FINAL REPORT

PHASE III INVESTIGATION OF THE *CLOTILDA* WRECK SITE (1BA704) BALDWIN COUNTY, ALABAMA

PREPARED FOR

ALABAMA HISTORICAL COMMISSION

PREPARED BY

SEARCH

SEARCH PROJECT NO. S21141

MAY 2024

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FINAL



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MAY 2024

SEARCH PROJECT NO. S21141

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EXECUTIVE SUMMARY

Between 2 May and 13 May 2022, SEARCH conducted Phase III submerged cultural resource investigations for the Alabama Historical Commission that were focused on archaeological and environmental characterization and structural integrity assessments of the *Clotilda* shipwreck (1Ba704) in the Mobile River, Baldwin County, Alabama. This work was done in partnership with RESOLVE Marine Group (RESOLVE), Stantec Consulting Services, Inc. (Stantec), and other partners. This project was conducted under nationwide permit SAM-2018-01100, issued by the U.S. Army Corps of Engineers in compliance with the National Historic Preservation Act of 1966, as amended.

James P. Delgado, PhD, RPA served as Project Manager. Dr. Delgado, Justin Dunnavant, PhD, Ayana Flewellen, PhD, and Michael L. Brennan, PhD served as Principal Investigators. Dr. Delgado meets the Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation* (48 FR 44716-42) and is listed on the Register of Professional Archaeologists (RPA). Fieldwork was completed by Michael Brennan, Bria Brooks, Austin Burkhard, James Delgado, Justin Dunnavant, Ayana Flewellen, Joseph Grinnan, Jay Haigler, Kyle Lent and Kamau Sadiki. SEARCH was subcontracted to RESOLVE Marine Group for this work, and brought in other partners and team members including Stantec, Terra Mare Conservation, Diving With A Purpose, the Slave Wrecks Project, Society of Black Archaeologists, University of West Florida, Dauphin Island Sea Lab, University of Wisconsin-Madison, forensic naval architect Larrie M. Ferreiro, PhD, SurvTech, Seatronics, Applied Technical Services, Inc., Southern Earth Sciences, Waypoint Analytical and Hydro International.

Industrial methods included a 100-foot spud barge with an American 5530 crane with a 140-foot boom and a 35 short ton lift capacity on site that assisted commercial divers in removing trees and other debris that had floated down river and snagged on the exposed hull remains of *Clotilda*, potentially harming the shipwreck. These obstructions also posed hazards to diver operations and limited access to the preserved lower hull structure and the interior of the wreck, which previously had not been accessible for study and documentation. Once the tree debris was removed from the site, divers lifted 94 disarticulated hull timbers and other artifacts from the wreck and surrounding riverbed for documentation aboard the barge by project archaeologists, conservators and scientists. Scientific sampling included sediment push cores for microbiology, meiofauna, heavy metal geochemistry, and pollen, which were processed on board the barge and sent to laboratories for analysis. Timbers and artifacts were photographed on deck, and diagnostic artifacts were sketched and scanned with LiDAR for 3D rendering. Four artifacts were retained at the request of AHC for conservation and further analysis. The remaining 90 timbers and non-wood artifacts were returned to the wreck and secured on the site by divers in a non-sensitive area of the wreck, which was then partially covered with sandbags filled with silt previously excavated from the site and screened, to stabilize the site.

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ACKNOWLEDGMENTS

We wish to thank Governor Kay Ivey and the Alabama Legislature for funding this phase of research, and Lee Sentell, Director of the Alabama Department of Tourism and Travel who funded the documentation of the project by Emmy Award winning videographer and photographer, Daniel Fiore.

Many agencies and organizations greatly contributed to the success of this project. The trust extended to the project by the Africatown community and the *Clotilda* descendants is gratefully acknowledged, and we again express our gratitude for being allowed to play a role in aiding the narrative of the *Clotilda* story. It was again an honor to be trusted with this resource and the stories the wreck itself can reveal, and to be able to answer questions in the two public meetings before and after the project's on-water work. We are also grateful for the involvement and contributions of Diving With a Purpose, the Slave Wrecks Project, and the Society of Black Archaeologists. We also acknowledge and thank Fredrik Hiebert, PhD, Archaeologist-in-Residence for the National Geographic Society, for his ongoing interest, involvement and support.

Once again, the tireless contributions of the leadership and staff at the Alabama Historical Commission (AHC) and the support of the Commissioners allowed the project to operate smoothly. The on-barge participation of Lisa D. Jones, MBA, Executive Director and State Historic Preservation Officer, and Stacye Hathorn, MA, State Archaeologist was greatly appreciated as both representatives of the state and as fellow cultural resources professionals, managers and archaeologists. As this report notes, once again the AHC demonstrated a best-practices approach to the people and to and for the resource as the stewards of the public interest. This was also powerfully demonstrated by AHC's commitment to daily release of images from the project and daily on-line posts of what had been observed and accomplished each day. This level of transparency and inclusivity provided access to the industrial setting and working environment throughout the project.

We also thank the U.S. Army Corps of Engineers (USACE) for their review, public consultation and coordination and approval of the permit for the project, and for the participation of USACE archaeologist Timothy Dodson, Regulatory Archaeologist for the Nashville and Mobile Districts as a valued colleague on the barge and in the water on this project, as well as Dylan Hendrix, Senior Project Manager for the Mobile District. We also again acknowledge and thank Senator Vivian Davis Figures for her continued involvement with this project and for her on-barge visit, and the visit to the project by the Commissioners of the Alabama Historical Commission. We also thank Col. Jeremy J. Chapman Commander and District Engineer for the Mobile District, for his and his staff's visit to the project, and Mayor Sandy Stimpson of Mobile for his visit with Meg McCrummen Fowler, PhD, Director of the History Museum of Mobile. The interest in first-hand observation by these government officials is appreciated.

We are grateful to the RESOLVE Marine Group for their management of the overall project and the exceptional support both on and off the barge as work progressed from planning to the other stages of this complex project. The various partners, subcontractors and experts who again assisted added much to this project and to the final results. We thank Aaron Joszef of RESOLVE Marine Group who served as the Project Manager and Safety Officer for this project. We thank Stantec, represented on the project by Dominic Kempson, Vice President, Environmental Services and Sector Lead, Water Resources, Carl Ferraro, Associate and Senior Environmental Scientist, Emma Hefernan, Fish and Wildlife Biologist, and Michael Moloney, PhD, Archaeologist, for their active roles and contributions. We thank Terra Mare Conservation, represented by Claudia Chemello, President and co-founder, and Paul Mardikian, co-founder and Senior Conservator, for their active roles and contributions. We also thank Pete Kelsey, SurvTech, Seatronics, Applied Technical Services, Inc., Southern Earth Sciences, Waypoint Analytical and Hydro International.

We acknowledge and appreciate the diligent analysis of the fabric sample (WP-26) from the site by the Smithsonian's Museum Conservation Institute, with our thanks to Paul Gardullo from the National Museum of African American History and Culture, and the analytical team of E. Keats Webb, Imaging Scientist, Thomas Lam, Physical Scientist, G. Asher Newsome, Physical Scientist, and Gwénaëlle Kavich, Head of Technical Studies/Conservation Scientist. This analysis confirmed that the sample was intrusive and likely originates from a nearby early twentieth century shipwreck that was partially scrapped next to *Clotilda*.

The support and assistance in the pre-project, field-work and post-project phases is gratefully acknowledged; we thank the SEARCH in-house family of Anne V. Stokes, PhD, CEO and Principal, James Pochurek, President and Principal, Michael Arbuthnot, MS, RPA, Vice President, Katryn Mitchell, PE, MBA, Director, Frederick A. Veitch III, JD, General Counsel, Michael Cugini, Senior Human Resources Director, John Albertson, MA, Senior Project Manager and Maritime Archaeology Sector Leader, Emily Moss, MS, Project Manager, Lisa McNeely, Senior Administrative Specialist and Executive Administrative Coordinator, Charity Marie Moya, Senior Logistics Specialist, Serena Arbuthnot, Senior Administrative Specialist, and Kristine Santos, Administrative Specialist.

This report was peer reviewed by Benjamin Ford, PhD, Ian Mcleod, PhD, Greg Waselkov, PhD, Jack Irion, PhD, Ellen Wohl, PhD and Elizabeth Pendleton, MA. The team appreciates their rigorous and detailed review, edits and suggestions.

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LIST OF ACRONYMS AND ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
AHC	Alabama Historical Commission
Al	Aluminum
As	Arsenic
ASV	Amplicon Sequence Variant
Ba	Barium
C	Centigrade
Ca	Calcium
CHIRP	Compressed High Intensity Radar Pulse
cm	Centimeter
Co	Cobalt
Cr	Chromium
CTD	Conductivity, Temperature, Depth
Cu	Copper
DNA	Deoxyribonucleic Acid
DWP	Diving With A Purpose
EPA	Environmental Protection Agency
Fe	Iron
FFM	Full Face Mask
FS	Field specimen
ft	Foot
G	Gram
GPS	Global Positioning System
GSA	General Services Administration
H_2S	Hydrogen sulfide
HAER	Historic American Engineering Record
HCl	Hydrochloric acid
Hz	Hertz
ICOMOS	International Council on Monuments and Sites
ICP-OES	Inductively Coupled Plasma Optical Emission spectroscopy
in	Inch
K	Potassium
kg	Kilogram
km	Kilometer
kHz	Kilohertz
L	Liter
Li	Lithium
LiDAR	Light Detection and Ranging
m	Meter
Ma	Million Years Ago
mg	Milligram

mi	Mile
ml	Milliliter
µmol	Micromole
Mn	Manganese
NDBC	National Data Buoy Center
NHL	National Historic Landmark
Ni	Nickel
NOAA	National Oceaographi and Atmospheric Administration
NRHP	National Register of Historic Places
NRIS	National Register Information System
O_2	Oxygen
OTS	Ocean Technology Systems
OTU	Operational Taxonomic Unit
Pb	Lead
PCR	Polymerase Chain Reaction
ppt	Parts per thousand
PSU	Practical Salinity Unit
RESOLVE	RESOLVE Marine Group
RFP	Request for Proposals
rRNA	Ribosomal Ribonuclaic Acid
SBA	The Society of Black Archaeologists
SEARCH	Southeastern Archaeological Research, Inc.
Si	Silica
Sn	Tin
Sonar	Sound Navigation Ranging
SOW	Scope of Work
Sr	Strontium
SS	Steam ship
Stantec	Stantec Consulting Services, Inc.
SWP	The Slave Wrecks Project
Ti	Titanium
TMC	Terra Mare Conservation LLC
TOC	Total Organic Carbon
UNESCO	United Nations Educational, Scientific and Cultural Organization
U.S.	United States
USACE	United States Army Corps of Engineers
V	Vanadium
XRD	X-Ray Diffraction
Zn	Zinc
Zr	Zirconium

INTRODUCTION

This report focuses on the results of the Phase III investigations of the remains of the 1855-built, 123-ton, 86-foot-long, 23-foot-wide, wooden two-masted schooner *Clotilda* (1Ba704), conducted in May 2022. This follows and builds upon work previously reported through earlier phases of the project as well as the National Register of Historic Places nomination of *Clotilda* as an historic and archaeological site of national significance, which summarized that which was known about the site following the various phases of archaeological investigation and archival research (Delgado et al. 2018, Delgado et al. 2019, Delgado et al. 2019a).

The work outlined in this report was the latest in a progression of studies that conducted a systematic survey of the Mobile River that identified a ship graveyard, scientifically identified one of the wrecks in the graveyard as *Clotilda*, and then conducted initial assessments of it with minimally invasive techniques while also monitoring environmental changes to the site. In the FY 2021 budget for the Alabama Historical Commission (AHC), the State of the Alabama through the Governor and Alabama State Legislature appropriated $1 Million for a Phase III assessment that would inform ongoing preservation efforts for the *Clotilda* wreck site.

In response to a request for proposals for the Phase III work, a consortium led by the RESOLVE Marine Group, SEARCH, Inc., and Stantec were awarded the project through a competitive bid process. Other projects partners are listed in this report, but it is important to call out the first on-site presence of conservators, Terra Mare Conservation LLC (TMC), as a key aspect of this project was a conservation assessment with an emphasis on understanding site conditions but also with a specific focus on a site preservation plan. As well, the project included partners from the Slave Wrecks Project and Diving With A Purpose, and with new partners from the Society of Black Archaeologists, who served as co-principal investigators. A broad range of partners from academia, research laboratories, and government also formed the largest team yet assembled for work on the *Clotilda* site. A range of *pro bono* services and assistance were also provided and acknowledged in this report.

Project work was planned for 2021, but was delayed by the COVID-19 pandemic until May 2022. The ten-day field project began on May 2 and ended May 11, 2022. All work was conducted under nationwide permit SAM-2018-01100, issued by the US Army Corps of Engineers in compliance with the National Historic Preservation Act of 1966, as amended. The Corps' letter of compliance in regard to the permit is included in this report as **Annex A**.

The ten-day maritime mission adhered to best practices for industrial and archaeological diving, documentation, scientific observation and sampling, conservation, engineering, and forensic science and practice. It met all conditions of the US Army Corps of Engineers' permit, was a model of diversity, equity and inclusion, public outreach, transparency and consultation. The team also followed guidelines set forth in the Abandoned Shipwreck Act of 1987 (43 USC 2101-2106) and the 1996 United Nations Educational, Scientific and Cultural Organization/ International Council on Monuments and Sites (UNESCO/ICOMOS) Charter on the Protection and Management of the

Underwater Cultural Heritage. In addition to the archaeological work, this phase of work also focused on supporting environmental and structural assessment of the site and an engineering study of the riverbed to inform stability. Coring, sampling and the placement of monitoring equipment enabled analysis of the composition of the sediment around the wreck, monitored water movement, and performed a biological review of the species that have colonized the wreck area. A report on the sediment sampling methodology by Stantec is provided in **Annex B**. A structural assessment appraised the level of deterioration and condition of the wood, with an emphasis on residual strength and stability of the wreck as well as implications for the ongoing preservation of the wreck if it were to remain *in situ*.

The project concluded with a meeting with the Africatown community at the Robert L Hope Community Center on May 12, 2022 to discuss the preliminary results of the work and answer questions. The RMG-60 was removed from the site on May 13, final scientific samples were packed for shipment to various laboratories, concluding this phase of archaeological and scientific investigations at the site. Weather and river conditions were highly favorable, with both minimal current and exceptional underwater visibility that ranged from eight to thirty centimeters; in most other phases, visibility has been less than eight centimeters and often dark with zero visibility.

Clotilda's Significance

The schooner *Clotilda* (1Ba704) is an archaeological site in the Mobile River that is submerged, substantially intact, and partially buried. The vessel is significant because it is the last known ship to have transported captives from Africa to the United States with the purpose of enslavement. As an archaeological site, the substantially intact wreck of *Clotilda* is of exceptional national significance as the only American slave ship lost in the context of its slave-trading career whose remains have been located and positively identified. The story of this vessel and attempts at its destruction to avoid prosecution, the resistance and resilience of the people forcibly brought to America in it to be enslaved, and their post-Civil War forming of Africatown, itself a National Register historic district of national significance, became an important touchstone in collective memory.

The 19th and 20th-century accounts of the surviving *Clotilda* captives in newspapers and magazines shared their story with a larger American audience. The ongoing survival of Africatown is a highly significant example of cultural persistence with great meaning. As such, pinpointing the exact location of *Clotilda*, the initial *focus* of that involuntary voyage that in time led to the creation of this African American community, takes on additional significance.

The wreck of *Clotilda*, located in 2018-2019 as part of a thorough archaeological investigation and confidently identified (Delgado et al. 2019b), is of national significance under National Register Criteria A and D for its associations with the ethnogenesis of the African-American community, especially through the voyage forcibly merging a diverse ethnic community of African captives into a community of involuntary "shipmates." That community, upon arrival in Mobile, was dispersed, but following the end of the Civil War and the abolition of slavery, one

group of thirty-two women and men from *Clotilda* formed their own new community and identity in Africatown, on land bought and leased from their former enslaver. There, with determination, resilience, and adhering to their beliefs and cultures, they forged a legacy that was passed on to their descendants.

Africatown, a National Register historic district (NRIS#12000990), was listed on December 4, 2012. Among Africatown's many culturally significant distinctions, the community members have a direct link to *Clotilda* and the illegal voyage. The connection between a specific vessel and a living community, Africatown, is rare and highly significant. *Clotild*a's connections to and role in regional maritime trade and commerce, reflected through its form and construction, cargo and voyages, illustrate how integrally the maritime commerce of the region was linked to the use of enslaved labor in maritime trades, industries, and agriculture. *Clotilda*'s entire maritime career is a microcosm of the maritime history of the Gulf of Mexico and its many ports of trade, including Cuba.

The forced diaspora of Africans to the Americas, including what is now the U.S., spanned four centuries with profound impact. The social, political, and economic fabric of American society was strongly influenced and molded by the diaspora and chattel slavery, with repercussions that powerfully continue in the 21st century, nearly two centuries after the end of institutional slavery in the U.S. The voyage of *Clotilda*, physically and symbolically, is of exceptional national significance, not only because it was the last known slave ship, and "infamous," but because it represents continuity in the institution of global and American slavery.

As a shipwreck which retains a high level of archaeological integrity, *Clotilda* has a unique place in the ongoing study of the slave trade and slavery. It offers yet more empirical archaeological evidence of how the slave trade worked in its last phase as an illegal activity within the parameters of a dominant social and economic system that tacitly or overtly accepted this type of illegal activity by participating in it, or by "looking the other way" as demonstrated by the reaction of Mobilians as the news of *Clotilda*'s voyage reached a national audience in 1860 with mocking denials in the local newspaper (Mobile *Daily Mercury*, July 28, 1860). At the same time, the "failed" effort to find the ship and its captives, followed by a half-hearted prosecution of the crime by local Federal officials with the responsibility of enforcing the law banning participation in the African slave trade also speak to an inherent acceptance if not complicity.

"Looking the other way" was denying knowledge of the origin of recently arrived people bound into slavery on various plantations, or the "failure" to find where *Clotilda*'s wreck was located in 1860. What has been recognized as far back as the late 19th century and what has carried forward are the survival of narratives and the passing on to later generations of what such a voyage was for the people captured and transported in *Clotilda*. The legacy of the *Clotilda* "shipmates," as they came to refer to themselves, is more than relaying the tale of their capture, sale and voyage.

The *Clotilda* Descendants Association, first incorporated in Alabama in 1984, was chartered to "preserve and perpetuate the culture and heritage of the last Africans brought to America . . . [and to] enlighten society about their descendants and African history" with a goal, now that *Clotilda*'s wreck has been identified,

> To bring all things *Clotilda* to light . . . things infamously, and literally done in the dark when that illegal ship set sail from Benin on the west coast of Africa with our terrified relatives crammed into overcrowded, filthy cargo holds. WE will forever tell their stories, uphold their legacy, build the 'Africatown Museum and Performing Arts Center' to honor them and others who helped shape the community . . . and press for accountability of the crime that *was Clotilda* (https://theclotildahistory.com).

The final voyage of *Clotilda*, as the last slave ship to carry captives to the U.S., transported 110 people, at least one and perhaps as many as three of whom died during the passage. The social impact of *Clotilda* at the time of its voyage was such that the event made news throughout the U.S. and internationally in 1860. A series of subsequent newspaper and magazine articles in the 19th century referenced the voyage, but specifically focused on the stories of surviving members of the community formed by the captives carried to Alabama on *Clotilda*.

Their accounts speak to the experiences of their capture, sale to Captain Foster, embarking on *Clotilda*, the voyage, and the evening disembarkation into the steamboat *Czar*. They speak of fear, of the strangeness of the Americans who took possession of them, of the experience of boarding *Clotilda* and being locked in the hold, of sea sickness, and of the death of at least one and as many as several of the captives at sea (Durkin 2024: 57–59). They also relate how they were taken in groups on to the deck when *Clotilda* was well out to sea, and their amazement at seeing nothing surrounding them but the ocean, with no hope of escape. Those stories offer a rare, first-hand account of an individual made a captive, sold, forcibly transported on a transatlantic slave trade voyage, in this case on *Clotilda*, and then enslaved in the US.

In the US, starting with late nineteenth- and early twentieth-century accounts, and in the aftermath of the early twenty-first-century identification of *Clotilda*'s wreck, the story of *Clotilda*'s final voyage from Ouidah to Alabama is now better known than other nineteenth-century slave trade voyages, in large measure because of the testimony of some of the captives taken to America in it and the publication of those accounts. This was the last recorded voyage of tens of thousands. In addition, Timothy Meaher, William Foster and the crew of *Clotilda* were never held accountable for their crime.

The schooner, in addition to the final voyage and suspected involvement in the slave trade, was also not "innocent." The complicity of the vessel and its owners in the crime of abetting the illegal slave trade began before and continued with the wager between Timothy Meaher and others to purchase, outfit and sail *Clotilda* to Africa. The discovery of the remains of the ship, and additional research, both archival and archaeological, have and will continue to add more to understanding and documenting how *Clotilda* was built and operated as part of and in support of an economic and social system that relied on chattel slavery and forced labor. Every voyage between 1855 and 1860 saw the schooner loaded and unloaded with enslaved labor, and loading products extracted, manufactured, or refined using forcibly stolen labor. Complicity in this crime was not relegated to the South alone. The trade and commerce of the South fed Northern and international coffers as well. To simply identify *Clotilda*'s context regarding slavery by focusing

on the final voyage is short-sighted. Instead, the economic, social, and political influences and consequences of slavery defined *Clotilda*'s entire career.

The focus of this story should therefore be on the people carried on board the schooner, their resilience and survival, and the ongoing saga of the families and the communities they have left as part of the fabric of Alabama, the US, and the world in the twenty-first century. In that context, the story of *Clotilda* and the people involved in its saga represent a local convergence of events that were both global and national in scope—the slave trade, both in Africa and transatlantic, the role of slavery in America, and the formation of the US, Alabama, and Mobile and especially of Africatown. *Clotilda* is the nexus of this story, as the vessel in which the primary act, accomplished through force, brought the people carried in it against their will to the US.

