTE DESCRIPTION
0.0 (0.0)		<i>PRIVATE</i> . Park at 444 Ontario Street to access Horse Island. Using care, cross tombolo to Horse Island.
0.4 (0.25)	0.4 (0.25)	At gazebo, change sandals/shoes for tour of island.
1.0 (0.6)	0.6 (0.35)	Walk counterclockwise the circumference of the island. There will be occasional, unofficial stops looking at limestone bedrock, joint patterns, glacial erratics and striations. STOP 1 is on the western edge of the island.
1.4 (0.85)	0.4 (0.25)	Continue along the circumference of the island to the north; head south to SH lighthouse and STOP 2 (led by Mrs. Diane Cozad, owner).
1.65 (1.1)	0.15 (0.1)	Continue south to gazebo. Change shoes/sandals.
2.0 (1.3)	0.35 (0.2)	Continue easterly across tombolo to mainland. Change sandals/shoes. STOP 3 .
2.8 (1.8)	0.8 (0.5)	Continue northeast on Ontario Street to STOP 4a at the derelict oil-transfer mooring dolphin.
2.95 (1.9)	0.15 (0.1)	Continue northeast along lakeshore exposure to STOP 4b at the memorial-cross vista.
3.2 (2.0)	0.25 (0.15)	Backtrack on Ontario Street approximately 80 meters to access road heading landward to the east-southeast. Continue 150 meters to SHB trail access where we will pickup the USA retreat/UK advance.
3.35 (2.1)	0.15 (0.1)	Continue northeast on right fork of trail to Fort Kentucky (STOP 5).
3.55 (2.2)	0.2 (0.1)	Continue northeast on trail, through parking lot and into the grassy quadrangle amongst buildings (STOP 6).
3.8 (2.4)	0.25 (0.15)	Continue approximately 25 meters northeast to pickup the trail, continue along trail, across road, another 150 meters to the lieutenant's house (smaller yellow brick structure) and continue 75 meters toward the gated road access to the harbor (STOP 7).
3.9 (2.5)	0.1 (0.05)	Access fenced, park area by using gate on the east side of the lieutenant's house and proceed to open grassy area by boathouse (do not follow boardwalk) (STOP 8).
4.0 (2.6)	0.15 (0.1)	Continue to lakeshore and walk approximately 75 meters to the west-southwest along rocky coast (STOP 9).
4.25 (2.75)	0.25 (0.15)	Return to parking lot and vans by lieutenant's house (take boardwalk).

Table 1. List of stops, locations and highlights.

Stop (#, name)	Location	Highlights
Start	N 43.941448°, W 76.138362°	<i>Private Residence</i> , 440 Ontario Street, 13685
1—Amphibious assault	N 43.942376°, W 76.147381°	Amphibious assault point at greatest concealment; primary impact of lake waves, rolled and concentrated glacial erratics
2—Lighthouse	N 43.942944°, W 76.144514°	Horse Island (Sackets Harbor) Lighthouse (1870)
3—Beach berm defense	N 43.941664°, W 76.138352°	USA-defensive killzone; convergent longshore drift (tombolo) and storm-wave-deposited beach berm.
4a—Cliff retreat @ oil-transfer mooring dolphin	N 43.946724°, W 76.132373°	(1 of 2) exposure of joint-controlled cliff-face retreat due to coincident impingement of wavefronts.
4b—Cliff retreat @ memorial cross	N 43.947352°, W 76.131250°	(2 of 2) “lake stack” in progress
5—Ft. Kentucky (c. 1814)	N 43.947241°, W 76.128554°	Remnant, post-battle earthwork of Ft. Kentucky with 32” cannon.
6—Barracks assault	N 43.948224°, W 76.126645°	Center of barracks where fighting in-line occurred (surrounded by post-war structures)
7—Navy Point/Harbour view	N 43.950032°, W 76.123795°	Protective spit and harbor, location of the USS <i>General Pike</i> , which was prematurely burned during the battle
8—Ft. Tompkins	N 43.950280°, W 76.125050°	Location of Ft. Tompkins, the primary blockhouse-style fort that successfully defended the harbor
9—Lake view and cliff face	N 43.950313°, W 76.125742°	A lake-side exposure view of the 7+-meter cliff that protected Ft. Tompkins from shelling
End	N 43.949700°, W 76.124362°	