Clotilda's Final Voyage

The schooner *Clotilda* arrived off the Point of Pines in Mississippi Sound, just outside Mobile Bay, on July 6, 1860 at the end of a four-month, nine-day voyage (Foster 1890; Robertson 2008: 63). The voyage commenced on February 27, 1860 when *Clotilda* cleared Mobile with the stated purpose of sailing to "St. Thomas or a Market" with a declared cargo of 41,000 board feet of lumber, eighteen barrels of whiskey, seventy-five barrels of flour, forty-six barrels of beef, and seventy-four barrels of bread. Instead of what he had declared, Captain William Foster planned an illegal voyage at the West African port of Ouidah, where *Clotilda* would forcibly embark enslaved persons purchased with money obtained from prominent Mobile businessman, ship builder Timothy Meaher (Roche 1914:71). Their intentions were a Federal crime, as American participation in the African slave trade had been declared illegal by the Congress of the U.S. in 1807. Slavery, however, remained legal in those states that wished to retain it, and the booming cotton economy of the U.S. depended on enslaved labor.

Ouidah was the home of Badahou, or Glele, the King of Dahomey from 1858 to 1889 (Appiah and Gates 2005:251). Meaher had proposed the voyage to Ouidah to his fellow slave holders as a bet that, the law notwithstanding, he and his co-conspirators could get away with the crime. As local historian Emma Roche would later write, "the wager was taken and the stakes were large" (Roche 1914:71). Several months after that bet, *Clotilda*, its hold packed with an unwilling human cargo, now came to anchor at an isolated spot, the journey almost complete. Foster (1890) later stated the crew stood at twelve, including himself.

The purpose of the voyage, Captain Foster would relate in a late life reminiscence, had not originally been shared with the crew. As of 1820, with the passage of an amendment to an act protecting commerce and prohibiting piracy, participation in the transatlantic slave trade became a capital offense. At the time *Clotilda* arrived off Mobile, seventy-four individuals had previously been prosecuted by Federal authorities for conducting or participating in slaving voyages with the intention of violating of that law, but none had been executed while others, though guilty, had been cleared of charges by sympathetic juries (Thomas 1997:774).

Nevertheless, it was a felony punishable by death. The crew, Foster would write, when they learned of the real nature of the voyage, mutinied and demanded more pay if they were to be involved in an illegal slaving voyage. Foster promised to pay them double their agreed-upon wages at the end of the voyage, although a later account suggests he may not have intended to do so, as his widow late in life related his belief that "promises were like pie-crust – made to be broken" (Roche 1914:85).

In his own reminiscence, written later in life (Foster 1890), he notes he paid his crew $8,000, which was the earlier, agreed-upon wage. Now, at the end of the voyage in early July 1860, anchored off the Gulf Coast of Alabama, they once again mutinied and demanded their extra money. On board *Clotilda*, as Foster negotiated for the final time with his crew, were one hundred and nine people locked below deck. Foster had purchased them from the King Glele of Dahomey at Ouidah on the west coast of what is now Benin. Foster had brought "nine thousand dollars in gold and merchandise," and upon landing in Ouidah, had told local officials he "wanted to buy a cargo of negroes, for which I agreed to pay one hundred dollars per head, for one hundred and twenty five" (Foster 1890). That led to direct negotiations with King Glele. Foster and Glele "went to the warehouse where they had in confinement four thousand captives in a state of nudity, from which they gave me liberty to select one hundred and twenty-five as mine, offering to brand them for me, from which I peremptorily forbid" (Foster 1890).

Although held at Ouidah, the captives had come into Glele's possession from raids on and warfare against various other cultures in southwestern and central Nigeria, Benin, and, in one case, as historian Natalie Robertson's research in West Africa has shown, "a Fon national from Dahomey itself" (Robertson 2008:6). War meant wealth, especially when captives were sold as "profitable commodities and exchanged for European goods on the Atlantic coast," a practice that dated back centuries (Smallwood 2007:27). Shaved, stripped, and taken offshore in long narrow canoes, men, women and children were loaded into the hold of *Clotilda* where lumber had been carried during the schooner's five-year career. A later account, drawing on the reminiscences of *Clotilda* survivors, stated that the "hole" was "better than most slavers," as it was "deep enough to permit men of lesser stature to stand erect" (Roche 1914:88). These were brutal, harsh conditions that the captives were forced to endure.

The size of the hold as a space in which 110 captives were forcibly imprisoned, meant tightly crowded conditions. One survivor, Baquaqua, later recalled that "day and night were the same to us, sleep being denied us from the confined position of our bodies, and we became desperate through suffering and fatigue" (as cited in Diouf 2007:62). The captives were locked in the hold for thirteen days following *Clotilda*'s departure from Ouidah, and then, according to Cudjoe Lewis and other survivors, the enslaved were allowed to go out on deck, possibly in small groups, but the circumstances and conduct of that part of the voyage is not documented. This access to the deck was unlikely available to all 110 captives and at all hours, but nonetheless it was "contrary to what was the norm during the illegal slave trade" (Diouf 2007:63). Diouf notes that two captives died on the voyage (Diouf 2007:64) and Foster's reminiscence states that one woman died on the passage (Foster 1890). Recent scholarship by Durkin (2024) suggests several people died during the voyage (Durkin 2024: 57–59).

After a forty-five day voyage from Africa, Foster waited off Mobile to meet Meaher "and party" for the purpose of landing the captive Africans and paying the crew off. Paying the crew was paramount; Foster later noted that the "mates and crew did not want me to leave the vessel until they were paid for voyage and said they would kill me if I attempted to take the negroes ashore without their money" (Foster 1890). Foster had previously made arrangements with the mates and crew to take the vessel to Tampico, Mexico, clean it up and change the name, and then get clearance for New Orleans. However, as Foster later wrote, "the parties failing to meet me in time compelled me to go up to Mobile" (Foster 1890). Foster landed and hired a horse and buggy for the overland trip from his point of debarkation to the coastal city of Mobile. Once in Mobile, Foster and Meaher chartered the Mobile-registered tug *William H. Jones*, colloquially known locally as *Billy Jones*, commanded by Captain James W. Hollingsworth, to take them back to *Clotilda* and then to tow it into Mobile Bay.

Paying off his crew and sending them away on the steamboat *Texas*, then bound upriver for Montgomery, Foster and a crew of five men, hired in Mobile, stayed with *Clotilda* as the tug towed it along the coast in the darkness of night. Working into the bay, past the city and evading mandatory customs inspection, the captain entered the Spanish River, and followed it up to the junction of the Spanish and Mobile Rivers. Foster's account states they "towed *Clotilda* into Mobile & up to 12 Mile Island & transferred the n**** on board the river steam boat the *Czar* & then I burned her & sank her in 20 feet of water, & then steamed 50 miles up the river & landed all the n**** on Dabneys Plantation" (Foster 1890). Emma Roche wrote a more dramatic account in 1914: "lights were smothered, and in the darkness quickly and quietly the *Clotilde*'s [sic] cargo . . . was transferred to the steamboat," and then "the *Clotilde* [sic] was scuttled and fired, Captain Foster himself placed seven cords of light wood upon her" (Roche 1914:96–97).

The steamer proceeded fifty miles upriver and landed the people in the canebrake on the banks of the river off the plantation of Virginia-born planter John M. Dabney. Dabney was a friend of the Meahers and one of the bettors and conspirators. There was a regular steamboat landing at Dabney's plantation, forty-nine miles up from the mouth of the river (Berney 1878:310). At Dabney's plantation, the captives were apportioned to the various parties in on the deal, enslaved and separated from the companions they had formed a bond with through their common ordeal as "shipmates" who had "become a second family" on *Clotilda* (Diouf 2007:82). Many of the captives were separated and never reconnected as they were sent in different directions, some far away. The *Mobile Mercury* noted on July 23, 1860, for example that "some negroes who never learned to talk English went up the railroad the other day. There were twenty-five of them, apparently all of the pure, unadulterated African stock" (as cited in American Anti-Slavery Society 1861:127). It was yet another heartbreaking time that would be recalled in later years by the survivors to interviewers late in life, and shared with family members.

In addition to the voyage violating the slave trade law, perjury on the official declaration when leaving port, and failing to report to Federal officials when reentering Mobile, the burning and sinking of *Clotilda* was barratry, the legal term for the crime of a captain deliberately wrecking or destroying his ship by any means. That law specifically included ships that were insured, as *Clotilda* was. The slave trading crime was quickly discovered, however, and the news of the illegal

importation of captives to be enslaved spread not only to government officials, but to the entire country via newspapers (Diouf 2007:77–79). On July 10, 1860, the [Nashville] *Tennessean* reported that "The Schooner *Clotilda* with 103 Africans arrived in Mobile Bay and a steamboat took the Negroes up the river" (The [Nashville] *Tennessean*, July 9, 1860:3). The event was nationally publicized, with stories in various newspapers, including the papers in Janesville, Wisconsin; Baltimore, Maryland; Wilmington, North Carolina; New Orleans, Louisiana; and Montgomery, Alabama, for example (*Janesville Daily Gazette*, July 14, 1860:3; *Montgomery Weekly Post*, July 18, 1860:1; the [Baltimore] *Daily Exchange*, July 11, 1860:1; the *Wilmington Daily Herald*, July 12,1860:3). The incident became international news with a summary of the slave trade in *The* [London] *Morning Post* on October 5, 1860 that included an entry for *Clotilda*.

The news, both locally anecdotal and nationally published, spurred a search for *Clotilda* by the US Government. The *Mobile Mercury* of July 28 questioned the search, claiming local "wags" were spreading false tales that had led to the US Marshal's actions:

> The wags are certainly incorrigible. They have had the Federal authorities quizzed bad enough, in all conscience, rung hither and thither, looking for the *Clotilde* [sic] and her negroes. We have no idea that any vessel by the name of *Clotilde* [sic] ever did bring any Africans inside of Mobile Bay, and that such a one is a mere fabrication; and no Federal officers have been on the qui vive for ever so long a time, all without making any discovery. The wags ought to have been satisfied with the trouble and anxiety they have given our very clever US officers, and it was cruel in them to start so soon again a report of the landing of a cargo of Africans at Mullet Point, last Friday night. We'll be bound if the Marshal should fire up the cutter and go down there, he wouldn't see a track of anything landed there but mullets. What these wags will get by shouting wolf, will be, by and by, when the wolf does come, and they shout wolf, nobody will believe them (as cited in the [New Orleans] *Times-Picayune*, July 29, 1860:3).

While the initial search failed to find *Clotilda*, or the people *Clotilda* carried to Alabama against their will, the U.S. Government pursued legal action against Meaher, Foster, and planter John Dabney. The search was ultimately of little avail, as the tensions of the time quickly led to the outbreak of the Civil War, and with that, Alabama's secession from the Union. Only Foster was punished with the imposition of a $1,000 fine for failing to meet with customs officials and return his documentation from the voyage. He never paid the fine. With that came the end of the legal case against the men, and pursuit of any others involved in the commission of the crime. Robertson (2008) provides an excellent summary of the legal cases (65–72).

Previous Investigations

Prior to this phase of work, four archaeological investigations were conducted on *Clotilda*. The first archaeological investigation to be conducted in the vicinity of the wreck site occurred in March 2018. The investigation assessed a shipwreck which was suggested to be that of *Clotilda*. The vessel was determined not to be *Clotilda* but did result in archaeological documentation of the Twelvemile Island Wreck Site (1Ba694), whose archaeological remains indicate that it is a Pacific Coast-built wooden schooner or auxiliary schooner of a type built extensively during World War I and possibly the four-masted auxiliary schooner *Else* (Delgado et al. 2018a). The first investigation concerning the wreck that was determined to be *Clotilda* was conducted in July 2018. The investigation included a comprehensive remote-sensing survey and subsequent diver investigations of a previously unsurveyed portion the Mobile River (Delgado et al. 2018b), which resulted in the documentation of numerous previously unrecorded historic vessels in a ships' graveyard.

The second investigation, conducted in December 2018 and January 2019, was an archaeological investigation of targets that had been imaged in the remote sensing record during the July 2018 investigation (Delgado et al. 2019). The December 2018 and January 2019 investigations were conducted to document all aspects of the imaged target, which was determined to be a historic shipwreck that was recorded and identified as 1Ba704 (*Clotilda*). The third, conducted in September 2019, involved a sector-scan sonar survey of *Clotilda* (Delgado et al. 2020). The fourth, conducted in March 2020, served to collect an updated dataset of remote sensing imagery of the site.

Current Objectives

The current phase of *Clotilda* work were conducted in accordance with the scope of work (SOW) defined by the AHC in its September 2020 request for proposals (RFP). The RFP requested diver assessment, artifact extraction, and specialized maritime archaeological investigations of the site. The RFP specifically asked for proposed research design and an artifact conservation plan as part of the response to the RFP. The proposed scope of work in the RFP specifically called for:

1. A high-resolution sonar survey of the interior of the exposed structure at 1BA704. The detailed imagery will inform assessment of risk to the site from the effects of ongoing erosion and other natural processes. The data will be used to develop a scientific, evidence-based plan to address and arrest effects of ongoing erosion and other natural processes, help to determine if stabilization of the site is necessary, and provide information to inform a preservation plan.

2. A marine geological study of 1BA704 that assesses the composition, structure, and resistance of the sediment in and around the wreck and an engineering assessment to determine both the stability of the site in its current context and the feasibility of any proposals to address stability problems if identified, such as a cofferdam or other structure that may be needed to protect

the wreck. The area around the wreck will also be investigated to evaluate the riverbed in consideration of erecting a monument on the site.

3. Installation, operation, and management of a system to measure and monitor river current and water movement both in and around the wreck for at least a year to further assess the degree of risk to the site from the effects of ongoing erosion due to seasonal water fluctuation and storm events.

4. A biological assessment of the benthic zone to identify the species that have colonized 1BA704, from bacteria through larger flora and fauna and to determine the degree to which the biological colonization of the wreck is causing decay.

5. A structural assessment of the hull by engineers to determine if the port side of the wreck, nearest the edge of the landform, needs support to preserve its integrity such as a cofferdam or other structure that may be needed to protect the wreck.

6. Targeted excavation to investigate the bulkheads and the hold of the ship with industrial dive efforts. Diagnostic and/or exhibit quality artifacts recovered during excavation will be stabilized and conserved, but the purpose of the project is to gather information necessary for a scientific, evidence-based plan to conserve and preserve 1BA704.

7. Collection of wood and iron samples from the decking, and frames inside the wreck and from areas currently buried to assess condition, level of deterioration, DNA sampling, and to inform a scientific, evidence-based plan to conserve and preserve 1BA704.

8. Systematic probing towards the stern of the vessel to confirm estimated length.

9. Assist AHC in providing information required to permit the project, including but not excluded to the Corps of Engineers Section 404 permit that will be required for the excavation.

All project work followed the detailed plan of work provided to the AHC in the response to the RFP in August 2020 that resulted in the award of the project. The research design, based on prior work, was subsequently utilized in the National Register of Historic Places nomination for *Clotilda* and accepted by the AHC and the Keeper of the National Register when the wreck was listed on November 8, 2021 as NRIS# SG100007119.

ARCHAEOLOGICAL RESEARCH DESIGN

To date, previous investigations have consisted of minimal intrusion. The focus was on identifying the extent of known wreckage, establishing identity, and understanding site conditions at present. The research questions initially formulated in 2018 were particularistic and tightly focused on assessing possible identification. Key questions in regard to the dimensions, shape and form of the hull, construction characteristics, the age of the wreck, and the site formation processes were paramount, as was determining if there were features specific to use of the vessel, if it was *Clotilda*, as a slave ship. Within this context, and the previous research design for assessing 1Ba704, a series of questions for ongoing archaeological work on *Clotilda* was developed. This was done noting that because of the unique nature of this vessel's ties to a living community of descendants, the archaeology of *Clotilda* should be a community endeavor and be tied to an overall archaeology that links *Clotilda* and its captives to Africatown and the larger descendant community.

An important aspect of this work is the focus on people. Based on the nature of this vessel and its voyage, different terms for people will be cited from historical records, and to describe the circumstances of captivity, confinement and abuse. "Captives," "enslaved," and "slaves" are among them. What we are speaking about are human beings. These were people taken against their will, and with no recourse, from their homes, from their families, and from their land and culture and transported to a new life of stolen, forced labor, and who were never able to return home. The story of *Clotilda* is one of their resilience and resistance, and of the lives they forged after 1865, building a community and families.

Clotilda Specific Research Questions

1. *Clotilda*'s remains indicate the survival of the partitions that were essential to the command and control of the captives.

A. What is the nature of the two partitions? What was their purpose?
B. Were they accessible below deck or only from above deck?
C. Are remains of platforms or partitions used to confine and accommodate a large group of people evident?
D. Historical accounts of other voyages on other ships indicate segregation by gender and age. Is there evidence of this embodied experience?
E. Are instruments or evidence of restraint present?
F. Are artifacts that speak to providing food and water for a large, confined group of people located within the remains?
G. Does the material record support a hypothesis of rotation of the captives to the deck on a regular basis?
H. Is there archaeological evidence that speaks to the day-to-day experience of confinement? What is the embodied experience of captives based on the structure of the vessel?

2. *Clotilda's* remains and history support the suggestion that the illegal slave trade had evolved in its last years to effectively use any vessel that was fast and could accommodate a human cargo of sufficient size to be profitable, given that the ban on the trade had made the transportation and sale of African captives more lucrative on a per person basis.

A. What aspects of *Clotilda* made it well-suited for selection for a slave-trading voyage?

3. The level of preservation suggests that more than vessel structure and equipment might rest inside the hull.

A. What, if any, material culture is inside the vessel? If any, what is its nature and cultural context? Are there surviving goods from the manifest of cargo outbound from Mobile that were intended for possible trade in Africa in addition to purchasing people with gold?
B. Are there DNA or other organic traces of humans and human activities such as food and waste disposal in the lower hold or specifically in the bilge?

4. The scuttling of *Clotilda* has been variously described as both "opening sea cocks" to flood it as well as fire.

A. What does the material record indicate in regard to the scuttling process? Was this a deliberate attempt to remove all traces of *Clotilda*, or to hide the wreck in plain sight with no obvious and direct evidence of its final voyage?
B. What does the site of the scuttling and subsequent land and water use around the site say about post-scuttling knowledge of the wreck's identity and interventions on the site?

5. At its most basic level, the substantial physical, archaeological remains of *Clotilda* offer a unique opportunity to assess a slave ship in three dimensions.

A. Archaeologists can potentially draw inferences from the survival of the slave ship as a physical space that in and by itself speaks to the conditions and the experience of being held captive and transported on a slave ship that to date no other site can as no other slave ships lost during or at the immediate end of the commission of their crime have been found or excavated. The first archaeologists to enter the hold of *Clotilda* will be the first humans to fully enter that space since the captives embarked against their will at Ouidah were taken out of the hold and off *Clotilda* to board the steamboat *Czar* on a dark July night in 1860. This project has endeavored to address inequities regarding inclusivity within maritime archaeological practices, descendant community engagement, and the need for diverse voices throughout the process.

METHODOLOGY

The main platform used in the effort was the RMG-60, a 100 by 40-foot crane and dredge barge based in Theodore, Alabama, which was moored at the site with topside support equipment for dive operations, artifact stabilization and storage, equipment use and staging, analyses and archeological documentation. After transporting the barge and equipment to the project site and securing the work platform, AHC held a consultation meeting with the Africatown community and a press conference in the Robert L. Hope Community Center.

Working from the RMG-60, RESOLVE divers conducted dives with surface-supplied air and Kirby Morgan Superlite helmets. SEARCH and DWP/SWP/SBA divers were also deployed for various aspects of the work that did not involve industrial diving. These divers conducted dive operations using SCUBA equipment with full-face masks, complete with diver-to-surface tethered communications. The team utilized Ocean Technology Systems (OTS) Guardian Full Face Masks (FFMs) paired with a MK-7 Buddy line with hardwired OTS Floating Communication Cables, with a breaking strength of 1,176 kilograms. Diver communications were real-time through a closed-system with archaeological interaction and guidance.

Project work commenced with the removal of thirteen trees or tree limbs and one stump snagged on the wreck which were compromising its structural integrity, and also removed a displaced buoy to provide access to the archaeological divers and to provide unobstructed images in the remote sensing. After confirming that the archaeological site was clear of obstructions, RESOLVE divers systematically removed 94 disarticulated timbers for archaeological assessment. That work focused on cataloguing every recovered timber, measuring, and photographing them, and in some cases with diagnostic ones, scanning them three-dimensionally. As this work progressed, maritime archaeologists from SEARCH, DWP, SWP and SBA conducted the initial archaeological analysis and preliminary identifications both underwater and on the barge as RESOLVE divers raised the disarticulated timbers and associated artifacts following the plotting of their positions.

Once the interior of the wreck was cleared, RESOLVE divers established a centerline in the wreck, laid a 2.5-foot grid, and began systematic probing to confirm the portions of the wreck buried under the mud remain intact and to ascertain the depth of the mud inside the vessel and collected hand cores to observe the nature of the sediment in and around the vessel. The centerline and grid also provided the means to carefully control and record the location where samples were collected and where artifacts are recovered during test excavations inside the hull. All of the disarticulated timbers were lifted onto the deck of the RMG-60, assessed, photographed, and in diagnostic cases, both scanned and drawn. A tank on the barge was prepared and was utilized as a wet storage for the protection of the timbers and artifacts as they were assessed and documented.

The RESOLVE dive team worked their way methodically around the wreck and finally through the center of the vessel to ensure that all the loose pieces were recovered and recorded. After the divers exited the water, SurvTech ran multibeam sonar and aerial LiDAR to provide the first clear

image of the wreck without all the trees, snags, and disarticulated timbers that previously obscured the view. SEARCH maritime archaeologists continued to collect side-scan sonar imagery each morning so any changes to the site could be observed daily. Conservators from TMC joined the team and began a preliminary assessment of the condition of the disarticulated timbers and artifacts recovered. They also stress-tested a disarticulated piece of a hull plank to collect information about hull strength. A section of one timber was retained for dendrochronology testing at University of Alabama.