STOP 1 – UK AMPHIBIOUS ASSAULT LOCATION/WINDWARD SIDE OF HORSE ISLAND (private)/ JOINT-CONTROLLED “BIOSTROME” (ORDOVICIAN)

N 43.942376°, W 76.147381°

At this location you are in the most concealed position with respect to Forts Tompkins and Pike near Sackett’s Harbour. This windward side of Horse Island was a “natural” place for Commanders Yeo and Prevost to make an amphibious assault (Figure 2). General Brown, NYM, however, had set up defensive positions in the treeline along this edge of the island. Upon dismounting, the UK troops were under fire from 6-pound field guns and the 32-pound gun, firing long range, from Fort Tompkins. Because the NYM were untrained, completely untested and feared the regular British troops, they retreated back across the shoal (tombolo) to the mainland where they set up another defensive position behind the storm-deposited beach berm (Figures 3 and 9).

“The militia soon began to assemble, and as fast as they arrived they were armed and sent to Horse Island, which was the point at which the enemy was expected to bind.”
(Rodgers, 1897)



Figure 9. Photograph looking northeasterly at the mainland edge of the tombolo. It was along this storm-deposited beach berm that NYM Brigadier General Brown rallied some retreating militia to “defend” the mainland from the advancing British. With British advancing a few men abreast across knee-deep water and mossy cobbles, this should have been a guaranteed “kill zone” sending the British in retreat. The untested NYM, however, retreated despite their significant advantage.

Geologically, Horse Island is a joint-bounded (Figure 10), biostrome-like, coarse-grained limestone with well-exposed orthocone nautaloids at lake level. This coarse unit is overlain by approximately 0.5 meters of nodular calcisiltites in 5-10-centimeter beds interbedded with silts and shales. As you walk the perimeter of the island to this location you will notice an excellent assortment of glacial erratics, which have been storm-wave concentrated into piles and mantling the northern shore. These erratics, gabbros, gneisses, Potsdam sandstone, pegmatic granites and porphyritic gabbros, likely rolled out of the glacial drift covering the island. On the

western-most lake-level exposure are a series of glacial striations with a mean vector of 196° ($n=8$, $\sigma=3.8^\circ$; Figure 11).



Figure 10. Satellite image of the Sackett's Harbour area highlighting the joint-controlled lakeshore and Horse Island (dashed lines). Inset is a rose diagram of both mainland and Horse Island joint data.

STOP 2 – HORSE ISLAND (SACKETS HARBOR) LIGHTHOUSE (c. 1870)(private)/INITIAL USA DEFENSIVE POSITIONS

N 43.942944°, W 76.144514°

The Horse Island lighthouse (Sackets Harbor, ARLHS USA-380) was originally emplaced in 1831 approximately 100 meters northwest of this location after Congress appropriated \$4,000 for the building of a 1.5-story keeper's dwelling and tower (LHF, 2014). By 1869, the lack of upkeep resulted in conditions beyond repair; therefore, Congress appropriated more funds for a new Queen Anne/Italianate brick lighthouse and keeper's dwelling (Figure 12). In 1899, the tower received a ten-foot addition raising its height to 55.5 feet (LHF, 2014). This light was decommissioned in 1957 and replaced by a modern, steel tower.



Figure 11. Perspective photograph of glacier striations on Horse Island. North arrow is oriented correctly.

Because Commanders Yeo and Prevost decided to await calmer waters after their arrival to the Sackett's area on the evening of 27MAY (and a bungled attempt at attack that day), Brigadier General Brown, NYM was able to set up hasty defensive positions in and around this location. Most likely, positions would have been naturally made beach-berm positions during the initial amphibious assault. As the NYM retreated through the woods at this location, the British Regulars were able to reform and be supported by their naval comrades. To the east of this location, there is a thought-to-be entrenchment used by the NYM during the assault; however, it is coincident with the jointing in the area and is most likely mass wasting in progress (similar to Stop #4).

“...separated from the mainland by a shallow strait, which is always fordable and sometimes almost dry. This strait, which, with the approach, formed a causeway 400 yards in length, had to be traversed by the attacking column...” (Hannay, 1903)

The military-geology of this island is limited to its ability to provide concealment to the amphibious landing party. This concealment was provided by trees growing atop a joint-controlled limestone “biostrome” that has withstood millenia of direct impingement of waves and storm waves. This energy was maximal on the western side of the island and wave refraction wrapped around the island providing sediment for deposition due to lack of competence in the leeward side of the island making the tombolo used for the mainland assault. Along the eastern edge of the island there is an elongated “entrenchment,” thought to be made/used by the NYM during the battle (and thereafter). Unfortunately, the structure is not man-made, but the intermediate phase of a block slump (similar to what can be seen at Stop #4). The strike of the feature is the same as the northwest-southeast joint set affecting the area. As far as its use by NYM during the War of 1812, that too is unlikely, for its orientation and location is on the Fort Tompkins/garrison side providing little defensive or offensive purpose.

STOP 3 – TOMBOLO/MAINLAND/USA-HELD KILLZONE FOR ADVANCING UK FORCE/STORM-DEPOSITED BEACH BERM

N 43.941664°, W 76.138352°

At this point, NYM had retreated after a perfect opportunity to “shoot fish in a barrel” on the island. After their splashy retreat across the tombolo, what militia remained were rallied by Brown, NYM to take defensive positions behind these storm-deposited beach berms. This defensive action is best summarized by a retreating NYM, “I fear we shall be compelled to retreat ... I know we shall, and as I am a little lame, I’ll start now” (quoted in Wilder, 1994). Despite this natural, 250-meter, amphibious “killzone,” the British regulars were able to cross the tombolo and make the mainland with little resistance and move northward along the shoreline to Fort Tompkins; CPT Viger of the British Voltigeurs (skirmish unit) flanked to the east trying to get around the US defenses (Figures 3 and 4).



Figure 12. Photograph of the Horse Island Lighthouse.

“The beach is of very limited extent, and bounded on the land side by a bank of sand several feet high, which had been thrown up by the current, as it rushed through the narrow channel separating Horse Island from the main. Behind this natural embankment, General Brown had formed a battalion of militia of 500 men” (Brown, 1827)



Figure 13. Satellite image of Horse Island with primary, secondary and tertiary wave crests highlighted. This image highlights well the wave-refraction and long-shore drift processes that accentuate the joint-controlled Horse Island and maintain the tombolo. During stormy times, these processes are magnified and provide most of the destructive and constructive events.



Figure 14a. View of Horse Island and tombolo from the mainland. This photograph was taken in April with relatively low water levels, thus showing the mossy, boulder-rich tombolo.



Figure 14b. View of Horse Island and tombolo from the mainland. This photograph was taken in October with relatively high water levels; likely the approximate water levels of late May in 1813 before lake-level management by the series of dams and locks on the St. Lawrence River.

This tombolo is the result of both wave refraction around the island converging at this location and longshore drift, which transports material around the island (Figures 13 and 14a,b). Its current geomorphology suggests that it is active only during conditions of greater than approximately 10-knot winds and 1-meter waves (pers. obsv.) with major storms being the most productive in re-working and re-organizing the tombolo. General composition of the tombolo is fine-coarse-grained clastics and shelly material. The erratic-rich locations, however, are probably the result of glacier-drift reworking and mantling along with human input. The island currently has electricity (run along the easterly side of the tombolo) and access to/from the island is commonly with vehicular traffic. As a result, concentrations of erratic boulders are likely accentuated due to reorganization for human purposes (such as the duck blinds on the west side of the island). Based on lake levels before the emplacement of dams along the St. Lawrence, the late-May battle date and historical accounts (e.g., Brown, 1827) the water level at the time of the assault was likely about knee-deep or “fordable depth” (Lossing, 1869)(Figures 14b).