SEARCH scanned the artifacts and disarticulated elements using Pix4D software to create photogrammetric images that may be viewed from multiple angles before RESOLVE divers placed them back inside the wreck; only four artifacts with diagnostic features and with the potential to yield more information were retained for conservation. The four artifacts retained for analysis were X-rayed post-fieldwork by Applied Technical Services. These artifacts were a deck beam with pulley and tiller rope from *Clotilda*'s steering mechanism, the lead hawse pipe that the cable for the starboard anchor passed through, a section of well-preserved planking with circular marks (kerf chatter) from a steam saw, and a section of hull from above the waterline; the latter was the first time structure from the upper hull had been observed on the site. Also retained were a small collection of diagnostic iron fasteners not previously documented in the earlier phases of work.

Once the recorded and tagged, timbers were carefully placed back inside the wreck, the team prepared the tank on the barge for screening sediment. The amount of sediment removed was limited by the Army Corps of Engineers permit. RESOLVE divers under direct archaeological supervision via helmet camera and voice communication hand fanned silt and mud into a 3-inch dredge with a quarter inch screen on either end to remove the sediment from a two by one meter area along the port side and against the aft bulkhead of the main hold. The sediment was also hand screened by SEARCH maritime archaeologists as it was pumped into a holding tank onboard the barge. No significant artifacts were found during the screening, but the screening did result in the observation of a large amount of charcoal from wood that was completely fire-consumed. This new observation added to previous evidence of the fire that had consumed the upper works of *Clotilda*.

With excavation revealing the curve of the hull at the turn of the bilge inside the hold, archaeologists then extracted wood samples and sediment in direct contact with the hull planks at that location as well as from inside the gap between two of the frames that divers accessed by drilling through the planking to reach it. RESOLVE divers neared the base of the excavation, scientists from Western Carolina University and Stantec arrived onboard and prepared sterilized receptacles to receive scientific samples, secured the samples for travel, and took custody of the specimens for transport to the respective scientific labs in which the samples will be analyzed. The scope of work for RESOLVE and SEARCH for this specific task was limited to coordinating and conducting the work to collect the samples; the analysis and any subsequent work with the samples was conducted independently and the RESOLVE/SEARCH team is not a party to or aware of the final results of this work.

All of the disarticulated timbers and artifacts, with tags attached to indicate their original provenience, were replaced in the forward area of the hull, just aft of the bow and in the silt-buried forecastle (crew quarters) area of the hull. This area is strongly reinforced. Care was taken not to return any timbers to the hull inside the main hold, which is more exposed and archaeologically sensitive. Following this, and with the collection of the last environmental samples for analysis, burlap bags were filled with the screened sediment collected in the holding tank. RESOLVE divers carefully placed the sandbags back in the vessel as a protection measure for the vessel itself and the timbers placed back inside.

HIGH-RESOLUTION SONAR SURVEY

High resolution geophysical survey was conducted throughout the course of the project to document the condition of the site ahead of the project and as the work progressed during the course of the operation. A multibeam survey of the wreck site out to the river channel and a LiDAR survey of the shoreline was conducted by SurvTech Solutions on May 3 and 6, 2022. Data were processed and cleaned and developed into the map of the site shown in **Figure 1.**

SEARCH maritime archaeologists conducted repeated side-scan sonar surveys over the wreck throughout the project to document changes to the site. Two sonars were used, an EdgeTech 4125 dual-frequency (600/1,600 kilohertz [kHz]) side-scan sonar and a Garmin echoMAP CHIRP 54cv echosounder. **Figure 2** shows a survey of the site following tree removal and prior to excavation. The removed trees, which were deposited off site in the river channel, and the two spuds holding the barge in place are visible at the top of the image.

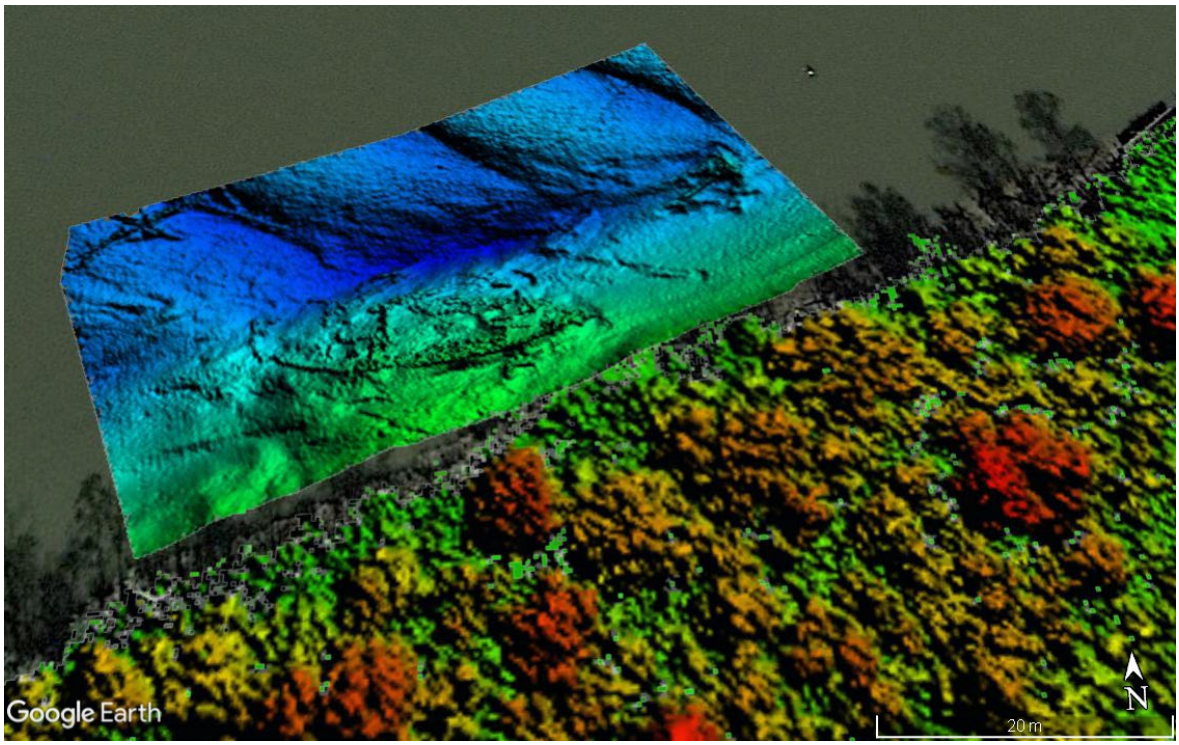


Figure 1. Multibeam sonar and LiDAR map of *Clotilda* wreck site and shoreline (SurvTech Solutions).

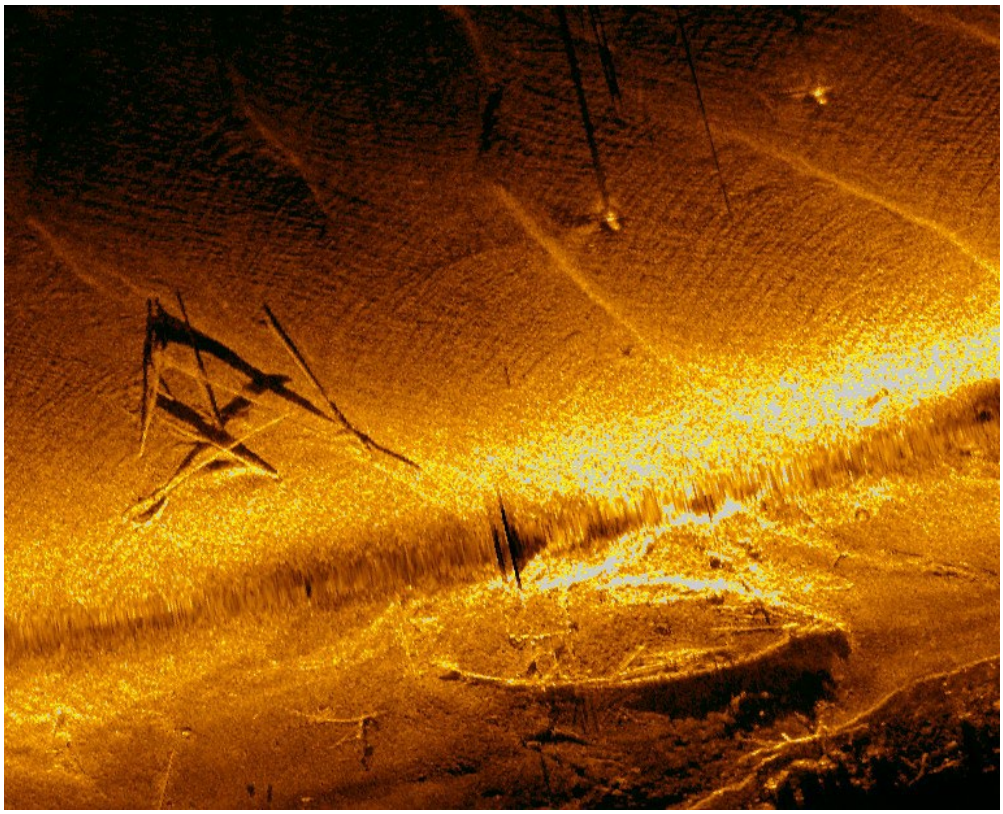


Figure 2. Side-scan sonar image of the *Clotilda* wreck following tree removal, May 2022.

ARTIFACT RECOVERY AND DOCUMENTATION

A total of 94 artifacts were recovered during the investigation (**Table 1**). In addition, both modern debris and tree debris was also present on site. The artifacts were for the most part disarticulated and scattered timbers. Visibility on the wreck, as previously noted, was at best one meter, and any movement of sediment resulted in near-zero visibility conditions. Timbers and other artifacts were assigned field identification numbers and provenienced with GPS waypoints, captured by RESOLVE specialists during artifact collection.

Due to the bulk of material, the field catalog for the artifacts utilized the waypoint numbers and assigned a secondary number for each artifact. For example, the five artifacts recovered from waypoint B1 are 1.1–1.5 in the field catalog. Artifact photographs are provided in **Annex D**.

Conservators from Terra Mare Conservation (TMC) assisted the SEARCH team with the temporarily recovered artifacts. Temporary wet storage included a 20’ x 8’ x 40” storage tank for large timbers, reinforced 5-gallon plastic pails, and polyethylene zip-lock bags of varying sizes for smaller artifacts and fragments. TMC conducted a visual and tactile assessment of approximately 50 timbers and artifacts temporarily recovered from the wreck site. A detailed condition assessment of sixteen (16) artifacts was carried out to supplement the findings of the visual/tactile inspection and gain a better understanding of deterioration mechanisms in effect at the wreck site. Ultimately, four artifacts, those collected from waypoints 1.2, 7.4, 12.1 and 22.1

were retained and taken to the History Museum of Mobile, where a conservation laboratory was established by and under the supervision of Terra Mare. Conservation of these artifacts continues in 2024.

Each timber and artifact was measured and digitally photographed with scale. Certain timbers were also sketched (**Figure 3**). Twenty eight (28) timbers and artifacts were selected for LiDAR scanning by Pete Kelsey. An iPhone 13 Pro was used to capture LiDAR and photogrammetry data of each disarticulated timber brought up from the *Clotilda* wreck site. The raw LiDAR and photogrammetric data captured by the iPhone was then combined using Pix4Dmatic software. Results/deliverables include 3D, colorized point clouds (.LAS files and/or .FBX files) of each timber scanned. This was the ideal solution for this project due to a compressed schedule and available space on the barge where all of the work was being done. A traditional terrestrial laser scanner would not have been practical. Point clouds were post-processed and cleaned in CloudCompare software and exported to the image files shown in **Figure 4**, **Figure 5**, **Figure 6** and **Figure 7**.

Table 1. List of timbers and artifacts recovered from the Clotilda wreck site.

Waypoint	Notes	Imaging	Result
1.1	Longer timber with mortise joinery, square fastener and holes for pins		Returned to site
1.2	Small piece has iron drift pin in it, badly corroded but diagnostic; circular saw marks	LiDAR sketch	Collected for conservation and analysis
1.3	10" x 2" mortise, 2 fastener holes, 6" apart	LiDAR sketch	Returned to site
1.4	Preserved square cut on one end		Returned to site
1.5	Molded bottle, 1888-1901		Returned to site
2.1	Square timber, worms and barnacles, green and black bacterial staining		Returned to site
2.2	Long, wide and thin plank, 3/4" fastener		Returned to site
2.3	Two iron drift pints together, perpendicular, 11" and 8"		Returned to site
2.4	Long, square beam with square holes inside, 18" apart	LiDAR	Returned to site
3.1	Three iron fasteners, 2 bolts and 1 pin all 3/4", longest is 13"	X-Ray LiDAR	Returned to site
3.2	Four 2 x 4" planks with wood borer holes		Returned to site
3.3	Long thin timber with tongue and groove, decorative panel	LiDAR sketch	Returned to site
3.4	Bent iron pipe		Returned to site
3.5	Perpendicular iron fasteners, 1 bolt, 4 pins in wood		Returned to site
4.1	Long thin timber with tongue and groove, decorative panel	LiDAR	Returned to site
4.2	Plank		Returned to site
4.3	Drift pins through 2 boards	LiDAR	Returned to site
5.1	Deteriorated timber, one nail hole		Returned to site
5.2	Square beam with three fastener holes, degraded	LiDAR	Returned to site
5.3	Timber with one end preserved better with organic staining, other end degraded. One fastener hole	LiDAR sketch	Returned to site

Table 1. List of timbers and artifacts recovered from the Clotilda wreck site.

Waypoint	Notes	Imaging	Result
5.4	Degraded, one fastener		Returned to site
6.1a	Slim beam with fastener holes	LiDAR	Returned to site
b	Slim beam with fastener holes		Returned to site
c	Slim beam with fastener holes		Returned to site
6.2a	Partially burned, organic staining, moderate degradation, 2 fasteners	LiDAR	Returned to site
b	Partially burned, moderate degradation, multiple fasteners		Returned to site
6.3	Iron brace/brackets	X-Ray LiDAR	Returned to site
6.4	Drift pin		Returned to site
7.1	2 fasteners and corroded washer		Returned to site
7.2	Preserved square section of beam with twisted iron spike	LiDAR	Returned to site
7.3	Iron object		Returned to site
7.4	Wood with metal steering gear, concreted. Wheel is 11" diameter	LiDAR sketch	Collected for conservation and analysis
7.5	Timber		Returned to site
7.6	Iron spike		Returned to site
7.7	Metal clamp/strap	LiDAR	Returned to site
7.8	Plastic cap		Returned to site
8.1a	Black stained beam, flat with teredo holes, one iron spike	LiDAR	Returned to site
b	Beam		Returned to site
c	Cracked beam, one spike		Returned to site
d	Beam		Returned to site
9.1a	Plank		Returned to site
b	Plank		Returned to site
c	Plank		Returned to site
d	Plank		Returned to site
10.1	Long degraded plank		Returned to site
11.1a	Plank	LiDAR	Returned to site
b	Plank		Returned to site
11.2	Plank	LiDAR	Returned to site
11.3	Flat wood with spike and red staining	LiDAR	Returned to site
12.1	Two pieces of hull planking with iron fasteners	X-Ray LiDAR sketch	Collected for conservation and analysis
13.1	Nails and two deep holes in timber	LiDAR	Returned to site
14.1	Large beam pulled up with crane from stern		Returned to site
15.1	Possible porthole, metal circle with screws recovered from shoreline		Returned to site
16.1	Long deck beam with staining and other pieces attached	LiDAR	Returned to site
16.2a	Timbers that fell off 16.1	LiDAR	Returned to site

Table 1. List of timbers and artifacts recovered from the Clotilda wreck site.

Waypoint	Notes	Imaging	Result
b	Timber		Returned to site
c	Timber		Returned to site
17.1	Charred timber from near shore		Returned to site
17.2a	Small possible burned timber from shore survey	LiDAR sketch	Returned to site
b	Small possible burned timber from shore survey		Returned to site
18.1a	Intact hull plank	LiDAR	Returned to site
b	Beam		Returned to site
19.1	Beam from stern with multiple spike holes, tapers at end	LiDAR	Returned to site
20.1	Light switches and wiring		Returned to site inside weighted crate for protection
21.1	Midship shoe leather sole, 3.5 x 2.5"	sketch	Collected for conservation and analysis
22.1	Lead hawse pipe flange 3.5 x 3.5"	LiDAR sketch	Collected for conservation and analysis
23.1a	Beam		Returned to site
b	Beam		Returned to site
23.1.2a	Beam		Returned to site
b	Beam		Returned to site
23.2a	Beam with fastener		Returned to site
b	Beam		Returned to site
c	Beam		Returned to site
23.2.2	Wood with 25" iron spike		Returned to site
23.3	Large set of three beams with spikes	LiDAR	Returned to site
24.1	Plank with iron fitting	X-Ray	Returned to site
25.1a	Small timber recovered during dredging with iron fastener	X-Ray	Returned to site
b	Small timber recovered during dredging		Returned to site
c	Small timber recovered during dredging		Returned to site
26.1a	Small piece of possible linoleum, 85 x 65 mm		Collected for conservation and analysis
b	Small piece of possible linoleum, 75 x 60 mm		Collected for conservation and analysis
27.1	Small 2.5" timber with hole, recovered while dredging		Returned to site
28.1	Small finds from screen including screws and glass fragments		Replaced in wreck inside weighted crate for protection

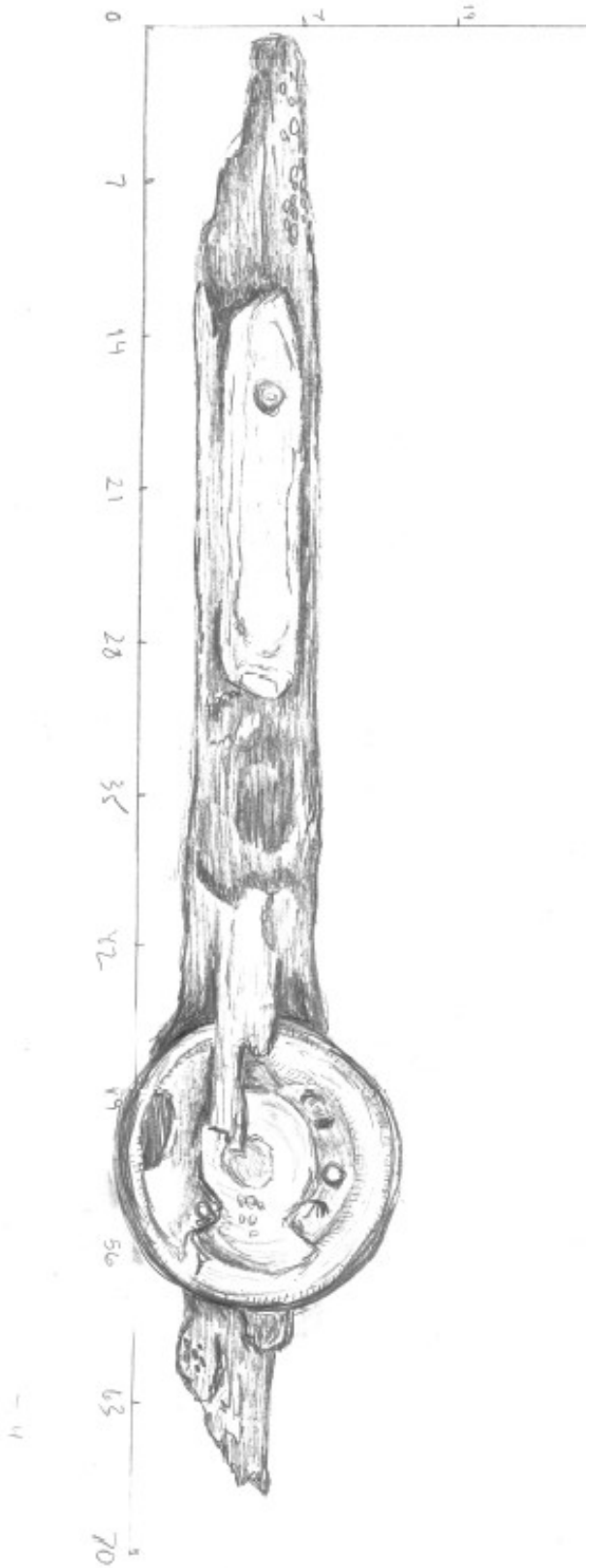


Figure 3. Sketch of artifact WP 7.4 with steering gear by K. Lent.