STOP 4a – OIL-LOADING FACILITY EXPOSURE/WESTERN EDGE OF UK ADVANCE/CLIFF RETREAT AND JOINT EXPOSURES

N 43.946724°, W 76.132373°

Along this stretch of the lakeshore, advancing British troops were weaving through the dense underbrush of a wooded landscape. In addition, they were beginning to tackle the man-made defenses, *abatis* or an obstacle made of trees/sticks with sharpened end toward the enemy (Figure 5).

“The American artillerists toiling in Fort Tompkins repeatedly discharged the 32-pounder into the woods toward the oncoming British. A deluge of cannon balls, grapeshot, and bullets lopped off treetops and branches, which flew in every direction. One nearly killed Captain Jacques Adhimar [British Army].” (Wilder, 1994)

The prominent structure at this location is the oil-loading mooring “dolphin,” which was part of a Mobil Corporation petroleum bulk-storage facility that was emplaced during the 1920’s (Figure 15). During WWII, tanks were added on the northern side of Ambrose Street expanding storage. Petroleum storage continued at this site until 1988 reaching 589Mbbbl capacity with storage tanks being dismantled in 1989. Several environmental investigations have been completed since the 1980’s evaluating the nature and extent of contamination; current results suggest that the site no longer contains any threat to human health or the environment (NYDEC, 2013).

STOP 4b – MEMORIAL CROSS VISTA/WESTERN EDGE OF UK ADVANCE/CLIFF RETREAT AND JOINT EXPOSURES AND LAKE “STACK”

N 43.947352°, W 76.131250°

Continuing north along the cliff face, the advancing British soldiers were under heavy fire from Fort Tompkins. In this approximate location, they were limited by the cliff and were mired in *abatis* or a man-felled brush-and-tree obstacle, but because the NYM were in retreat, much of this advance was unimpeded until they reached the cantonment clearing 100 meters or so farther north (Figure 5).

Geologically, this area shows pronounced weathering of the northwest-southeast joint sets, which are coincident with impinging wave fronts. The notched cliff face to the south (Horse Island way), begins to give way to a more vertical cliff that begins to show joint weathering deep into the cliff to reach the antithetic east-west joint sets. As a result, “lake stacks” are forming and collapsing from this point north to the harbor. From the cross location, you can see this transition from notched cliff face to sapped and retreating, vertical cliff face.

STOP 5 – FORT KENTUCKY (1814)/NYS MILITIA RETREAT/EARTHWORKS AND 32# CANNON

N 43.947241°, W 76.128554°

This 1960's reproduction 32# gun represents the firepower available atop Fort Tompkins. Just after the repulse of the British, Sackett's Harbour defenses were augmented with Forts Kentucky (palisaded earthwork), Chauncey (stone tower), Stark (earthworks) and a ring of earthworks connecting them to Forts Virginia and Volunteer (NAF, 2014). As the British advanced along the lakeshore, dealing with the woods and *abatis*, the NYM were making their way through the same along this path to the barracks, Fort Tompkins and Volunteer.



Figure 15. View from the memorial-cross location looking southward to Horse Island. Notice the notched lakeshore due to weathering of joint sets.

STOP 6 – BARRACKS/IN-LINE ENGAGEMENT

N 43.948224°, W 76.126645°

This is the approximate location of the Smith (Basswood) Cantonment (palisaded barracks complex with four blockhouses) where the soldiers were garrisoned (officers were quartered in village homes). At this point, the Americans were in line and prepared for the mired British advance. When the first “red jacket” was visible, the Americans fired from the line. Sending a staggering blow to the advancing British, the well-trained British responded in kind and were able to overcome the Americans with rapid and precise fire and advance, pushing the Americans back to the protection of the cantonment (Figures 5 and 6).