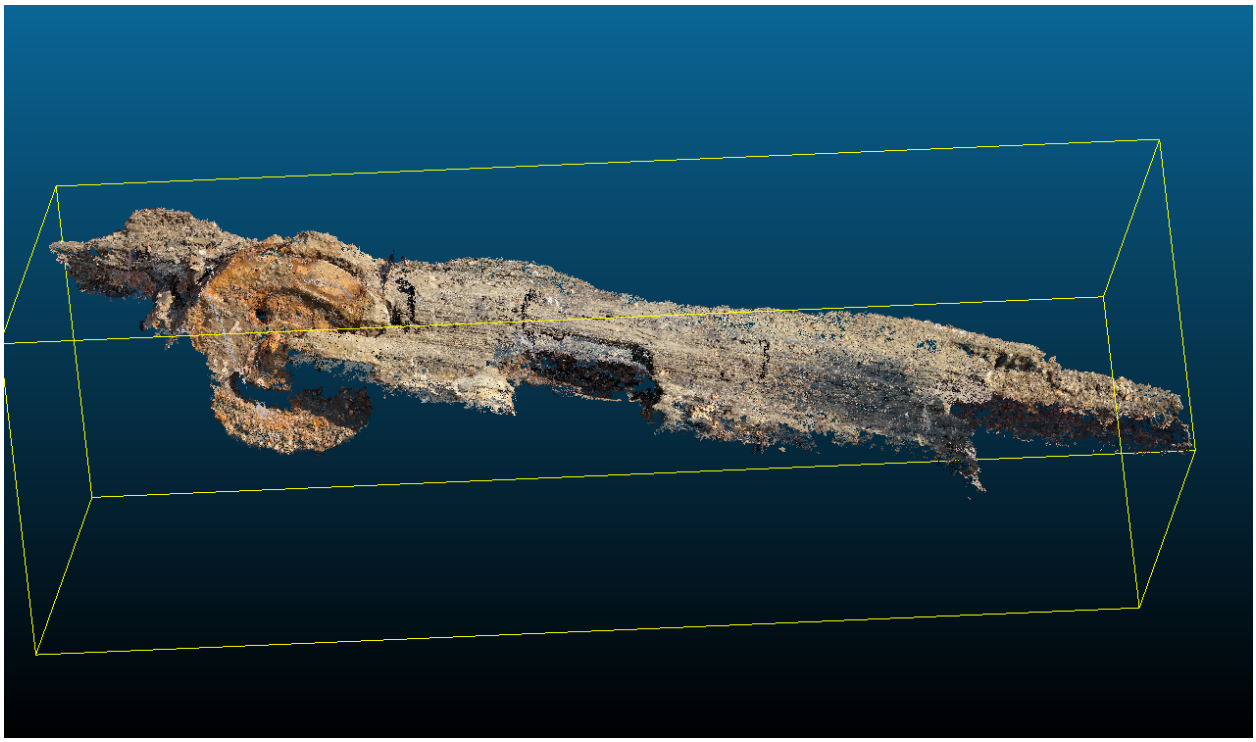


Figure 4. Artifact WP 7.4, timber with steering gear.

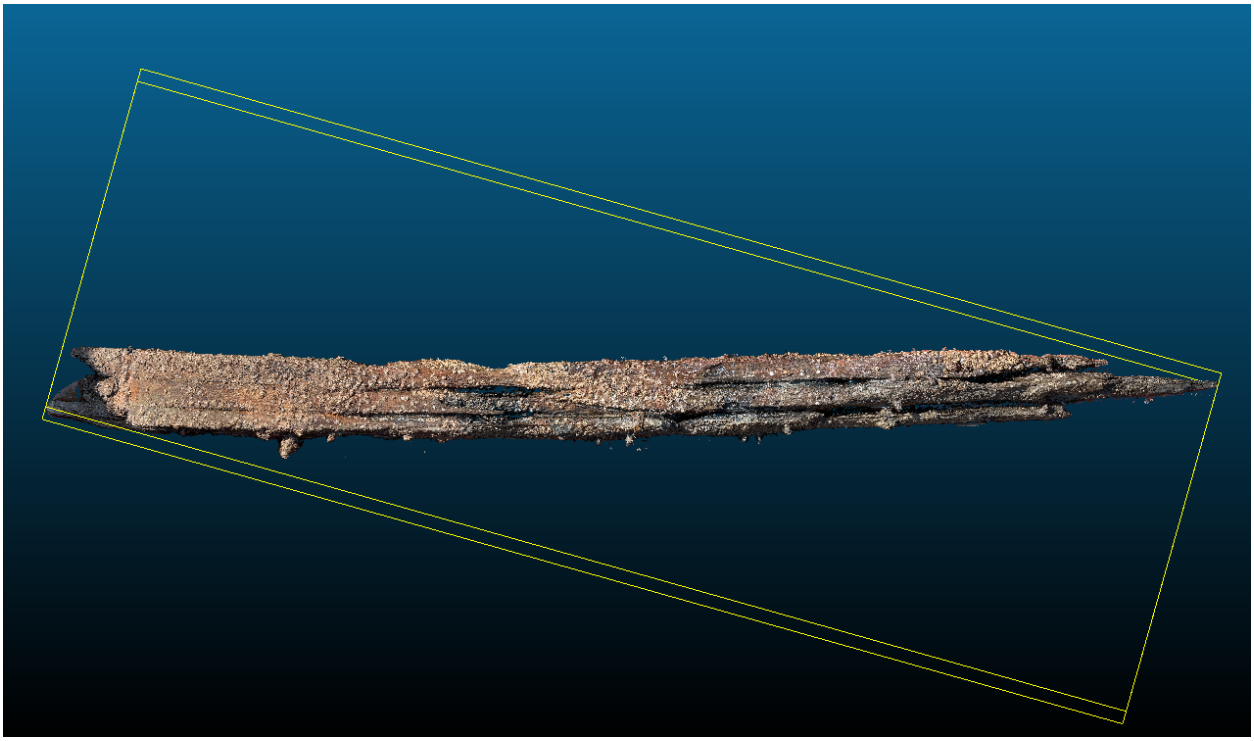


Figure 5. WP 23.2 whole beam shelf clamp, port quarter.

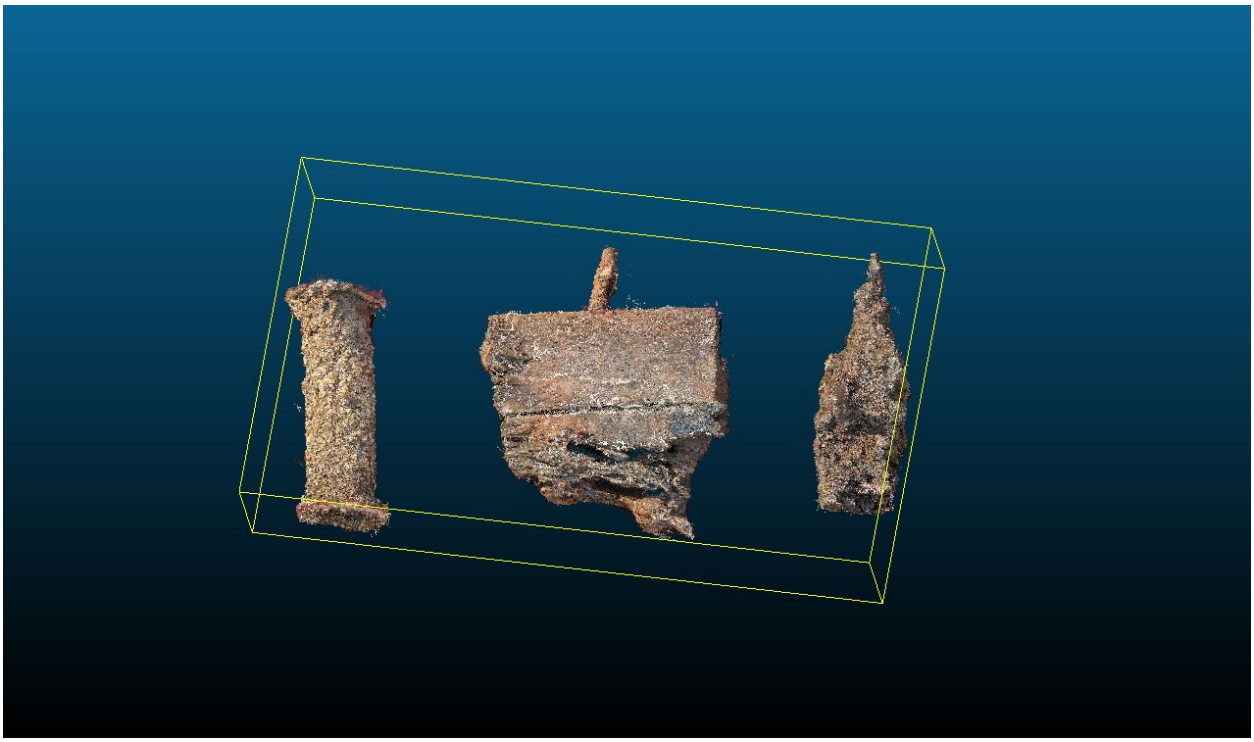


Figure 6. WPs 1.2, 12.1 and 22.1.



Figure 7. Timber WP 1.3 with mortise joinery.

Conservation Assessment

Between May 6 and 13, 2022, conservators Paul Mardikian and Claudia Chemello from TMC provided professional services in conservation, cultural resources management, and site preservation in support of archaeological investigation by SEARCH and RESOLVE Marine during a field deployment to investigate the wreck of *Clotilda* located in a section of the Mobile River in Baldwin County, Alabama. The site deployment was conducted to evaluate the deterioration of the wreck's materials and consider preservation strategies for *Clotilda's* long-term preservation.

During the deployment, TMC collaborated with team members on board the barge and with remote team member Vincent Blouin, naval architect and marine engineer. Timbers and artifacts temporarily recovered by RESOLVE Marine divers were inspected to determine their condition. A radiography inspection of a limited number of iron and composite artifacts was carried out to assess the level of corrosion and the corrosion risks in effect at the site and confirm visual observations. At the conclusion of the site work, TMC assisted RESOLVE Marine in transporting four artifacts to the Mobile Museum of History for storage while awaiting conservation. A separate proposal for the conservation of the four artifacts was submitted at the request of the AHC.

Following the deployment, the density and moisture content of a small number of wood samples was measured, along with mechanical testing to assess degradation and residual mechanical properties. Environmental, geotechnical, geochemical and ecological data collected from the site was reviewed, and preliminary *in situ* preservation options were evaluated and visualized.

The investigation found that, in general, *Clotilda's* surviving timbers appear to have retained a dense core, with a moisture content that was lower than anticipated. These observations were confirmed by mechanical testing of wood samples to assess the modulus of elasticity and tensile strength. However, the recovered timbers were heavily damaged by marine borers, colonized by barnacles and most likely fungi and bacteria, and were notably affected by erosion and moderate to severe mechanical damage. The presence of wood checks and deep splits on both small and large timbers, some going through the entire thickness of the board, could significantly affect the structural stability of the wreck if widespread. The structural integrity of the wreck overall, and particularly the parts still buried in sediment, could not be directly assessed.

No borer activity was noted on the three wood core samples removed from the bilge indicating that sediment coverage in this area may be sufficient to reduce oxygen levels and prevent borer colonization as well as reduce biodeterioration by fungi and bacteria. The dendrochronology sample analyzed at University of Alabama was unable to provide a date of construction due to a limited number of rings in the sample and a lack of necessary analogs in the southern pine record of the Gulf Coast. Further samples from the wreck for dendrochronology would help refine the analysis

Corrosion of the metallic artifacts, particularly the iron fasteners, is pervasive and varies from moderate to severe to total loss. Localized burial conditions on the wreck may be conducive to

complete loss of the structural integrity of the fasteners. The structural integrity and stability of the fasteners on the wreck could not be directly assessed.

The location of *Clotilda* in a shallow, medium to high energy brackish water environment, coupled with the biological and physical processes of deterioration observed, poses an immediate threat to the wreck's long-term survival. The level of damage observed indicates that many of the processes have been in effect for quite some time and likely fluctuate with prevailing climatic and environmental conditions.

The wreck is extremely vulnerable to physical damage from vessel strikes, impacts with floating objects, as well as damage from vandalism or severe weather events. There is a possibility of partial or complete loss of the surviving hull resulting from such events. Stabilization of the wreck, physical protection through reburial, and security are immediate needs.

PART I: ENVIRONMENTAL CHARACTERIZATION

THE MOBILE RIVER

The Mobile River watershed is a broad drainage system spanning much of the southeastern U.S. with areas of Alabama, Mississippi, Georgia, and Tennessee comprising the fourth largest river discharge in the continental U.S. The upland watershed drains an area of 115,513 km^2 (44,600 sq mi) into the coastal watershed where it empties into Mobile Bay (Smith et al. 2013). The confluence of the Tombigbee and Alabama rivers form the Mobile River where it runs for about 72 km (45 mi) to the bay (Byrnes et al. 2013; Alarcon et al. 2009). The Mobile River, however, only flows as a single channel for about 9 km (5.5 mi) before it splits into the deltaic floodplain of the Mobile-Tensaw delta (Schroeder 1977). The Tombigbee and Alabama rivers drain the upland physiographic provinces of eastern Alabama that consist of the Fall Line Hills and Black Prairie Belt, and then flow into the Southern Hills District where they meet to form the Mobile River; these physiographic provinces consist of the Chunnenuggee Hills/Pontotco Ridge, Southern Red Hills/North Central Hills, Lime Hills, and Southern Pine Hills (Byrnes et al. 2013). The expansive watershed to the north drains other provinces, including parts of the Blue Ridge, Piedmont, and Appalachian Plateau. The geologic provinces to the south comprise the East Gulf Coastal Plain.

The southernmost Appalachian Mountains begin in northern Alabama and these highlands govern much of the Mobile River watershed, which draws runoff from these mountains down through Alabama to the bay. The Taconic event, the first of three orogenies that created the Appalachians, is visible in sedimentary and metamorphic sequences in northern Alabama. These metasedimentary rocks comprise the Dadeville Complex and the Blue Ridge and include high grade metamorphism of sedimentary deposits, granulite and eclogite facies metamorphism, bimodal volcanism, and granitic plutonism that date to the Early to Middle Ordovician (485.4-458.4 Ma) magmatism (Ma et al. 2019). The area consisted of a back arc basin with continental margin siliclastics that was metamorphosed to middle and upper amphibolite facies and was followed by granitoid intrusions during the Middle Ordovician. Much of the Dadeville Complex in central Alabama consists of the Ropes Creek Amphiboite formation, which is intruded by the Waverly Gneiss, consisting of "biotite-hornblende quartzofeldspathic gneiss with layers of amphibolite, calc-silicate rock, garnet-bearing quartzite and muscovite schist" (Ma et al. 2019:586) as well as other gneiss formations and granitic batholith intrusions. These metamorphosed mafic and intermediate volcanoclastic rocks indicate the Complex is the remnants of a Taconian-aged volcanic arc. Serving as the high terrain at the north edge of the Mobile River watershed, the geology of these southernmost Appalachian Mountains governs much of the clastic mineralogy of eroded material that is transported through the watershed.

The Tombigbee and Alabama rivers predominately flow through a series of geological formations of the Cretaceous period that run in an arc through central Alabama and north into eastern Mississippi that represent the relict Cretaceous shoreline. These sedimentary deposits occurred when the southeastern US was a nearshore shallow sea, and many of these formations contain fossils, including those of mosasaurs and other aquatic dinosaurs (Kiernan 2002). These

Cretaceous sedimentary deposits include the Ripley Formation and the Eutaw Formation, as well as chalk deposits, such as the Prairie Bluff Chalk and the Demopolis Chalk. The Eutaw Formation consists of Upper Cretaceous cross-bedded and laminated glauconitic sand and clay. The Tombigbee sand member of this formation is a Late Cretaceous massive fine glauconitic sand. A thin bed of fine gravel marks the base of the formation, and the sand layers show distinct stratification. The Tombigbee sand member is located at the top of the sequence and is fossiliferous at the upper part (Cushing et al. 1964). The Ripley Formation consists of clay, sandy clay, and thin sandstone beds and includes a transitional zone of clay above the Demopolis chalk. The Demopolis chalk is dominated by the presence of the foraminifera species *Globotruncana calcarata* (Mancini et al. 1996). The Mooreville chalk, on the other hand, is a mixture of impure chalk and chalky marl with thin beds of very fine sand scattered throughout (Cushing et al. 1964).

Tectonic activity governed the formation of much of southern Alabama, with significant sand deposition from erosion of the southern Appalachians, which accumulated as the result of basin subsidence caused by rifting continental margins in the Upper Jurassic (Oxfordian, 163.5-157.3 Ma) period (Mancini et al. 1985, Tyrrell 1972). This was followed by terrigenous fluvial-deltaic clastic deposits during the Lower Cretaceous (145.0-100.5 Ma), and the deposition of massive sands along the coastal margin during the Upper Cretaceous (100.5-66.0 Ma) that lithified into sandstone formations (Mancini et al. 1987). Salt domes and tectonic highs in the Jurassic combined with basement subsidence governed the Upper Jurassic deposition of the Norphlet sandstone, especially in the Mississippi Interior Salt Basin; these highs also served as sources of some of the sediments. The Denkman Sandstone Member of the Norphlet Formation extends from southwestern to offshore Alabama and is dominated by quartz-rich sandstones with thicknesses up to 184 m (600 ft). These sands, unlike the red Norphlet sandstones farther west in Mississippi, consist of gray to brown, well-sorted, very fine to medium grained sands with subrounded quartz grains. The average composition of these sands is 72.5% quartz, 15.0% feldspar, 4.4% rock fragments, 3.8% cements, 3.2% clay, and 1.1% accessory minerals (Mancini et al. 1985, Wilkerson 1981). These sands formed in an arid climate, which stemmed from the barrier provided by the southern Appalachians to air and water circulation in the Upper Jurassic period, and the paleogeography of the area was a broad desert plain with the mountains to the north and east and a developing shallow sea to the south. These sandstones are known by drilled wells in southern Alabama where the Norphlet sandstone outcrops, such as for the Flomation gas field in Escambia County, and the Copeland oil field in Washington County (Mancini et al 1985).

Drilling elsewhere in central Alabama also defined the massive sandstone complexes of the Upper Cretaceous Tuscaloosa Group, principally at the South Carlton field in Clarke and Baldwin Counties, and Pollard field in Escambia County. This group includes the Massive sand interval, which consists of structureless, micaceous, calcareous, glauconitic, and quartz-rich sandstones that were deposited in a wave-dominated delta system; and the overlying Pilot sand interval, which accumulated during a marine transgression and consists of shelf sands and clays and is similar in structure to the Massive interval, but with marine bivalve fossils and claystones included (Mancini et al. 1987, Fisher 1969). The Massive sand interval interbedded unit is thinly bedded and marks a change from fluvial-dominated deltaic deposition to marine dominated

deposits while the sandstone unit is well-sorted and quartz-rich and indicative of stacked coastal barrier sand accumulation (Fisher 1969). The sandstones are thick and structureless with thin, silty and claystone interbeds. The average composition is 60.0% quartz, 12.2% accessory minerals, 9.7% clay matrix, 6.6% glauconite, 4.5% cements, 3.9% feldspar, and 3.1% rock fragments, primarily muscovite. The Upper Cretaceous Eutaw Formation overlies the Upper Tuscaloosa sandstone and consists of micaceous, calcareous, glauconitic, fine-grained sandstone and fossiliferous, calcareous claystone. Above this lies the Selma Group chalks that originated from marine-shelf deposition later in the Cretaceous (Mancini et al. 1987).

The sediments deposited throughout and from the distributary Mobile-Tensaw Delta system into Mobile Bay reflect the various lithologies of rock formations within the Mobile River watershed (Byrnes et al. 2013). This delta is one of the largest inland deltas in the U.S. and drains into Mobile Bay through five main channels: the Mobile, Tensaw, Raft, Apalachee, and Blakeley Rivers. The head of the delta is where the Alabama and Tombigbee Rivers join to form the Mobile River, which flows for 9 km (5.5 mi) before splitting into the Mobile and Tensaw Rivers as well as branching out into myriad of other bayous, lakes and interchanges as the topography levels out into low swampland (Isphording et al. 1996; Robinson et al. 1956). The flow of the delta system is highly variable, ranging 100 to 15,000 m^3s^{-1}, and strongly tidally-influenced (Dykstra et al. 2022). At regular flow, water remains primarily within the main river channels, but greater flow causes spillover into the surrounding swamps. Tidal effects drive variability in water levels and velocities as incoming tides elevate water levels and reduce the flow velocity. The tidal influence decreases upstream; tidal influence is strong enough at times to cause the Mobile River to flow upstream (i.e., ebb and flood; Isphording et al. 1996). Periods of greater water flow counteract the tidal influence and the greatest flow is recorded seasonally between December and May. Tidal action also affects the salinity of the lower channels of the delta. Salt water was observed as far north as mile 30 upstream during periods of low river flow, but typically the salt wedge only reaches about mile 23 (Robinson et al. 1956). Increases in river discharge significantly decrease salinity intrusion.

Sediment load through the delta is also dependent on river flow. During periods of low water flow, the amount of sediment movement is low and stays within river channels; sediment load increases during higher flow as the river becomes erosive, sediment moves downriver and deposition occurs within the delta and surrounding swampland (Isphording et al. 1996). Net fluvial sediment discharge into this delta system is estimated at 4.69 million tons per year, most of which flows out into the shallow Mobile Bay. Sediment discharge captured within the delta accretes during high flow periods when the water flows over the banks into the swampland and marshes (Aust et al. 2012). This inorganic sedimentation is essential for vertical accretion and maintaining the level of the freshwater marshes above sea level, and tidal fluxes deliver oxygen and nutrients (Smith et al. 2013). However, lock and dam systems upstream along the Tombigbee River and widening of the river channel in the 1950s and 1960s caused a loss of downstream sediment loads, and therefore increased the importance of organic sedimentation in the marshes along the delta (Smith et al. 2013). However, studies of the swamps and marshes along the Mobile-Tensaw Delta found that inorganic sedimentation into the riparian forests were sufficient for the health of the swampland (Aust et al. 2012).

The coastal ocean governs the dynamics of the downstream section of a river and the dynamics of flow are impacted by sea level variations, weather processes like storm surges, and tides. In addition, "tidal influences on the river discharge modulate the rates of sediment supply to the coastal ocean, and are a key factor controlling delta formation" (Hoitink and Jay 2016:262). As river flow coming down the main river channels reaches the deltaic system, it spreads out over a wide area through the network of natural levees, flood basins and distributary channels (Dykstra and Dwonkowski 2020). However, the reach of tidal influence also affects the movement of water downriver. The boundary of the end of salinity intrusion from the coastal ocean upriver and the limit of tidal intrusion is a "tidal river" that typically consists of a segment of river that feels these effects from these ocean dynamics (Hoitink and Jay 2016). This tidal river, therefore, is the section of river influenced by tides and marine forces but where salinity no longer intrudes; this can extend for hundreds of kilometers inland. The limit of salinity intrusion will vary seasonally and is controlled by river flow (Hoitink and Jay 2016).

In the Mobile-Tombigbee river system the transition between tidal-dominated and river-dominated morphology was observed about 40-50 km (25-31 mi) inland of the bayhead, downriver of the Mobile-Tensaw bifurcation, although tidal influence was observed past this point (Dykstra et al. 2022). Periods of high river flow will have a comparatively steep water level slope that pushes the tidal reach seaward and has resulting currents that scour the riverbed; at periods of low flow, tidal influence and salinity reach much farther inland. Also during high flow in periods of flooding, water will spill over dams on the various tributaries, which causes fluvial flood waves to propagate downriver through the deltaic-estuarine system and contributing to the flushing of the system (Dykstra and Dzwonkowski 2020). As these waves enter the delta, they slow and attenuate due to the broader areal expanse of the system at this point, and change from diffusive waves that propagated down the river channels to dynamic waves along shallower bed slopes in the estuary.

This dynamic fluvial and tidally-influenced deltaic environment is complex and variable. Changing winter storm cycles, warming climate, and rising sea level continue to influence the variations in floodwaters entering the system, the tidal influence of salinity, and the deposition or removal of sediments in this branch of the river. While changing, the environment described above likely remains similar to that of the last century and a half. This is the riparian landscape into which *Clotilda* was scuttled at the end of its voyage in 1860.

METHODS

Oceanographic

A set of environmental sensors were installed for a period of two weeks in the river channel adjacent to the wreck. Two 300 kHz Teledyne RD Instruments WorkHorse Sentinel V Acoustic Doppler Current Profilers (ADCP) were deployed on aluminum moorings with marker buoys on the river channel side of the shipwreck. One was placed approximately 15 m (50 ft) off the bow

and 8 m (26 ft) off the stern. A ValePort MIDAS SVX2 CTD was attached to the mooring frame of the upstream ADCP off the bow.

The sensor moorings were deployed on 3 November 2021 and recovered on 18 November. The CTD recorded observations at 1 Hz from 3 to 9 November before the battery ran out.

A solar powered Hydro-Logic Level Logger was installed on a tree on the riverbank prior to the end of the project. The Hydro-Logic Flow Logger is a precision flow meter that transmits real-time measurements to a website through cellular data for live tracking of water movement in rivers and streams. This flow meter measures water levels through radar. The Hydro-Logic Timeview is a cloud-based server access where flow data is uploaded for real time monitoring. This sensor takes readings every 10 minutes of the water level at the *Clotilda* wreck site. Recording started May 12, 2022 following the installation of the sensor.

Geotechnical

A set of two 15-m (50-ft) sediment cores were collected from the middle of the Mobile River channel by Southern Earth Sciences on 18 and 19 January 2022. The geotechnical cores were bored into the riverbed at locations approximately 485 m (1,590 ft) upriver and 466 m (1,530 ft) downriver of the wreck in locations clear of any previously recorded archaeological site or remote sensing survey targets. The soils borings were advanced with Standard Penetration Test (SPTs) to a depth of 15 m (50 ft) below the mudline with barge-mounted drilling equipment. Test borings were performed with mud rotary drilling. Drill rods were removed at 1.5 m (5 ft) intervals and soils samples were collected with a 5 cm (2 in) split tube sampler. The cores and samples were examined in the lab and underwent general classification.

A set of 12 samples were collected from the two cores, seven from the first core and five from the second, and additional analyses were conducted on these, which included moisture content determination and grain size analysis with sieve washes. A second set of these samples was collected for mineralogy and sent to Activation Laboratories Ltd. in Ancaster, ON, Canada. X-Ray Diffraction (XRD) was performed on these samples for the purposes of lithology and mineralogical composition. Corundum (Al_2O_3) powder was mixed with the sand samples as a known internal standard. XRD analysis was conducted with a Bruker D8 Endeavour diffractometer with a Cu X-ray source. PDF/4/Minerals ICDD database was used for mineral identification and quantities were determined with the Rietveld method, which is based on the full diffraction pattern from crystal structure refraction data.

Sediment cores

Four sets of four 20-cm (8-in) sediment push cores were collected by divers in the sediment at four locations around and within the *Clotilda* shipwreck. Set A was collected of surface sediments from outside the hull at the port side bow on the river channel-facing side of the wreck. Set B was collected of surface sediments from near the inner hull planking on the inside of the wreck on the starboard side, midships. Set C was collected from surface sediments on the outside of

the starboard hull aft in the area nearer the shore and sheltered from current by the wreck structure. Set D was collected from the base of an excavation unit that was dredged by divers during the investigation. These cores were collected along the port side inner hull planks at a depth of approximately a meter and a half below the mudline.

Each set of four cores was placed in a basket designed to keep them vertical and raised to the barge deck with a crane. On deck, they were dried off and labeled, then divided for separate analytical procedures that each had different preparation requirements. The four cores for geochemistry were extruded vertically and subsampled at 5 cm (2 in) intervals to four samples per core. The cores for pollen were extruded and two subsamples were collected from each core to be shipped to Dr. Angelina Perrotti for processing. The cores for microbiology were sealed with electrical tape around the caps on either end and placed in a cooler with dry ice before transport to the freezers at University of West Florida. The cores for meiofauna were processed on deck following procedures outlined below.

Geochemistry

A total of 16 sediment samples were delivered to the Waypoint Analytical Louisiana laboratory in Marrero, LA on 13 May 2022. These sediment samples were analyzed for trace metal chemistry and Total Organic Carbon (TOC), performed by Waypoint Analytical in accordance with Standard Methods. All quality validation was conducted according to guidelines established by the USEPA and NELAC. All methods undertaken were in accordance with Waypoint Analytical Louisiana, Inc.'s Louisiana Environmental Laboratory Accreditation Program and are within acceptance ranges established for that program.

Trace metals were analyzed with Inductively Coupled Plasma–Optical Emission Spectrometry (ICP-OES), EPA method 6010D. The following elements were analyzed: Li, Al, Si, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Sr, Zr, Ba, Sn, Pb. Sediment samples were digested into solution following EPA Method 3050B, which uses nitric acid, hydrochloric acid, and hydrogen peroxide. This dissolution process forms an aqueous sample that is then aspirated into the argon-plasma discharge for analysis through the ICP-OES. Background correction was conducted through analysis of a series of known standards and set spike concentrations for quality control. Laboratory blanks were prepared and analyzed along with the sample solutions. TOC was analyzed with the Walkley Black Method, which uses a volume of acidic dichromate solution to react with a measured amount of sediment to oxidize organic matter, which is followed by a titration of ferrous sulfate.

Meiofauna

Three ~20 cm (8 in) cores were collected by divers at the bow, mid ship, and stern of the *Clotilda* wreck (Sites A, B, and C, respectively). The top 5 cm (2 in) of each core was extruded, and bulk fixed in 95% ethanol and rose Bengal stain. The remainder of the core was sieved over a 500-micron sieve and the material retained was fixed in 95% ethanol and rose Bengal stain. Fouling organisms were collected from wooden planks of the wreck and stored alive in seawater. Fixed

and live samples were taken to the Dauphin Island Sea Lab where fauna was extracted from the bulk sediment samples using a LUDOX extraction (Burgess 2001) and picked from the sieved material by hand. Living samples were identified then fixed in 95% ethanol. Extracted fauna were counted and identified using a Leica M125 stereoscope.

Microbiology

DNA was extracted in triplicate for each site with ~0.3-5 g of sediment using the Zymo DNA isolation kit protocol (ZymoBIOMICS™; Irvine Ca) and with some modifications. Sediment was placed into 2 ml Zymo bead beating tubes. Each sediment sample was subsampled into three separate bead beating tubes. All samples were exposed to bead beating using ~1 min bursts at setting S4500 (PowerLyzer homogenizer; MoBio Inc. Carlsbad, CA) using 5x cycle replications (dwell ~1 min). All samples were then extracted according to the Zymo DNA isolation kit protocols. DNA extracts from sediment subsamples were pooled to ensure sufficient DNA concentrations for downstream processing. DNA quantity and quality was semi-quantified using a ThermoFisher NanoDrop1000 Spectrophotometer. Replicate samples (n=3) were pooled and shipped to the University of Illinois at Chicago Sequencing Core (UICSQC) for PCR amplification of the 16S rRNA gene using universal prokaryotic primers as previously described (Parada et al. 2016), 515F-Y (5'-GTGYCAGCMGCCGCGGTAA) and 926R (5'-CCGYCAATTYMTTTRAGTTT), and subsequent, paired-end deep sequencing using an Illumina MiSeq 739 platform (FASTQ Generation 2022-09-05 00:30:21Z; FASTQ Generation Version: 1.0.0).

Raw sequences were successfully downloaded and analyzed for initial quality and quantity of data. Illumina (MiSeq) amplicon sequencing yielded ~ 0.4 million, 300 bp sequences, ranging from 18k–137k (mean 47k) for sites A-D. Comparable success on the 'upper' core samples was not achieved for attempts to evaluate 'deeper' core samples (n=4) due to limited gDNA quantity and quality most likely from high compaction or high levels of contaminants.

Sequence data files for both forward and reverse sequence reads (~20k-140k reads per file) were 'trimmed' of extraneous 'primer ends.' Demultiplexed raw sequences were then quality filtered (i.e., removal of bases with low PHRED quality scores; removal of 'uncalled bp (N)), length filtered (discarding sequences falling short of adequate size) and merged using compatible software (i.e., PEAR). Data was processed in a workflow that combined the Quantitative Insights into Microbial Ecology (QIIME2) package and VSEARCH including initial conversion of Fastq files into compatible 'Fastx' files. Sequences that were merged successfully and passed the quality control and chimera removal steps were those used for the determination of sample composition operational taxonomic unit (OTU) and amplicon sequence variant (ASV) determination in QIIME2, followed by taxonomy assignment. In brief, amplification primers were removed and the data were converted to a single FASTA file using QIIME2 scripts. Software (i.e., UCHIME) was used to identify and remove chimeric (spurious sequences) OTUs. Remaining (non-chimeric) OTUs (representative sequences) were then used to create a database against which all the sequences, including singletons, were mapped to form an OTU count table, which is used for estimating species richness. Taxonomy assignment (i.e., UCLUST algorithm against the most recent Silva

database), with possible subsequent rarefaction, and UniFrac calculations, lead to approximation of the classified and unclassified bacteria present in the core samples.

Pollen

Eight sediment core subsamples were received by A. Perrotti in March 2022. One cubic centimeter subsamples were measured for pollen extraction using displacement in HCl after adding 1 tablet of *Lycopodium clavatum* (Lund University Batch #280521291, containing 13,761 +/- 448 spores/tablet). Note that *Lycopodium* spores exhibited clumping in all samples, so pollen concentration values may not be reliable. Initial evaluation of the samples indicated high clay content and several also exhibited high charcoal concentrations, both of which can hinder pollen recovery. Thus, three different processing protocols were deployed (**Table 1**). See Faegri and Iversen (1989) and Riding (2021) for detailed description of each process. The remaining pollen residue was then preserved in glycerine. The third processing round resulted in the highest palynomorph recovery, so results discussed in this report are from batch 3. Following this analysis, pollen residues and slides will be curated by A. Perrotti.

Table 1. Processing steps for 3 batches of pollen samples from the *Clotilda* site. The numbers reflect the order in which the process was deployed. The third batch resulted in the highest palynomorph recovery.

Process	Batch 1	Batch 2	Batch 3
10% HCl rinse	1	1	1
10% KOH, boil for 10 minutes at 100° C	2		
Swirl and decant		2	
180-micron sieve		3	
6-micron sieve		4	
48% HF, boil for 20 minutes at 100° C	3		2
10% HCl, boil for 5 minutes at 100° C	4		3
Acetolysis (9:1 acetic anhydride:sulfuric acid solution) for 10 minutes at 100° C	5		5
Flotation in Sodium Polytungstate with specific gravity of 2.1		5	4

Samples were mounted on slides and minimum of 200 terrestrial pollen grains were counted while also using a rarefaction curve to monitor sample richness. In the circumstance that pollen preservation was absent or low and a 200-grain count could not be achieved (in the case of upper A), 220 *Lycopodium* spores were counted. Due to low pollen preservation, the counts from upper A should be interpreted with caution, as relative pollen abundances are not reflective of the vegetation assemblage (Havinga, 1963) in samples with such poor pollen preservation.

Unfamiliar pollen grains were keyed to potential identification using pollen references such as Kapp et al. (2000) and Gosling et al. (2013). Unknown pollen grains were drawn and described, and imaged when possible.

RESULTS

Oceanographic

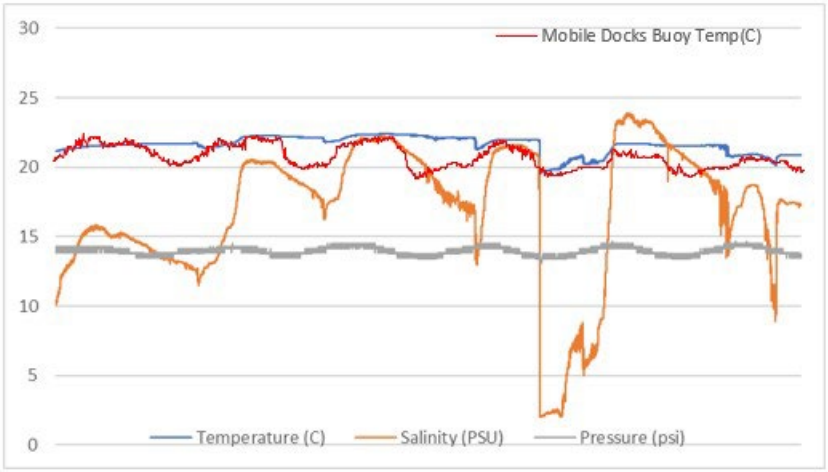


Figure 8. Graph of CTD data for temperature, salinity and pressure with the Mobile Docks buoy temperature.

The CTD deployment provided a snapshot of the river conditions over a period of seven days during low flow, late autumn conditions. Temperature ranged from 19.6 to 22.4° C and salinity ranged from 2.0 to 23.9 PSU. Pressure, correlating to water level, or depth, was less variable and corresponded primarily to tidal effects, as illustrated in **Figure 8**. Tidal influence is also apparent in the temperature and salinity data, with salinity showing a greater range of variation. While the pressure does not show much change over the course of this period, the salinity indicates stronger tidal influence over the course of the week. The tidal range increased from November 3 to November 8 from 0.3 to 0.8 m (1.0 to 2.5 ft) (**Figure 8**). Salinity during high tide increased at the *Clotilda* site over this time from 15 PSU on the 3rd to 24 PSU on the 7th.

Despite the gradual rise in salinity by higher high tides as the week progressed, a pulse of freshwater passed through on November 7 that drove the salinity almost to zero. This downward spike is also apparent in the temperature. Rain in northern Alabama over November 4 and 5 traveled through the watershed and passed Twelvemile Island on the 7th, lowering the salinity and temperature temporarily. Data logged from the NOAA National Data Buoy Center (NDBC) buoy at Mobile Docks is more governed by ocean parameters and higher salinity, but also shows this downward trend in temperature as the freshwater input increased on November 7. Pressure logged by the CTD at the *Clotilda* site did not register a rise in water level from this influx of freshwater from northern Alabama. As water enters the delta from the main river channel, it spreads out across the myriad channels and basins of the delta, so the pulse downstream of colder, freshwater influenced the salinity at the wreck, but did not significantly raise the water level. However, this event, captured by the period of CTD logging, is indicative of the dynamic fluctuations in temperature and salinity that occur at the wreck.

The two ADCPs logged from November 3 to 18 and registered a range of water movement across the wreck, principally governed by the tidal variation. The highest velocity logged was 80 cm s^{-1}, which equates to a 1.6 knot current. The data were processed with Ocean Data view to produce the plot in **Figure 9** of the data from the downstream sensor off the stern. The east channel of the river around Twelvemile Island at the site of *Clotilda* runs approximately 250° WSW and this direction of flow is shown as the dominant current across the site. Also indicated in these data is the effect of high tide on the river flow, which shows that at higher high tides, the river slows slightly upstream as the salt wedge is pushed forward on the rising tide. The depth shown on the graph in **Figure 9** is indicative of the water level above the ADCP as tidal fluctuation moved water over the site, and these correlate with the tidal flux shown in **Figure 8**. As indicated previously for the CTD plot, the high tide increased in height over the first four days to a spring tide from November 7-8, and then decreased to a spring tide with lower high tides and higher low tides from November 13-14. This tidal flux is directly represented in the velocity plot, which also illustrates that at weaker tidal influence, the river did not reverse flow during the neap tide. These tidal fluctuations result in the variance in both flow and salinity levels at the site.

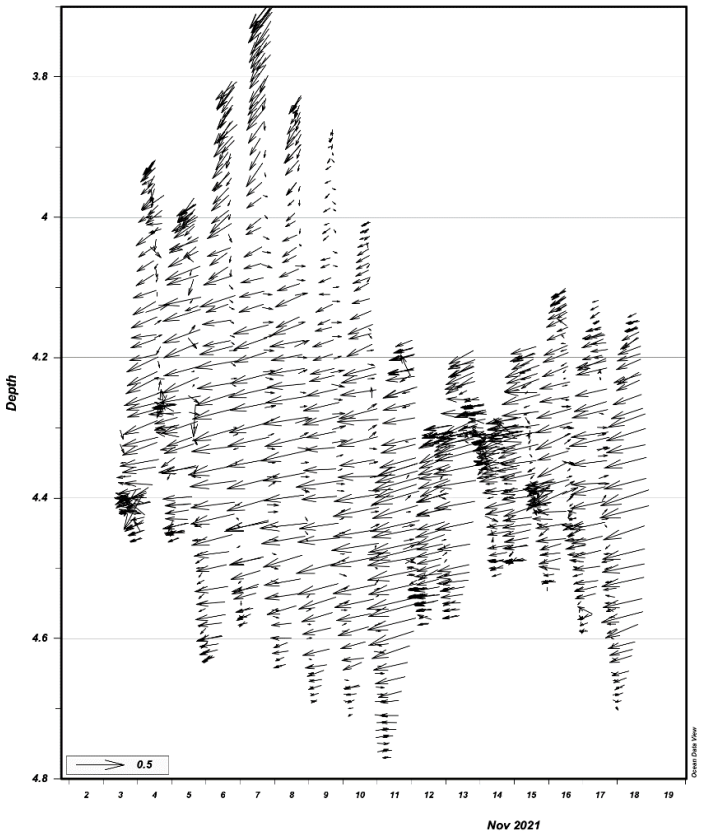


Figure 9. Plot of ADCP current data from November 3-18 versus depth, indicating change in pressure.

The Hydro-Logic Flow Meter data, which has been recording readings since May 12, 2022, was downloaded from the TimeView website at the end of November to show preliminary results of this real-time monitoring of the river water level (**Figure 10**). Levels are shown in meters from the recorded height of the sensor on the tree along the riverbank, which measures from a datum at 5.03 m (16.5 ft) above sea level. River level is shown to have been lower in the early summer and fall, with higher levels in August and September, which is consistent with observations from periods when SEARCH has been on site.

Geotechnical

Water depth at both geotechnical locations was approximately 4 m (14 ft). Sediments below the mudline consisted of sands and silty sand of varying density and gradation. Sands at boring location GT-1, the upriver location, were very loose to a depth of 4 m (14 ft) and loose to a depth

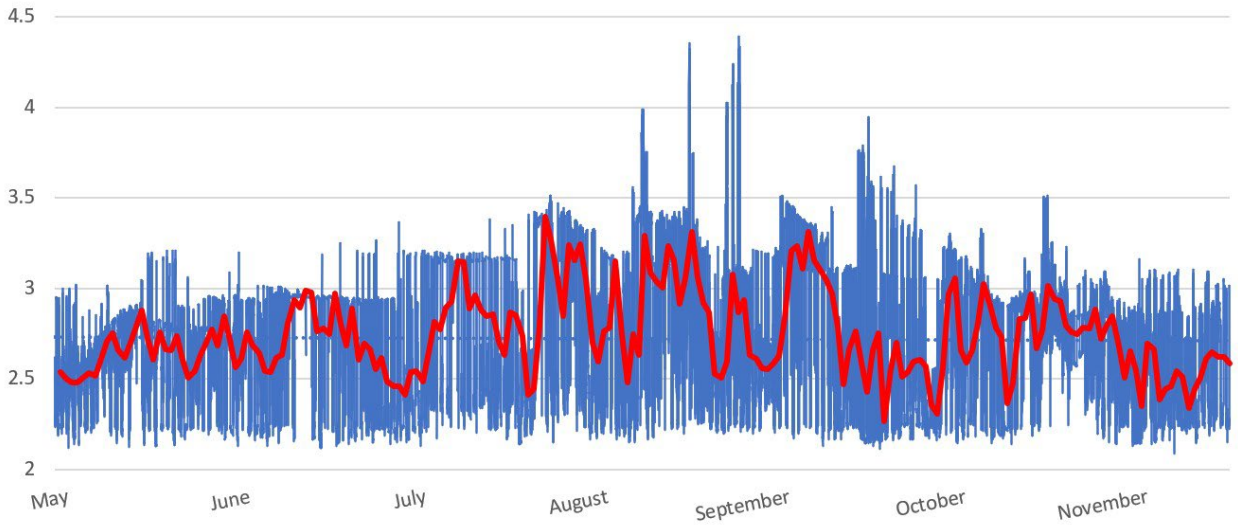


Figure 10. Data series from the Hydro-Logic Flow Meter from May to November 2022 showing real time water level (m) readings (blue) and average water level (red).

of 10 m (32 ft), followed by medium density sands to termination depth at approximately 14 m (46 ft) below the mudline. Pea gravel was encountered at a depth of 11.5 m (38 ft). Sands at boring location GT-2, the downriver location, were very loose to a depth of 2.4 m (8 ft) followed by loose consistency to 5.5 m (18 ft), followed by medium dense sands to termination at 16 m (52 ft) below the mudline. Pea gravel was encountered in the sands at a depth of 8.5 m (28 ft).