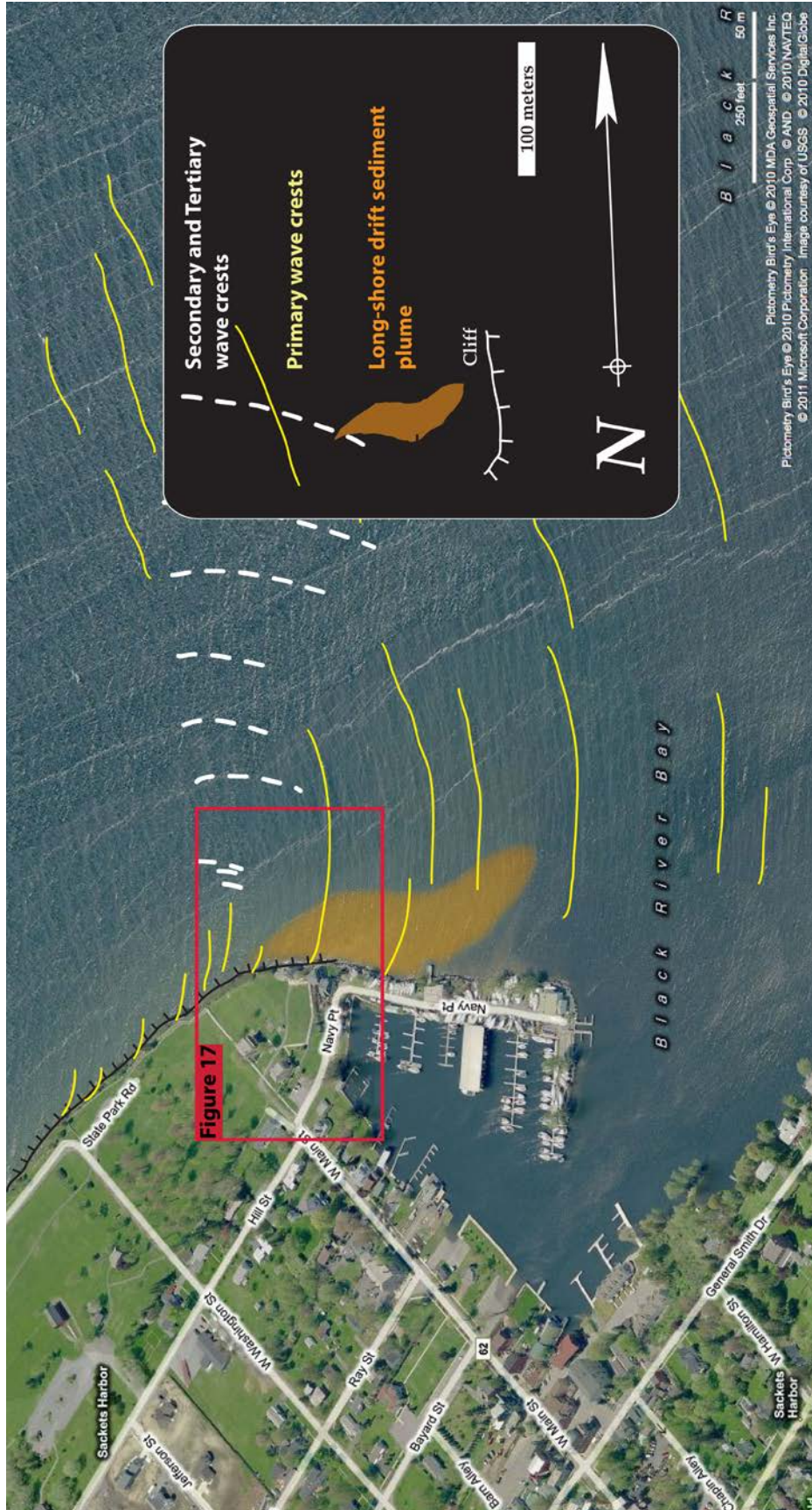


Figure 16. Satellite view of Navy Point and Sackets Harbor showing primary and secondary wave crests and long-shore drift sediment plume. The divergence between the current, low-energy sediment plume location and the actual Navy Point spit, shown in this image, is lessened during storm events. Stormy conditions increase the competence of longshore drift and wave refraction leading to preservation of the Navy Point.