Grain size analysis indicated the sediments are primarily sand, the majority of which passed through a No. 40 sieve and was retained on a No. 200 sieve. These results classify the materials as fine sand according to the AASHTO Soil Classification System. Two soil samples from core GT-1 had >25% that passed through the No. 200 sieve, classifying the material as silty sand; these were found at depths of approximately 3.5 m (10 ft) and 10.5 m (35 ft) below the mudline.

X-ray diffraction determined the down-core mineralogy of the sand deposits in the river channel near the site of the *Clotilda* wreck. Quartz (SiO_2) sand comprised 96.7-99.8% of the deposits. Trace amounts of other minerals were found in the cores, with 0.2-0.4% of the titanium-iron oxide ilmenite ($FeTiO_3$) in each. The graph in **Figure 11** shows the samples from the two geotechnical cores combined and organized by depth. The feldspar mineral plagioclase ($NaAlSi_3O_8$-$CaAl_2Si_2O_8$) was found in some of the sand deposits, with trace amounts in the upper 5 ft (1.5 m), a section from 10-20 ft (3-6 m) containing 0.4-0.7%, and another section at 35 ft (10.5 m) depth with 0.5%. The phyllosilicate mineral, mica (commonly muscovite – $Al_2K_2O_6Si$), was found in two subsamples of

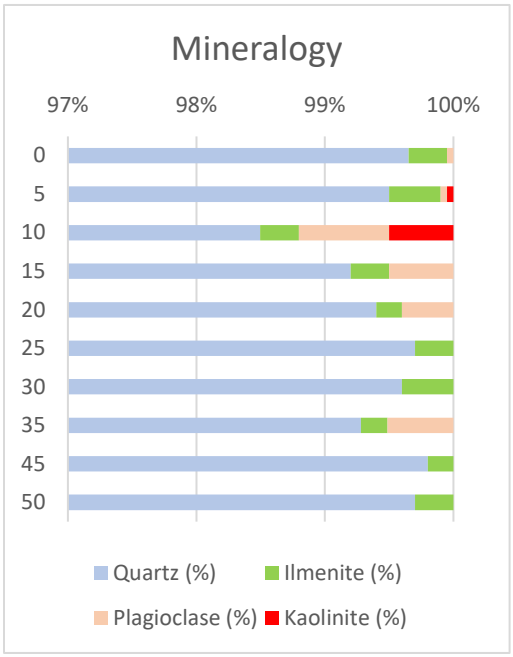


Figure 11. Graph of down-core mineralogy from XRD analysis at 5 ft (1.5 m) intervals.

the upriver core 1. The sample from 10 ft (3 m) below the riverbed yielded 0.2% mica and the sample at 35 ft depth had a relatively high amount at 2.6%. Lastly, the clay mineral kaolinite ($Al_2Si_2O_5(OH)_4$) was found at 5- and 10-ft (1.5 and 3 m) depth at trace amounts and 0.5%, respectively.

Geochemistry

Elemental concentrations (mg/kg) for 19 elements and TOC (%) are presented in **Table 2**. These results are plotted against depth to look down-core in 5 cm (2 in) sections in **Figure 12** for TOC, Li, Al, Si, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Sr, Zr, Ba, and Pb. Tin (Sn) was below detection limits of the ICP-OES and is not reported. In general, heavy metal concentrations increase with depth in most of the cores. Core A has lower concentrations of many metals, such as Fe, V and As, especially in the upper 10 cm (4 in). Core D, which was recovered from inside the hull of the wreck following diver excavation, is enriched in most of the elements, particularly the heavy metals.

Table 2. Geochemistry results for 5 cm subsamples of each push core. Data is presented in mg/kg except for TOC.

Sample	TOC %	Li	Al	Si	K	Ca	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Sr	Zr	Ba	Pb
A 0-5	0.87	8.35	5900	691	619	7790	43.6	12.10	10.60	194	7430	3.74	5.09	4.36	23.7	2.29	51.6	4.33	35.4	4.69
A 5-10	0.93	9.65	4380	744	510	5290	30.1	9.63	8.29	237	6940	3.43	4.21	4.19	21.0	2.31	41.7	4.53	28.6	3.97
A 10-15	0.58	12.70	8350	734	856	1150	48.0	16.80	15.20	191	11900	5.20	7.35	6.04	33.6	2.66	16.0	4.88	35.8	5.85
A 15-20	0.75	10.30	5830	675	698	6300	41.8	12.80	10.70	169	10200	4.19	5.70	7.07	28.3	2.84	50.7	4.67	30.0	5.75
B 0-5	1.42	12.00	6340	657	702	1690	42.0	14.20	12.40	112	8140	3.82	5.68	6.19	36.9	2.84	18.1	5.24	24.8	5.74
B 5-10	2.01	10.60	7290	711	857	5350	51.6	14.30	13.50	156	11300	4.30	7.09	6.24	37.0	3.52	51.5	5.04	32.0	5.70
B 10-15	1.85	13.80	9610	476	1200	1950	72.5	18.80	17.70	161	13000	4.94	8.02	8.43	90.4	4.61	23.1	5.67	47.2	8.16
B 15-20	1.67	17.20	12500	858	1360	1530	74.3	20.70	19.90	215	16500	6.13	9.01	8.59	130.0	4.65	20.8	6.65	94.3	8.34
C 0-5	1.50	16.10	9400	838	862	29500	55.3	17.70	16.50	608	13800	4.70	7.71	6.58	52.8	3.52	191.0	4.97	116.0	12.20
C 5-10	1.71	14.40	9690	779	892	15100	57.4	18.00	17.20	551	14700	5.00	8.00	7.34	67.9	3.75	104.0	5.07	97.8	16.80
C 10-15	1.64	17.00	12200	736	994	5680	54.0	20.40	19.20	303	15500	5.24	8.46	7.22	84.4	4.63	41.7	5.72	80.0	17.40
C 15-20	1.41	19.00	13800	791	1130	4080	60.2	24.10	22.50	358	16600	6.14	10.10	8.65	108.0	4.07	34.2	5.93	85.7	14.00
D 0-5	1.33	19.80	15700	705	1250	1010	59.2	25.30	21.20	322	17700	5.30	9.23	8.21	59.8	4.14	13.8	6.47	98.2	14.90
D 5-10	1.09	21.10	18000	926	1470	1080	60.5	29.10	25.30	413	19300	5.55	10.50	9.09	56.8	4.09	15.0	6.33	86.7	13.50
D 10-15	1.18	22.90	17800	457	1230	1490	58.0	29.90	27.30	245	17200	5.66	10.70	8.95	51.7	4.03	17.3	6.30	87.9	11.00
D 15-20	1.07	19.60	17200	863	1130	1310	62.2	29.90	24.90	593	18000	5.86	10.30	9.45	52.8	4.06	15.6	5.16	83.8	12.60

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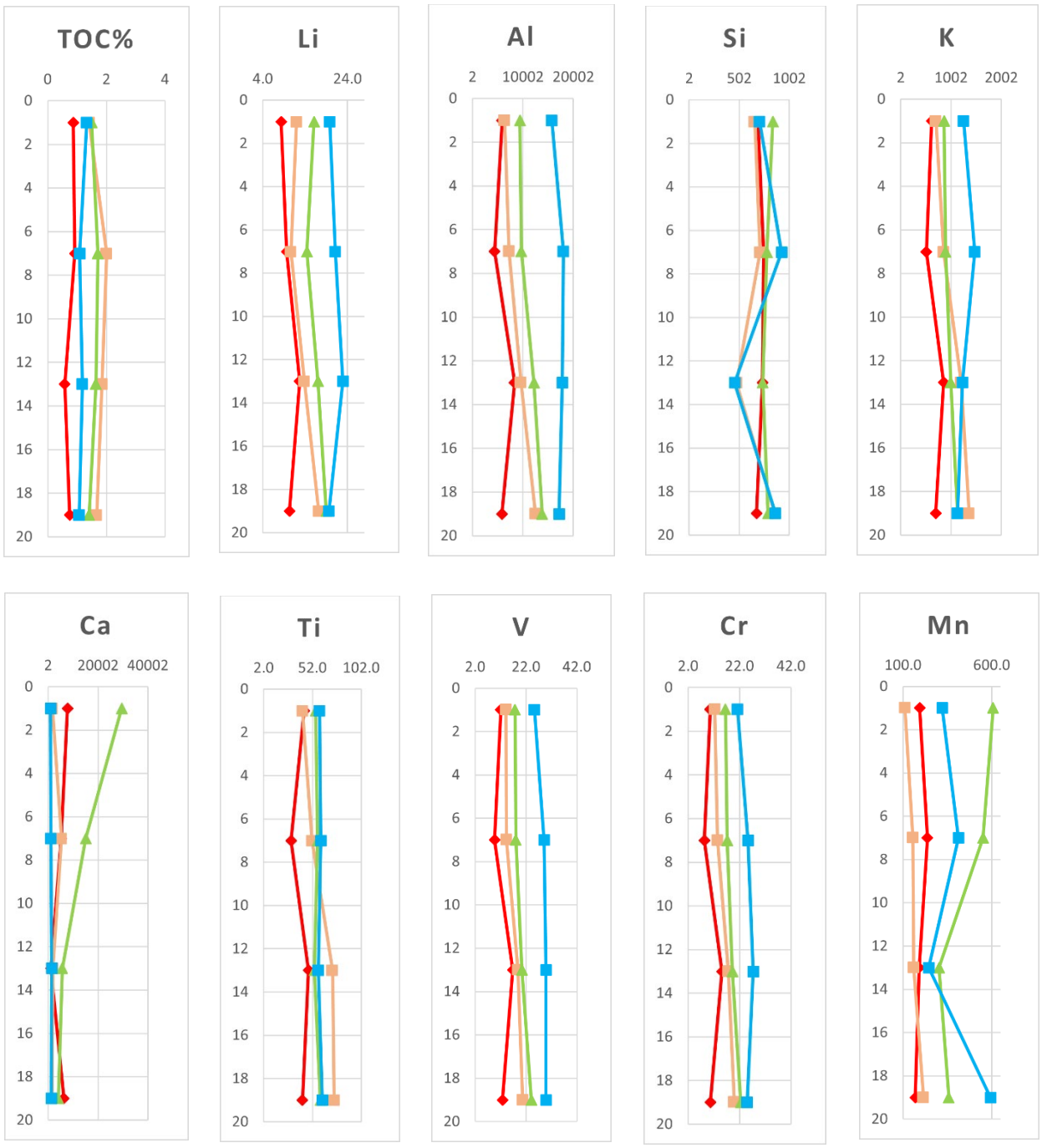


Figure 12. Total organic carbon (TOC) concentration (%) and Trace metal concentrations (mg/kg) of Li, Al, Si, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Sr, Zr, Ba, and Pb in 5 cm subsections of sediment cores plotted against depth below sediment surface. Core A (red ◊), core B (orange □), and core C (green Δ) contain surface sediments, and core D (blue □) contains sediments from inside the hull.

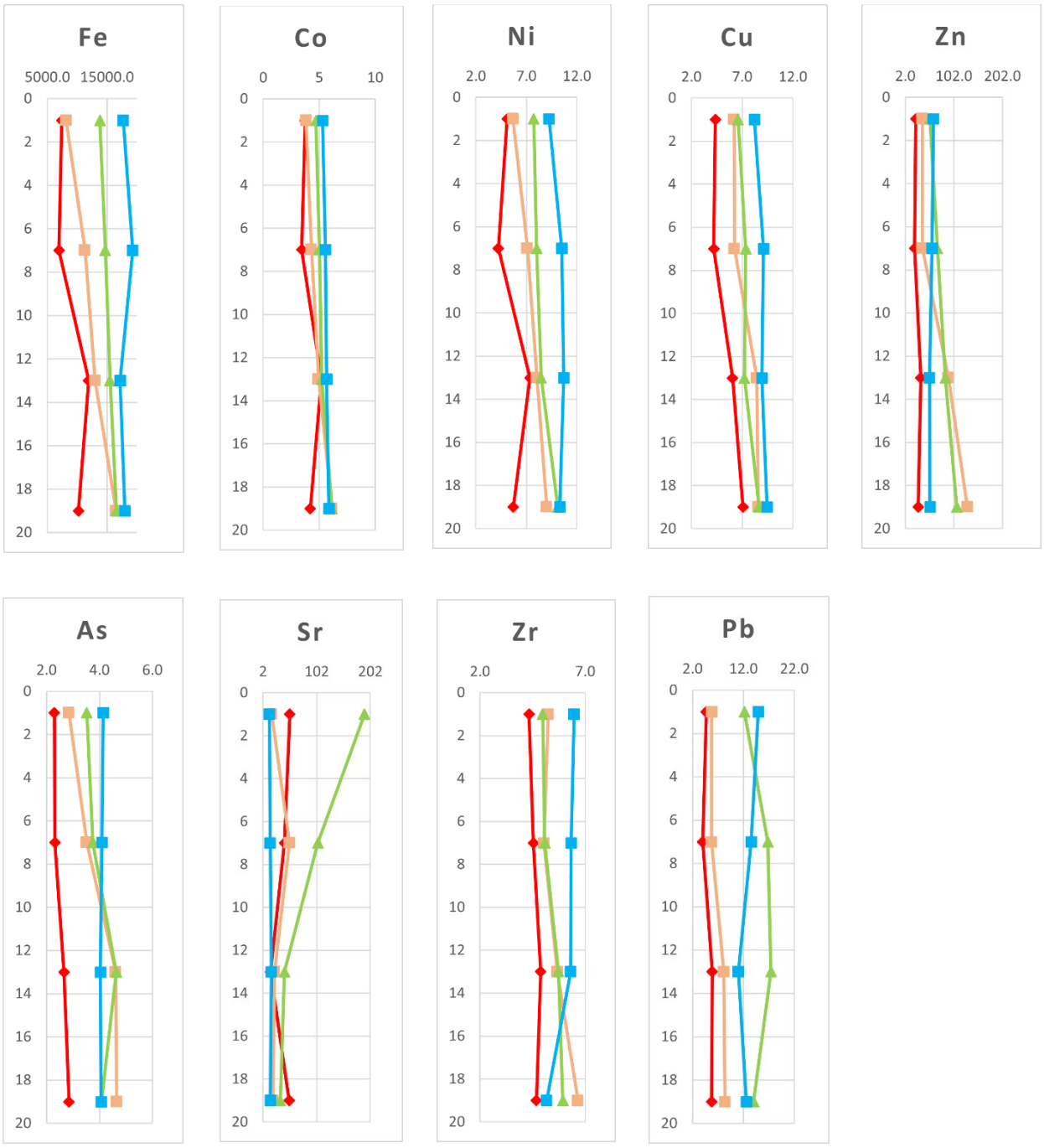


Figure 12 (cont). Total organic carbon (TOC) concentration (%) and Trace metal concentrations (mg/kg) of Li, Al, Si, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Sr, Zr, Ba, and Pb in 5 cm subsections of sediment cores plotted against depth below sediment surface. Core A (red ◊), core B (orange □), and core C (green Δ) contain surface sediments, and core D (blue □) contains sediments from inside the hull.

Meiofauna

Infauna

Meiofaunal abundance was generally low for all three sites sampled (**Table 3**). Cores A and C were numerically dominated by nematodes, while the community from core B was evenly distributed between nematodes and harpacticoid copepods. Other fauna, such as Platyhelminths (flat worms), and oligochaetes occurred sporadically and in very low numbers (**Table 3**). The nematodes collected consisted primarily of deposit feeders, facultative predators, and epigrowth feeders (Moens and Vincx 1997, Schmidt-Rhaesa 2020). None of the meiofauna collected are known to consume or bore into wooden substrates.

Table 3. Meiofauna extracted from each site.

	Site A	Site B	Site C
Nematode	25	4	55
Oligochaete	0	0	3
Harpacticoid Copepod	0	4	0
Chironomidae (insecta)	1	0	0
Platyhelminth	4	0	1
Rotifera	2	1	0
Total fauna	**32**	**9**	**57**

Macrofaunal infauna were largely absent from the three sites, and only occurred in the sample from site C. At site C, we found one macrofaunal insect larvae (Chironomidae; non biting midge) and three macrofaunal oligochaetes.

Epibenthic Macrofauna

Above the sediment, the exposed beams of the *Clotilda* harbored a large population of mud crabs (Panopeidae) as well as the wood boring isopod *Sphaeroma terebrans*. Of these macrofauna, only *S. terebrans* is known to actively bore into wood (**Figure 13**).

Fouling organisms

Fouling organisms scraped from exposed beams consisted of the barnacle *Amphibalanus subalbidus*, the false mussel *Mytilopsis leucophaeta*, and tube building amphipods (Corophiidae). Evidence of both living and dead individuals of each community were visible on the exposed beams.

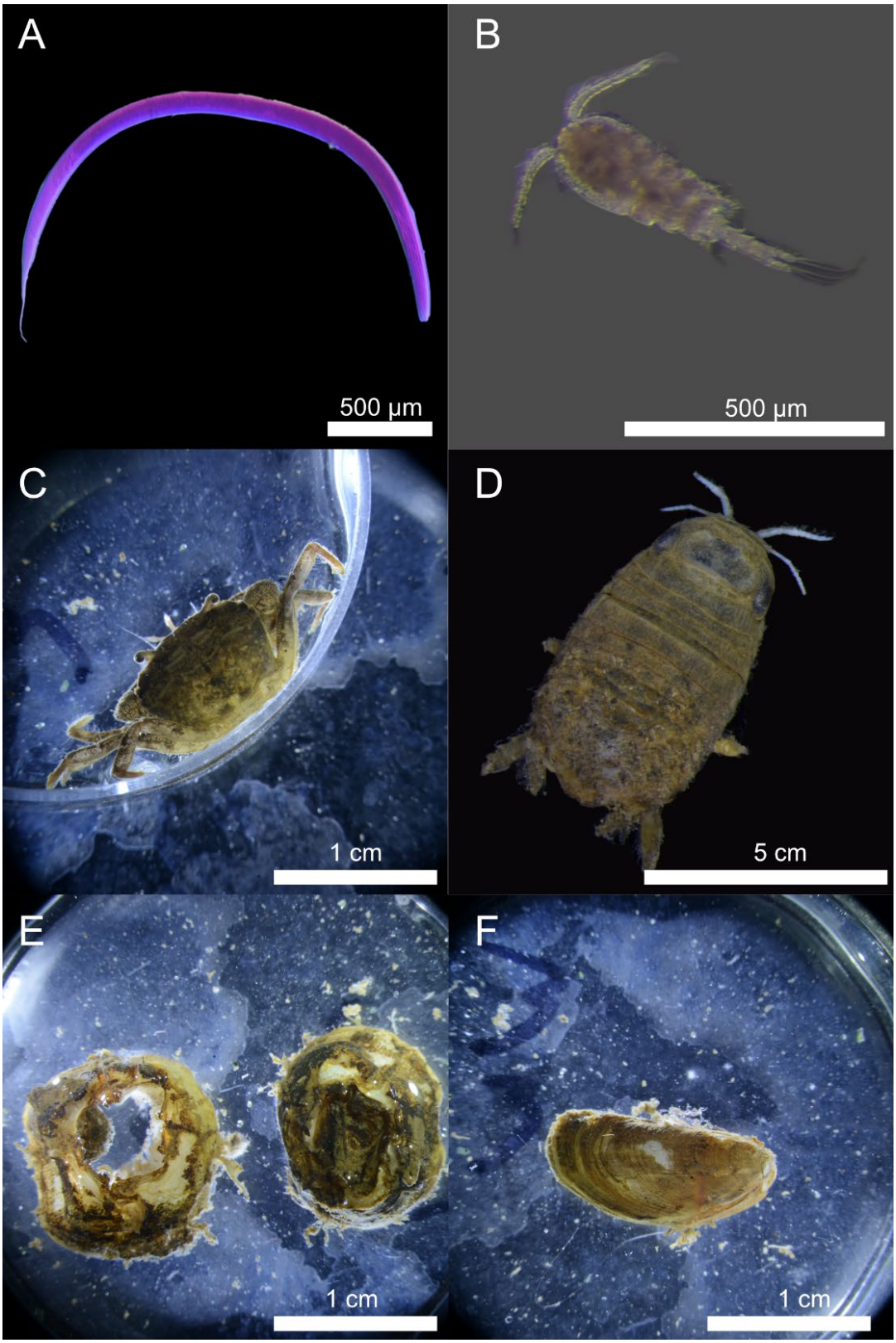


Figure 13. Organisms found in abundance at *Clotilda*. A. Nematoda sp. indet. B. Harpacticoid copepod sp. indet. C. Mud Crab (Panopeidae). D. Wood boring isopod, *Sphaeroma terebrans*. E. Barnacle, *Amphibalanus subalbidus*. F. False mussel *Mytilopsis leucophaeata*

Microbiology

Representative sequences were entered into a database against which sequences were mapped to form an OTU count table, which is used for estimating species richness. Taxonomy assignment lead to approximation of the classified and unclassified bacteria present in the core samples. The genetic database identified 237 taxonomic groups of archaea and bacteria present in the four cores collected at the wreck, 24 archaea and 213 bacteria (**Figure 14**).

Data are reported as Amplicon sequence variants, or ASVs. The Amplicons are replicated DNA sequences that are binned according to sequences that match. These binned variants are correlated with genetic sequences that have been matched. Gene sequences were then compared against a database to identify the sequences to phylum, class, order, family, genus and species levels.

Pollen

The pollen samples in this study are dominated primarily by arboreal taxa (62-80% of the total pollen assemblage of each sample) typically associated with eastern US deciduous forests including hickory (*Carya*), hackberry (*Celtis*), cypress family/bald cypress (Cupressaceae, *Taxodium*), ash (*Fraxinus*), sweet gum (*Liquidambar*), tupelo (*Nyssa*), ironwood/hophornbeam (*Ostrya/Carpinus*), and willow (*Salix*). Herbaceous pollen comprised 17-27% of each pollen assemblage (**Figure 15**) and include types such as ragweed (*Ambrosia*), aster family (Asteroideae/Asteraceae), and grass (Poaceae).

Because pollen samples originate from several cores with low sampling resolution, results are discussed as an environmental snapshot rather than a record of environmental change throughout time. In addition, pollen samples in this study are considered for their potential correlation with previous pollen studies completed on the Mobile-Tensaw River Delta, including Lake Shelby (Liu and Fearn 1993), Mobile Bay (Smith 2020), and an unpublished pollen dataset from Weeks Bay (by Miriam Fearn, retrieved from the Neotoma Paleoecological Database, DOI 10.21233/rbjr-2h86). In general, we can consider the top samples of the aforementioned pollen records to align temporally with the samples from 1Ba704. The Weeks Bay pollen record aligns closely with the majority of the pollen assemblages in this study, with moderate pine (**Figure 16**), oak, grass, and cypress pollen. However, the Mobile Bay and Lake Shelby datasets record a much larger proportion of pine pollen (up to 80%) which suggests that the samples from the 1Ba704 cores may not align temporally with the top of the Mobile Bay and Lake Shelby cores. Alternatively, it is possible that the depositional environments are significantly different among sites.

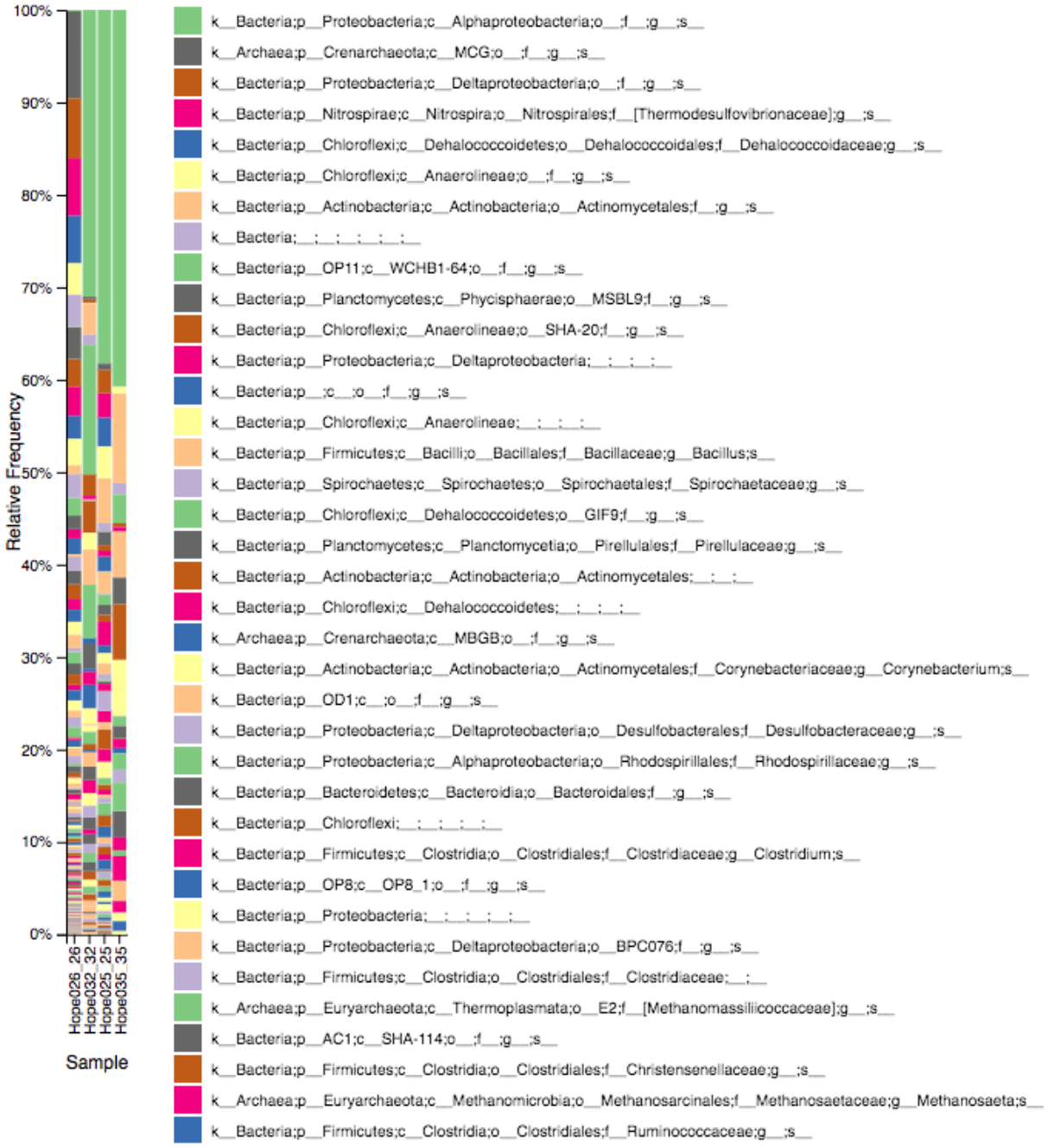


Figure 14. Microbiology results showing Level 7: Kingdom-----to----- species. Core A (#25), Core B (#26), Core C (#35), Core D (#32).

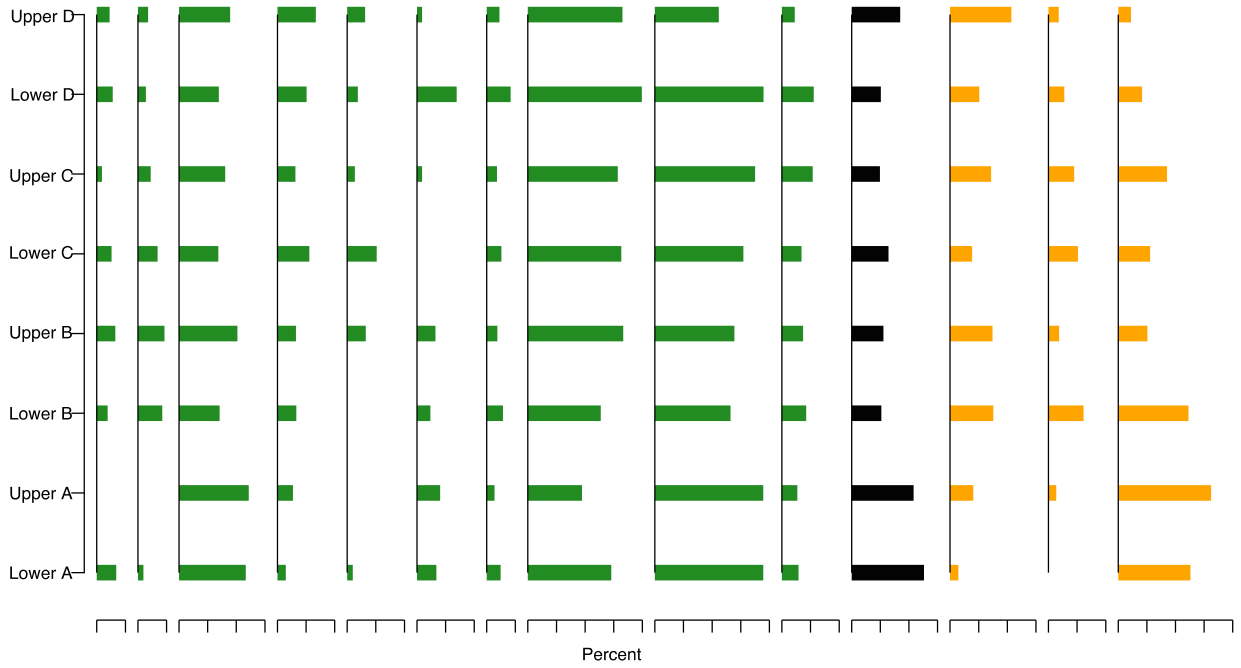


Figure 15. Relative abundance of major pollen types. Named taxa comprise at least 15% of the total pollen assemblage from all samples. Green shading represents arboreal taxa while orange shading represents herbaceous taxa. This figure should not be interpreted as a stratigraphic diagram as samples Lower A through Upper D are not in ascending stratigraphic order.

Though low energy fluvial depositional environments can be promising locations for paleovegetation reconstruction (Cambon et al. 1997, Smirnov et al. 1996) pollen records from fluvial sites have unique considerations in comparison to more traditionally analyzed lake and pond settings. Limitations include overrepresentation of pollen from riparian vegetation, potential for long distance transport of pollen from far upriver, and a lack of deeply stratified, continuous sediments. In addition, fluvial environments sometimes have sediment deposition and scouring, resulting in the resuspension and redeposition of pollen and minerals downstream (Gorham 2001). Furthermore, the salinity of the estuaries such as the Mobile River/Mobile Bay could inhibit pollen preservation, as high pH, alkaline environments can degrade pollen (Dimbleby 1957).



Figure 16. Example microscope photograph of Pine pollen (Pinus sp.). Photo by A. Perrotti.

Overall, the pollen assemblage from the 1Ba704 cores reflects a deciduous hardwood forest with adequate moisture. Despite the sediments likely being colonial in age, no pollen from a domesticate was definitively identified. However, it is difficult to identify pollen from common domesticates to the genus or species level, particularly when found in low concentrations. For example, a single Malvaceae pollen grain was identified in sample Lower D, the family that includes cotton (*Gossypium sp.*). Additionally, many samples contained pollen grains from the rose (Rosacae [e.g., apples, stone fruits]), grass (e.g., corn), mustard (Brassicaceae [e.g., mustards, cabbages]), grape (Vitaceae) and parsley (Apiaceae [e.g., carrots, many spices]) families. Though the origin and precise taxonomic affinity of many of these pollen types is not known, their potential economic significance as plants grown in small scale gardens or larger scale crop fields is a possibility. Alternatively, they may be directly associated with site 1Ba704. Despite lacking a clear signal of domesticate pollen in the cores, the abundance of the disturbance taxa such as ragweed and amaranth indicate significant open patches and widespread vegetation disturbance in the region.

DISCUSSION

Oceanographic

The location of the *Clotilda* shipwreck in the east channel of the split of the Mobile River around Twelvemile Island places it firmly in the deltaic floodplain of the river in a dynamic environment that is influenced by tidally-driven salt water and the influx of freshwater during flooding events. The site is therefore in a fluctuating environment that is dependent upon season, storm events, and tidal patterns, which have a profound impact on the site formation processes and preservation potential of the wreck. The present state of the site is the result of the sum of these environmental parameters over more than a century and a half, as well as targeted anthropogenic impacts such as dynamite and incidental vessel strikes. While storm events and flooding may place the wreck at risk of erosion from its location against the riverbank, the

fluctuating salinity at this point in the Mobile-Tensaw River system benefits the preservation potential of the site.

The *Clotilda* wreck seasonally lies within the "tidal river" section of the Mobile River deltaic system, as defined by Hoitink and Jay (2016) and discussed previously, which is influenced by the landward movement of tides, and alternately is within a salty estuary. The salinity influence extends farther than the reach of the salt wedge as seawater is pushed landward, but the wreck is located within the segment that still receives salt water from the ocean. The extent of the tidal influence is governed by the dynamics of river flow, which vary seasonally and fluctuate in response to inland weather events (Hoitink and Jay 2016). Tidal propagation through river channels during periods of low flow and strong tides are further complicated in delta systems with multiple channels, such as the Mobile-Tensaw system. This also has direct impacts on how and where sediments are deposited in the channel system. "When the tidal currents are strong, the suspended sediment tends to be dispersed through the water column. However, when the currents slacken, the mud settles to the bed, creating a near-bed layer of elevated concentrations that may become fluid mud. While this dense suspension is stationary, the basal part may consolidate sufficiently to escape erosion when the tidal currents accelerate again" (Dalrymple and Choi 2007:159). Therefore, sediment deposition at the *Clotilda* wreck site is intermittent and dependent upon numerous fluctuating flow conditions.

The ADCP current data illustrates the flow structure of the river at the wreck location during a period of low flow in November 2021. These data, illustrated in the graph in **Figure 9**, show a predominate flow pattern directly downstream, which at this point in the river channel flows at approximately 250° WSW. In addition, these data show a small amount of reverse flow during high tide at times when the river flow does not overtake this effect. "Tidal modulation of river flow causes significant variations in current speed, and current reversals occur, but the water flow is dominated by the river and hence seaward-directed currents are stronger and act for longer than landward-directed flows" (Dalrymple and Choi 2007:166). The presence of the reverse flow in this location is illustrative of the tidal influence and the presence of salinity in the river water during certain flow conditions. Salinity, shown in the CTD data in **Figure 8**, similarly fluctuates with the tides during this period of low flow. Periods of high river flow would remove the salinity from the system to a greater extent, as is indicted by the influx of rainwater from inland on November 7. During a rainy season, the salinity may decrease to near zero through multiple tidal cycles. Such flow regimes would also hinder sediment deposition.

The Mobile River system is unique in that the range of river discharge is high but the relative magnitude of tides is small, which creates a dynamic system, but is illustrated by the dominant downriver flow patterns by the ADCP data. The reverse flow detected during the data collection would not have been present in higher flow conditions. The influence of the tide, however, is potentially specific to the location of *Clotilda* against the southeastern bank of the east branch of the river around Twelvemile Island. The complexity of the delta system with numerous channels and natural levees causes the river flow and tidal influence to vary throughout the delta. This inequality in river discharge distribution is referred to as asymmetry in the channel geography. The division of water at river bifurcations is governed by "channel dimensions and

hydraulic roughness" between the two channels (Buschman et al. 2010:1). The geometry of the Mobile River around Twelvemile Island, which is not symmetric, likely follows this asymmetric flow where water from one channel may flow back through another and may result in net circulation around Twelvemile Island in low flow conditions. In periods of higher flow, there would be more equal movement and flow conditions between the two channels. However, given that the west branch around the island is the one maintained as the navigable waterway and is deeper, the water flow is likely faster. Therefore, reversing the flow direction (and momentum) by flooding tides would then be easier on the shallower east side at the *Clotilda* site. Such flow circulation patterns around island are observed in the tidal reaches of the Columbia River and Mekong River (Lutz et al. 1975, Ogston et al. 2017). At high river discharge, where flows no longer reverse, flow no longer circulates around the islands. This is a flow pattern likely present at Twelvemile Island where there is likely more tidal influence on the east branch, especially in low flow conditions, and therefore higher salinity fluxes through that part of the river in which *Clotilda* lies.

Geotechnical

The geotechnical cores collected in the river channel upstream and downstream from the *Clotilda* wreck indicate a strong flow regime at this point in the river that does not allow for net sediment deposition. While periods of low flow or slight reverse flow will support settling of sediment particles, periods of higher flow during storm events or rainy seasons are erosive enough to remove any deposits within the river channel; this is indicated by the nearly-pure sand deposits collected in both cores within the river channel. Fine mud and silt is built up along river banks in certain areas, such as around the wreck, depending on the water flow patterns at river channel bends. Flow conditions are also influenced by the installation of lock and dam systems upstream in the Tombigbee River and widening of parts of the channel in the 1950s and 1960s (Smith et al. 2013). Such anthropogenic impacts caused a loss of net sediment downstream, however the consistency of sand in the cores indicates that these flow conditions have been present over a long time scale.

The presence of highly variable river events also influences erosive events that impacts sediment deposition. Dykstra and Dzwonkowski (2020) observed the events as river (fluvial) waves propagating through the deltaic system of the Tombigbee-Alabama River from the inland dams. These waves are caused by large precipitation events in the watershed, and propagate downstream through the system and act to flush the system. Due to climate variability through time, precipitation has intensified, causing the flood waves to become larger (Dykstra & Dzwonkowski 2021). Such wave propagation influences the river discharge and the bed slope, likely causing additional scour to what would occur due to normal high flow periods (Dykstra et al. 2022). Such flow pulses could also cause erosion along the riverbank and potentially impact the wreck's location there. These waves also affect the morphology of the riverbed. Sand wave bedforms are apparent in the multibeam sonar map (**Figure 1**) on the channel side of the wreck and are indicative of these stronger periods of flow influencing the structure of the riverbed. Due to sea level rise, the site may have also become deeper through time (~40 cm [16 in], some of

which may have been offset by sediment deposition) increasing backwater effects that slow the flow of river events and may be reducing the scour effects at the site.

The X-ray diffraction analysis of subsamples of the geotechnical cores also provided a snapshot of the clastic material being washed down river through the watershed. The sands in the cores are almost entirely quartz sand, however there are pockets of trace minerals throughout. The mineralogy overall is reflective of the coarse fraction of the geologic formations inland. For example, the Denkman Sandstone member of the Norphlet Formation is a quartz-rich sandstone with fine to medium subrounded quartz grains and as much as 15% feldspar (Mancini et al. 1985, Wilkerson 1981). Plagioclase is found to a small extent in the upper sections of the cores and in one subsample at 10.5 m (35 ft) depth, and kaolinite, which is a clay byproduct of plagioclase erosion by carbonic acid, is also present in certain upper sections of the cores (**Figure 11**). All subsamples of the cores also contained 0.2-0.4% ilmenite, or iron-titanium oxide. This mineral is commonly found in geologic formations inland through central Alabama, such as the Lisbon Formation and Citronelle Sands, which the Tombigbee and Alabama Rivers flow before joining into the Mobile River (Isphording and Flowers 1980). Other clastic minerals, such as micas, are commonly found throughout igneous and metamorphic formations throughout the area, and these heavier, coarse minerals comprise the sediments that remain deposited in the higher flow regime of the Mobile River channel.

Geochemistry

The general trends of the trace metal concentrations and total organic carbon (TOC) in the sediment cores from *Clotilda* are indicative of the differences in the water flow regimes around the wreck that influence sediment deposition behind the barrier of the wreck's structure. Generally, the four cores reflect the variability in the micro-environments created by the presence of the wreck in the river. Core A indicates exposure of the sediments to the river's flow and is depleted relative to the other cores in many trace elements as well as TOC. Cores B and C show more accumulation of heavy metals due to the wreck providing shelter for burial of accumulated metals inside the wreck as it filled in, as well as behind the wreck in the lee of the river flow. Core D was collected once divers had dredged down inside the hull and taken against the interior hull ceiling planking, and is therefore enriched relative to the surface cores in trace metals.

No elevated metals were apparent in the 20 cm (8 in) push cores that would be expected from corroding elements of the vessel. Push cores collected at the Monterrey A shipwreck in the Gulf of Mexico in 2013 showed elevated copper in sediments adjacent to the remnants of copper sheathing from the ship's hull (60 mg/kg) compared to control sediments collected 60 m from the wreck (8-12 mg/kg) and resulted from corroded copper being deposited into the sediments near the wreck (Brennan 2018). *Clotilda* was copper sheathed; however, divers only felt the smooth metal sheeting when they reached down into the sediment and felt along the lower parts of the hull. The sediment cores collected outside the hull (cores A and C) did not collect sediment deep enough to collect sediments near the copper. Additionally, the Monterrey A copper

sheathed hull was exposed to seawater while that remaining on *Clotilda* is buried, possibly preventing corrosion in the anoxic sediments.

Dissolved trace metal concentrations in both water and pore water, the water within sediments, has been shown to correlate with stream flow. Trace metal deposition into sediments is typically associated with colloidal or particulate Fe or Mn that is deposited in solid form as Fe-Mn-oxyhydroxides and which other trace metals adsorb onto and are deposited along with these particles (Huser et al. 2011). In river systems, these oxyhydroxides are the main carriers for heavy metals such as Zn and Ni through adsorption of trace metals onto the mineral structure (Du Laing et al. 2009). Other metals are transported through organic matter in the water. A variety of metals have a high affinity for organic matter or suspended organo-metallic colloids, such as V, As, Cu, and Pb, and these are commonly increased with increasing trends in TOC and Fe. Colloidal Fe, commonly in the form FeS or FeS_2 (pyrite), is stabilized by increasing dissolved organic carbon (DOC) and has been shown to correlate with V and As trace metal concentrations (Huser et al. 2011).

TOC was lowest in core A, located on the river channel side of the wreck, and highest in cores B and C, especially at the 5-10 cm (2-4 in) level. These two cores, from inside the hull and on the shore side outside the wreck, are sheltered from the river's flow and locations where organic matter can settle. Core D had slightly lower TOC than B and C; this core from the lower sediments after diver excavation was similarly protected from flow, but organic matter was consumed over time following burial. Trace metals with TOC-affinity, however, such as V, As, Cu, Pb, and Cr, are elevated in core D, as well as the lower parts of cores B and C, because the heavy metals remain following burial and microbial decay of organic matter. TOC enhances metal adsorption to sediment phases. Sedimentary TOC increases as sediment grain size decreases because organic matter adsorbs onto mineral surfaces, and therefore have more surface area in fine grained sediments, such as clay and silt (Tukura et al. 2007, Nelson and Sommer 1982). The presence of TOC also influences the concentrations and accumulation of trace metals that have an affinity for TOC, which are taken into sedimentary solid phase by adsorption onto mineral surfaces, principally, Fe-Mn-oxyhydroxides ((Fe,Mn)O(OH)).

Arsenic is the most strongly correlated metal with TOC ($r = 0.627$). Like other transition metals, As is commonly enriched in silts, clays, and peat due to the higher organic content relative to sands, and greater surface area on fine-grained sediments (Ahmed et al. 2010). In addition, As substitutes into the crystal structure of sulfide minerals into the place of sulfur, so the formation of FeS in anoxic environments can incorporate As not only through adsorption but through direct substitution, and is indicated by the strong correlation between As and Fe ($r = 0.826$). Arsenic is efficiently adsorbed onto or co-precipitated with hydroxides in oxic conditions, and in anoxic conditions, As is reduced from its fifth to third valence state and incorporated into solid state in sulfide minerals (Gorny et al. 2015). Vanadium is also common in organo-metallic colloids and associated with TOC content. In oxic waters, V is soluble in water as vanadate (e.g., HVO_4^{-2}) and adorbs onto oxyhydroxides and clays in the sediment. However, in anoxic sediments and porewaters, V is reduced to vanadyl, the tetravalent isotope (e.g., VO^{+2}) that will coprecipitate with organic matter and sulfide minerals (Wu et al. 2020; Emerson and Morford 1999). Finally,

under fully anoxic conditions, V may be reduced to the insoluble V(III) species by hydrogen sulfide (H2S) in the porewater and precipitate as hydroxides; this could be the pathway V takes as it is buried and removed from contact with the sediment/water interface within the wreck as sequestration of heavy metals occurs in low oxygen conditions (Wu et al. 2020).