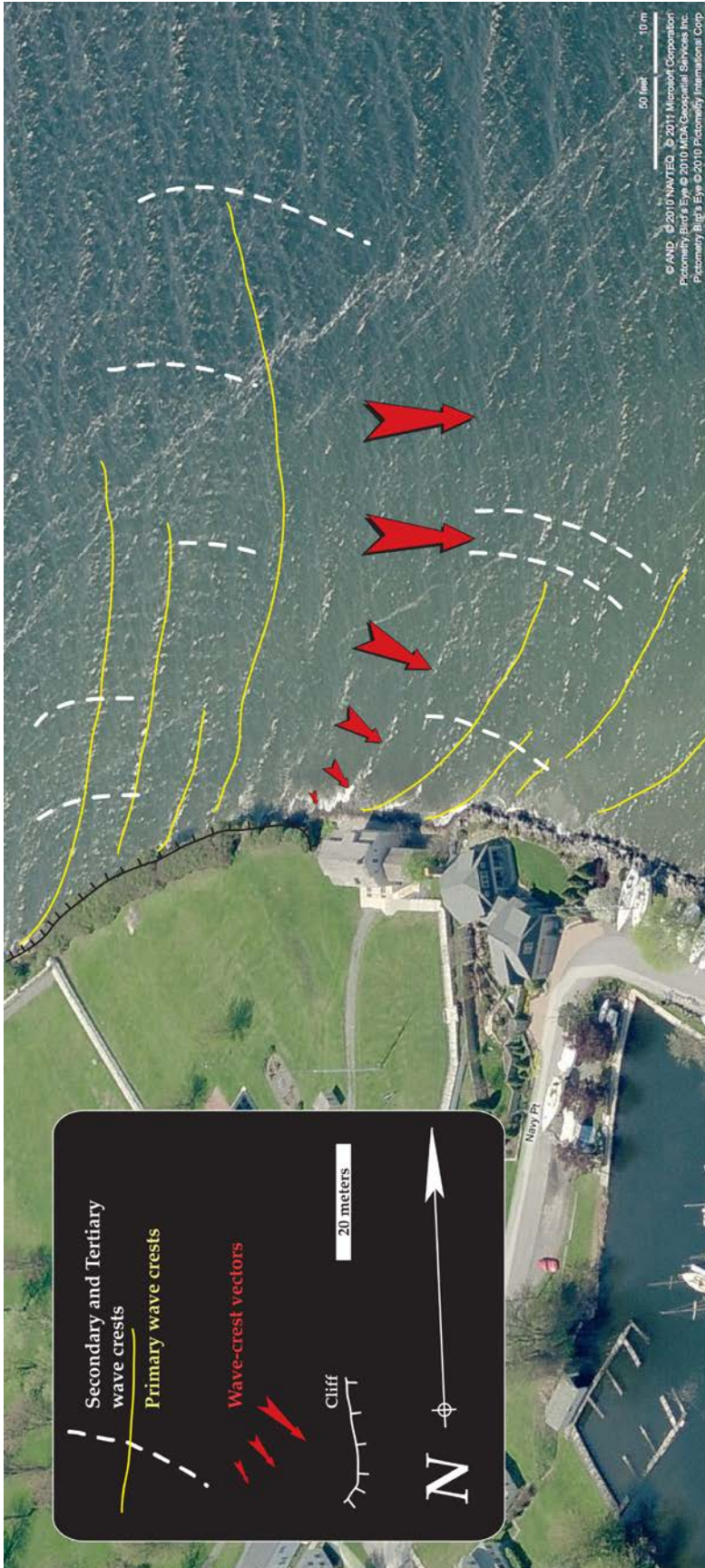


Figure 17. Close up of wave refraction into Navy Point (spit).

STOP 7 – NAVY POINT AND SACKETT’S HARBOUR/DRY-DOCKED USS *GENERAL PIKE* AND FORT PIKE/HARBOR AND STORM-DEPOSITED SPIT

N 43.950032°, W 76.123795°

From this location, the “Navy Point” spit is visible (Figures 16 and 17). In this relatively deep-water harbor (3-4m) the recently “laid down” USS *General Pike*, a 28-gun (24# each) corvette, named for the recently killed explorer/general Zebulon Pike (of Pike’s Peak fame) was being constructed. This was the strategic key to the battle—completion of the USS *General Pike* would promise lake superiority to the US before the end of the sailing season, leading to control of Lake Ontario. This, however, was not the case, during the melee a signal was confused and sailors began setting the stores on Navy Point and the USS *General Pike* ablaze (Figures 6 and 7). Luckily, such hasty creations during wartime were made of green wood and the damage was limited, yet significant enough to guarantee British control of Lake Ontario until the following sailing season (1814).

Geologically, Navy Point is a storm-deposited spit resulting from the longshore transport of sediments from the southwest between here and Horse Island. At the time of the battle, this spit was likely a relatively fine-grained mass that would be altered during significantly stormy periods. With increased human intervention, the spit has become mantled and a more-or-less permanent structure for the protection of the harbor. Contemporaneous maps of the harbor (e.g., Wilkinson, 1816) show the “recurve” or waning wave-refracted, longshore drift appendage at the terminal end of the spit. This portion of the landform, too, has been mantled and has been turned into a docking structure.

STOP 8 – FORT TOMPKINS/PRIMARY HARBOR DEFENSE/JOINT-CONTROLLED MASS-WASTING BLOCK

N 43.950280°, W 76.125050°

This location was the center of the primary, blockhouse fortification for Sackett’s Harbour. Mounted with a 32# cannon (like the replica at Fort Kentucky, Stop #5), it was the deciding factor in the success of the Americans and their downfall! Well-aimed shots from this gun kept the British at bay; however, because of confusion and lack of communication, overshots from the British Naval ships landing in/around Navy Point, were interpreted as enemy-controlled Fort Tompkins (Figure 6). Regardless, Fort Tompkins remained in American hands and was key to defending the harbor.

In this approximate location there is a block of harbor cliff that is in a medial state of mass-wasting failure. This intermediate failure is recognized by the joint-controlled gradient changes in the lawn adjacent the boathouse. These gradient changes (or escarpments) are coincident with the overall joint sets in the area (Figure 10). This portion of the cliff face is significantly larger than the other recently failed cliff sections (seen from Stops #4a,b) and, as a result, was “too large” to fully fail.

STOP 9 – LAKE ONTARIO SHORELINE/DEFENSIVE CLIFF FACE/SHOREHAM INTERVAL EXPOSURE AND WAVE-CUT CLIFF

N 43.950313°, W 76.125742°

Naval support of the British invasion at Sackett’s Harbour was nil. Primarily, relegated to an amphibious support role, the calm winds rendered their support useless. Of the ships near Horse Island, only one was equipped with “sweeps,” or long oars, the HMS *Beresford*, which was able to slowly maneuver itself into a supporting role. This supporting role, however, was hampered by the incessant pounding of the the 32-pound Fort Tompkins gun and the inadvertent, yet careful placement of the Fort. The 7-meter cliff face below the Fort was a serendipitous protector (Figure 18). Because of the cliff and the placement of the Fort, at ranges naval firing ranges of 500 meters or so, accurate fire required an approximately 0.4-degree-boresight elevation

precision to place a shot through an approximately 25m² window of “opportunity.” Although the British seamen were excellent shots and well trained the task proved too difficult.

“Most of the enemy’s shot fell against the rocks [cliff] below the battery. One of these (a thirty-two-pound ball) came over the bluff, struck the earth not far from Sackett’s mansion (then occupied by Vaughan’s family), and plowed a deep furrow into the doorway.” (Lossing, 1868)

Geologically, this cliff represents about seven meters of Trenton Group, “Shoreham” interval limestones of the Sugar River Formation (Table 2). From this location toward Horse Island, the overall topography of the land dips approximately 8m/km along the strike of the lakeshore (Wallach and Rheault, 2010), which is due to the Lake Ontario Homocline (Kay, 1942). This homoclinal structure is likely the result of Adirondack mountain orogenesis to the east with relatively recent glacial isostatic rebound. Along the lakeshore, from this location, there are excellent opportunities for fossil collection and observation of mass-wasting processes due to shoreline weathering and erosion.

Table 2: Formational description of the Navy Point cliff.

Formational description	Thickness (m)	
	of unit	to base of section
TRENTON GROUP		
Sugar River Formation		
Limestone and shale (90/10); limestone, medium-light gray (N6) to dark gray (N4), calcisiltite to fine-grained calcarenite; relatively homogenous.....	1.5	6.3
Limestone; light gray (N7) to dark gray (N4), calcarenite to calcisiltite with shaley partings and occasional shelly, coquina-type calcarenites; generally nodular bedding; occasional bioturbation; bryozoans, <i>Paucicrura</i> , <i>Sowerbyella</i> , <i>Flexicalymene</i> , <i>Cryptolithus</i> and <i>Prasopora</i> ...	3	4.8
Limestone and shale (70/30); light gray (N7) to medium-light gray (N6), calcisiltite to calcarenite; laterally continuous centimeter-scale limestone beds with occasional thicker, 10-20cm, medium-grained calcarenite beds; bryozoans, <i>Paucicrura</i> , <i>Sowerbyella</i> , <i>Flexicalymene</i> , <i>Cryptolithus</i> and <i>Prasopora</i>	1.5	1.8
Limestone; medium-light gray (N6), calcirudite to very-coarse-grained calcarenite (shelly coquina); homogenous bed with rippled surface; <i>Oniella</i> and <i>Paucirura</i>	0.3	0.3

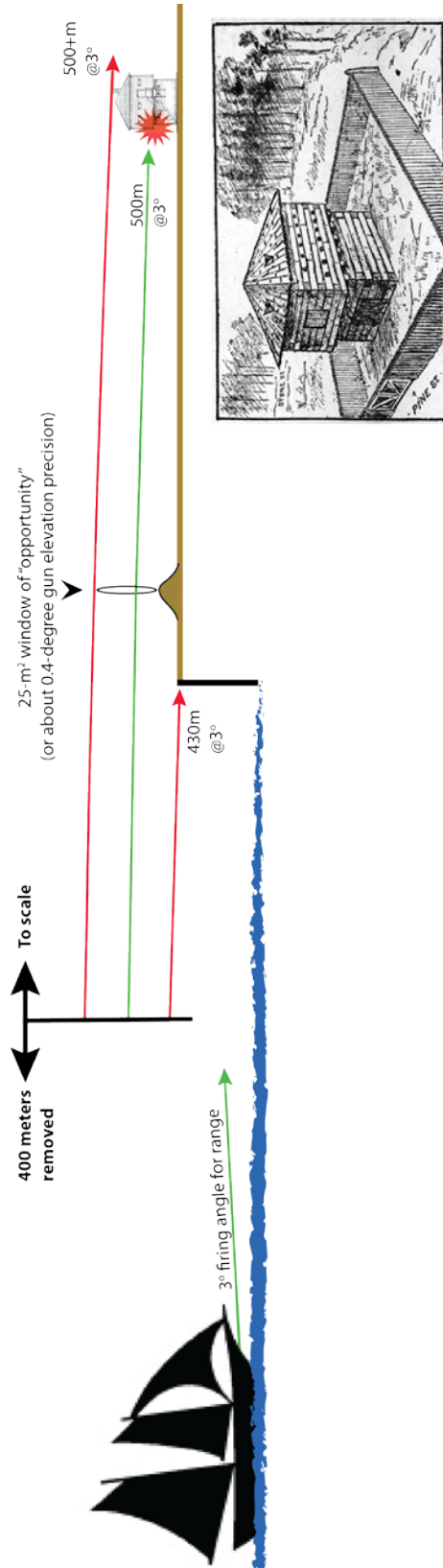


Figure 18. Scale reconstruction of the exemplarily-placed Fort Tompkins. Naval fire from the HMS Beresford (or other naval vessel) would be proximally limited to the harbor and the fort by a) fire from Fort Tompkins and b) unknown bathymetry of the lake. As a result, typical shots from the ship would be in the 100's meter range (here shown from 430 to 500 meters). In order to make a hit on Fort Tompkins, sailors would need to "hit" a 25-square-meter "window" of opportunity, which would only be successful if they were able to fine-tune their traverse (left-right) and elevation (up-down, 0.4-degree range at 500 meters). Although British sailors were excellent shots, winds, waves and return fire prevented them from successfully defending their advancing infantry.

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