Heavy metals accumulate in sediments through several complex processes and mechanisms that are dependent on the type of sediment matrix and properties. Certain trace metals are associated with solid phases and are directly adsorbed onto the surfaces of fine-grained clay particles or hydrous ferric and manganic oxides, and in some cases direct precipitation into solid phase (Ghrefat et al. 2006; Leivouri 1998; Ankley et al. 1992). One of the conditions necessary for the enrichment of sediments with certain heavy metals is the redox state of the sediment. Redox-sensitive trace metals include Cu and V and are enriched in anoxic sediments and depleted in oxic sediments, defined as <10 µmol/L O_2 and >1 µmol/L H_2S (Nameroff et al. 2002).

The sediments of the Mobile River are typically anoxic below the upper 5 cm (2 in). Vanadium and Cu results from the cores at *Clotilda* indicate this with lower concentrations in the top 0-5 cm (0-2 in) and 5-10 cm (2-4 in) in cores A, B, and C but core D shows higher concentrations of both metals as it was further below the mudline. These two metals are also strongly positively correlated (r = 0.886). If oxygen were to penetrate below the sediment, these redox-sensitive metals would be released into the water column. “V is released from sediments when Mn reduction occurs near the sediment-water interface (where oxygen penetrates <1 cm [0.4 in]). Accumulates in anoxic sediments via diffusion across sediment-water interface to removal depth” (Nameroff et al. 2002:1140). This explains the lower concentrations of V and Cu in core A, which is more exposed to river flow and subject to reoxygenation. Therefore, Cu and V that are deposited within the hull of the wreck became more concentrated as burial occurred.

Copper and V are also strongly correlated with Fe (r = 0.901, 0.929), because ferric oxyhydroxides and the Fe-cycle drive the trace metal geochemistry in anoxic sediments. Chromium and As also have strong positive correlations with Fe (r = 0.944, 0.826), Ni has strong correlations with V, Cr, Cu, Co, and Fe, and Co has the strongest correlations with Ni and Fe (**Table 4**). These trace metals are released during diagenesis as the adsorption locations on oxyhydroxide particles are dissolved. Under anoxic conditions in the sediments, metals are released into the porewater during the reductive dissolution of Fe-Mn-oxyhydroxides from their places adsorbed onto the mineral structure. Sulfides, primarily FeS, formed during the reduction of sulfate can remove heavy metals from the porewaters and immobilize them in the sediments as solid phases (Pan et al. 2019). Iron typically dominates heavy metal mobility, while Mn-oxides play a significant role in capturing metals such as As, Co, Zn and Cr because they have a greater adsorptive capacity on the oxide surface for transition metals.

Table 4. Pearson correlation coefficient matrix (r) for trace metal chemistry data. Statistical significance (*p* > 0.05) is when r > 0.2 (after Nameroff et al. 2002:1153).

	Al	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Pb
TOC	0.082	0.063	0.162	0.075	0.229	0.179	0.229	0.263	0.567	0.627	0.340
Al		0.992	0.981	0.461	0.945	0.845	0.957	0.867	0.455	0.723	0.690
V			0.986	0.468	0.929	0.844	0.961	0.886	0.428	0.702	0.664
Cr				0.454	0.944	0.887	0.985	0.897	0.527	0.764	0.692
Mn					0.546	0.394	0.466	0.358	0.152	0.291	0.694
Fe						0.915	0.969	0.901	0.603	0.826	0.789
Co							0.930	0.868	0.744	0.787	0.639
Ni								0.915	0.590	0.804	0.712
Cu									0.633	0.837	0.612
Zn										0.827	0.505
As											0.695

However, while Fe concentrations in the sediment cores are strongly correlated to concentrations of redox sensitive heavy metals (V, Cr, Co, Ni, Cu, As), such correlations were not apparent with Mn (**Table 4**). Manganese is more sensitive to redox environments than Fe, and the riverine environment around Twelvemile Island, which transitions from saline to fresh seasonally and through tidal influence, is not likely consistently reducing enough to enrich the sediments in Mn (Du Laing et al. 2009:3979). TOC is significantly correlated with Fe at r = 0.229 and not significant with Mn at r = 0.075. In addition, river flow can cause re-oxidation even in reducing conditions through resuspension of settled sediment during changes toward more turbulent flow conditions. Therefore, Mn cycling is stimulated by tidal influence and changing flow conditions, which leads to continuous metalloid liberation into the overlying waters until burial occurs (Pan et al. 2019:9). Such processes at the wreck site govern the variability in Mn concentrations (**Table 4**) and indicate why most heavy metals are correlated with Fe concentrations instead. The redox sensitive metals, including Fe, are depleted in the surface 0-5 cm (0-2 in) sediments due to the dynamic riverine environment, and are only enriched in the sediments following burial. Like Fe, these transition metals are enriched in core D from the interior of the wreck from the formation of iron sulfides and removal of these metals from the porewater and deposited into solid phase and burial through adsorption onto sulfide minerals or direct precipitation. Iron is depleted in the upper 10 cm (4 in) of core A, specifically, because of the remobilization of sediments exposed to the higher area of river flow at the exterior of the wreck (e.g., Morford and Emerson 1999). Iron may also be in lower concentrations here due to a higher quantity of quartz sands nearer the river channel; decreasing proportions of sands and an increase in clays, muds, and organic matter cause a rise in iron content (Helz et al. 1985, Huser et al. 2011).

Another factor governing the fate of heavy metals in the sediments at the *Clotilda* wreck site is salinity, which we have shown to be highly variable and dependent on tidal influence and river flow. Salinity and flow in river channels and deltaic floodplains are factors that affect the desorption of heavy metal ions from solid phase oxides. The oxic-anoxic interface, located within the upper 5 cm (2 in) of sediment, and the anoxic layer below, govern the flux of trace metals from the overlaying waters to the sediments, and fluctuating water levels, turbulent flow, and changing salinity can move the oxic-anoxic interface (Du Laing et al. 2009). In addition, higher salinity increases the concentration of major cations (Na, K, Ca, Mg), or salts, in the water, which

compete with heavy metals for adsorption sites on mineral surfaces. Copper is known to be affected more by increased salinity than other metals, such as Cr, Ni and Zn, likely due to its affinity for organic matter (Du Laing et al. 2009). The seasonal changes in river flow, storm events, and tidal influence that causes variable salinity in this part of the Mobile River therefore presents changing conditions under which heavy metals may be remobilized as soluble form or maintain their adsorption on sulfide solids and made immobile through precipitation and burial.

The *Clotilda* shipwreck lies in a dynamic and fluctuating riverine environment with conditions governed by seasonal and periodic flooding and diurnal tidal effects. Scour caused by increased river flow can resuspend deposited sediment and remobilize trace metals into the water, while periods of low river flow are dominated by increased salinity due to the stronger tidal effect; these fluctuations change the oxygenation of the sediments, availability of cations, and ability of solid precipitates to form and be deposited at and around the wreck. In addition, the presence of the wreck structure in the river creates microenvironments as the remains of the hull shield areas within and behind the shipwreck from the river flow. These sheltered areas develop anoxic environments for the precipitation of sulfide minerals and trace metals to deposit, as well as buildup of organic matter, compared to the river-side area of the wreck that is exposed to more moving water.

Meiofauna

Meio and Macro infauna

It is unlikely that any of the burrowing meio or macro fauna have a significant effect on the *Clotilda* wreck. None of the infauna collected from the sediment cores bore into or readily consume wood, so their direct effects are limited. While the burrowing activities of infauna mixes oxygen into sediments potentially allowing aerobic microbes greater access to buried portions of this ship (Meysman et al. 2006), these activities are unlikely to affect the wreck structure, as macrofaunal abundance is extremely low. Meiofauna have been shown to significantly increase solute transport in surficial sediments as well (Aller and Aller 1992), though these effects are limited to the upper few millimeters and are not likely to significantly increase degradation to the wreck.

Epibenthic Macrofauna

The mud crabs (Panopeidae) collected from the wreck are not expected to affect the integrity of *Clotilda*. These small crabs form burrows in the sediment and feed primarily on barnacles, clams and other small invertebrates (Schubart et al. 2000). They likely only utilize the wreck as a foraging ground or as refuge from predators. *Sphaeroma terebrans* are the only fauna we collected that are expected to have a significant, direct impact on the wreck. These isopods are wood boring, but not wood consuming, primarily utilizing wood substrate to construct burrows and brood young (Rice et al. 1990). In high numbers their burrows have a honeycomb or “shotgun blast” appearance and can lead to significant damage in submerged woods (Rice et al. 1990). These isopods prefer lower salinity brackish waters and readily colonize most woods. They have been documented in bulkheads, pilings, boat hulls, and have even caused considerable damage to some mangrove populations (Rehm and Humm 1973). *Sphaeroma terebrans* is sensitive to low

oxygen, however, so its effects are not likely to extend below the surface of the sediment. Exposed portions of the wreck are likely to be continually colonized and degraded by these isopods, though the rate of such degradation cannot be estimated based on the current data.

Fouling Communities

The fouling communities collected from *Clotilda* all consist of organisms that utilize wood as a substrate for settlement and growth, but do not actively bore into or consume wood. As such, it is unlikely that the barnacles, false mussels, or amphipods will cause significant damage to the exposed wood. Once settled, however, these organisms can be difficult to remove without causing damage to the wood beneath.

Potential salinity ranges at Clotilda

The biological communities present at the *Clotilda* wreck are indicative of a brackish to freshwater environment, as would be expected based on the wreck's location. The infaunal community, including nematodes, oligochaetes, chironomids, harpacticoids, and platyhelminths, are commonly found in brackish water environments, and many of their representatives have broad salinity tolerances (as low as 2 ppt) (Pinder 1995, Giere 2009, Schmidt-Rhaesa 2020). *Sphaeroma terebrans* is considered extremely euryhaline, with lethal salinities reported at 0.5 ppt, and above 50 ppt, but their ideal range is likely between 4 and 28 ppt (John 1969). The barnacle *Amphibalanus subalbidus* is likewise extremely tolerant of low salinities and has been reported in waters with salinities as low as 0.8 ppt (Kennedy and DiCosimo 1983), although studies suggest that they can only reproduce at salinities above 2 ppt (Dineen and Hines 1994). Finally, the false mussel *Mytilopsis leucophaeata* has an observed salinity range of 0 – 32 ppt (Castagna 1973), but is found in greater abundances between 1-10 ppt (Kennedy 2011) and larvae survival requires a minimum salinity of 5 ppt (Verween et al. 2007).

Living individuals of all organisms mentioned above were found either on the *Clotilda* wreck or in the surrounding sediments, with *S. terebrans, A. subalbidus*, and *M. leucophaeata* all occurring in abundance. The minimum reported salinities for *S. terebrans, A. subalbidus* and *M. leucophaeata* are 0.5, 0.8 and 0 ppt respectively, but both *A. subalbidus* and *M. leucophaeata* can close their shells, effectively sealing themselves off from unfavorable conditions for short periods of time. Because *S. terebrans* does not possess this ability, its minimum salinity tolerance is potentially more indicative of local conditions. The presences of *S. terebrans* therefore indicates that the local salinity had not dropped below 0.5 ppt in the days preceding or at the time of collection and their apparent abundance suggests that the salinity frequently fell in their optimal range of 4–28 ppt. Additionally, the presence of M. *leucophaeata* indicates that the surrounding waters reach a minimum of 5 ppt at least episodically, otherwise larval settlement of these bivalves would not be possible. In short, no purely marine organisms were found among the faunal assemblage at the site, and all can tolerate moderate salinities, indicative of the variable environment at this point in the Mobile River.

The only organism found at the *Clotilda* wreck that is expected to directly degrade the vessel is the wood boring isopod *Sphaeroma terebrans*. The effects of this isopod should be limited to the areas of the wreck currently exposed to the water column and buried portions should remain

intact as long as they remain beneath the sediment. Without quantifying the extent of the colonization or the population size, it is not possible to estimate the extent or rate of degradation caused by *S. terebrans*, but damage to the *Clotilda* wreck from these organisms is likely to continue as while the timbers remain exposed. No other fauna collected in the sediment samples or found growing on the vessel bore into wood, or directly consume it, so the effects of these organisms is expected to be minimal.

Microbiology

The presence of the *Clotilda* wreck in a dynamic estuarine environment contributes to the story the wreck tells through its tenure in the Mobile River and the environmental mechanisms that contributed to the site formation processes. The study of microbial communities at historic wooden shipwreck sites is a relatively new endeavor, and has been done primarily at deep water wrecks, including those in the Gulf of Mexico and the Black Sea (e.g., Hamdan et al. 2018, Brennan et al. 2013). The *Clotilda* wreck lies in a transitionary environment between freshwater and marine, but the influence of the salt wedge through tidal effects, as discussed previously, is present to such an extent that microbial communities, especially those buried in the sediment in anoxic conditions, are likely less affected by pulses of fresher water, and these sediments provide conditions similar to those along shallow marine continental margins. Many bacteria identified through this analysis are common and expected - for example, the *Actinomycetales*-order *Actinobacteria* that metabolizes nitrogen, or *Pirellulaceae*, a *Plantomycetes*-class commonly found in aquatic environments - and these were ubiquitous throughout the sediment samples. However, there are certain bacteria identified in these results that have specific roles within the microenvironment of the *Clotilda* wreck that are important in the biogeochemical processes occurring within the site.

Bacteria in Marine Sediments

The microbial biomass of marine sediments has been explored through ocean drilling over the last few decades. Cell concentrations have been found to be significantly higher in organic-rich anoxic sediments of coastal and continental margins compared to the organic-poor sediments of the open ocean, and abundance is greater in surface sediments than those older and deeper (Hoshino et al. 2020). A diverse biomass has been found to be ubiquitous in anoxic sediments, due in a large part to the absence of dissolved oxygen and high organic content, and the composition of these communities can be greatly influenced by geochemical properties as well as changes in temperature, salinity, and pressure. Oxic marine sediment are typically dominated by *Proteobacteria*, particularly the *Alphaproteobacteria* class, and microbes of the *Firmicutes* phylum, while those in phyla *Cholorflexi* and *Plantomycetes* dominate anoxic sediments. However, despite the dominance of these phyla in oxic versus anoxic sediments, certain anoxic sediments can contain bacterial communities of types found in oxic sediments (Hoshino et al. 2020).

Microbes of the *Chloroflexi* phylum, including both *Anaerolineae* and *Dehalococcoidetes* classes, were found present in core B from the surface interior of the wreck. Microbes such as SHA-20 that were found in all four cores, were elevated in core B, while other *Chloroflexi* were only found

in core B. Members of *Chloroflexi* belonging to the *Dehalococcoidia* family, which are considered strongly anaerobic, have been found in aerobic communities (Hoshino et al. 2020). *Dehalococcoidetes* were found in both A and B cores, but higher abundance in B. The meiofauna results also indicate a more stable, anoxic area of sediment in the interior of the wreck, with few nematodes, resulting in less bioturbation and therefore less reoxygenation of surface sediments. Additionally, the partially aerobic genus *Bacillus* of the *Bacilli* class of *Firmicutes* was found in higher abundance in cores A and C and fewer in B, further indicating that the interior surface sediments within the wreck are more stable due to less bioturbation and water movement (Lovley 1991). The *Actinobacteria Streptomyces* is capable of aerobic growth (Khomyakova et al. 2022) and was found only in core A, potentially indicating the surface sediments across the wreck site between the river channel and the shoreline undergo different levels of disturbance from water flow and therefore oxygenation. Other *Actinobacteria* of the *Actinomycetales* order were found in all four sediment cores. These microbes are found widespread in marine environments, including mangrove wetlands, continental shelves and the open ocean; diversity of these microbes, however, is greater in shallower environments (Chen et al. 2021)

Iron- and Sulfate-Reducing Bacteria

The degradation of organic matter occurs in anaerobic environments and includes processes of denitrification, iron reduction and sulfate reduction (Sun et al. 2014). The microbially-mediated reduction of iron in these anoxic environments is one of the main processes that reduces both dissolved and solid ferric iron to its ferrous form. This process is referred to as dissimilatory iron reduction, and the microbes that perform this function are diverse (Su et al. 2020). Sulfate-reducing microbes are also widespread in marine, brackish, and freshwater anoxic environments. These microbes oxidize H_2 or carbon molecules to acetate or CO_2 and couple that with the reduction of sulfate or other sulfur electron acceptors (Miletto et al. 2011). *Desulfovibrio* is one genus of *Deltaproteobacteria* that reduces sulfate to sulfide through a process involving enzymes within its cytoplasm that accepts an electron from donors that can include hydrogen and a variety of organic compounds that are broken down (Voordouw 1995). The end result of these reactions is hydrogen sulfide, which then often forms iron-metal sulfides within the sediment. Fe(III) can be the electron acceptor for *Desulfovibrio* in anoxic sediments, and through the reduction of iron and formation of sulfides, these microbes catalyze the removal of heavy metals from the system through immobilization in solid form and subsequent burial, and are thought to be responsible for the removal of heavy metal pollutants from contaminated environments (Voordrou 1995).

The presence of certain microbial communities in the sediment cores from *Clotilda* are indicative of the anoxic environment within the sediments covering the wreck, but also the effect of the river flow on the surficial sediments. The *Deltaproteobacteria*-class families *Desulfobacteraceae*, *Desulfobulbaceae* and *Desulfovibrionaceae* (and genus *Desulfovibrio*) were only present in the A, B and C cores, and not found in core D. “Iron-oxidizing bacteria (FeOB) and sulfur-oxidizing bacteria (SOB) may utilize the oxygen penetrating to the subsurface soil… the oxygen then may be used for the oxidation of reduced compounds, such as ammonia, ferrous iron, sulfide, and methane, thus regenerating electron acceptors for anaerobic bacteria” (Sun et al. 2014:10). These microbes’ absence from core D indicates the stability of the sediments below the sediment/water interface as oxygen from the river flow is absent compared to surface sediments.

These sediments within the wreck are therefore entirely anoxic at the depth approximately 4 feet below the mudline, and the heavy metals these bacteria immobilize during sulfate reduction have already been reduced (Voordouw 1995:2815). The abundance of microbes in sediments typically decreases with increasing depth and therefore age of the sediment, and as burial ensues, interaction with the water column and other sources of nutrients ceases, and activity slows (Hoshino et al. 2020). Less is known about other microbes, such as those of the OP11 phylum and the *Anaerolineae*-class SHA-20, both of which were found at *Clotilda*. These are typically found in reduced environments and are likely involved in the sulfur cycle (Harris et al. 2004). These were found in all four cores, and concentrated in core D, a further indicator of the reducing environment within the wreck, and suggestive of sulfate and sulfide presence, which is expected in anoxic sediments (Harris et al. 2004, Youssef et al. 2011, Zhang et al. 2018).

Heavy Metal Cycling

Sulfate-reducing bacteria are the drivers behind the breakdown of organic compounds and removal of heavy metals into solid phase. Operating under anaerobic conditions, these microbes use sulfate as the terminal electron acceptor to reduce it to sulfide as H_2S. This allows for the precipitation of sulfide metals in the sediment, utilizing the biologically produced H_2S and producing insoluble metal sulfides, thereby removing them from solution (Cabrera et al. 2006). *Desulfobulbaceae* are a family of sulfate reducing chemotrophs that are important in biogeochemical cycles in anoxic aquatic sediments (Li et al. 2021). The *Deltaproteobacteria* genus *Geobacter* is known to reduce metals in subsurface sediments, particularly iron (Sun et al. 2014). Iron and manganese in aquatic environments are reduced from Fe(III) and Mn(IV) states by microbes such as *Geobacter* and *Bacillus*, which releases other metals, such as Ni, Co, Cu, and Mn(II) into solution that can be taken into solid state as sulfide minerals (Lovley 1991, Rodionov et al. 2006). Levels of certain heavy metals have been found to be toxic to sulfate reducing bacteria of the *Desulfovibrio* family (Cabrera et al. 2006, Ni et al. 2016, Xie et al. 2016). The geochemical data for the *Clotilda* sediment samples was bulk geochemistry analyzed after dissolution, which includes metals that were removed from the system in solid phase as stable sulfides. Core D sediments had higher levels of metals like Zn and Cu due to solid phase and burial in the sediments within the hull. However, some of these concentrations of heavy metals inside the wreck may be at levels that are toxic to some bacteria. In addition to iron and manganese oxyhydroxides in the sediment, it is possible that the corrosion byproducts from metal fasteners on the wreck also contribute to the bacterial reduction of metals and formation of sulfide minerals.

Microbial Degradation of Wood

The primary degraders of archaeological wood are wood-boring bivalve mollusks. However, research into anoxic conditions at buried marine archaeological sites have shown that in anaerobic conditions, both fungus and bacteria can degrade wood. Wood borers require oxygen, so in anoxic waters, the primary degradation of wood structure and cellulose has been found to be bacteria (Kalenitchenko et al. 2018). Studies in the 1990s on wooden timbers from the wreck of *Defence,* a Revolutionary War wreck in Maine waters, tested the preservation potential if the artifacts were reburied, thereby recreating the anaerobic environment in the sediment (Reiss and Daniel 1997). Following reburial of portions of the wreck in 1970, timbers from *Defence* were

found to have bacterial damage from tunneling and "screw form" bacteria, which were not identified (Reiss and Daniel 1997:337). More recent studies of shipwreck timber reburial found that after 3 years, exposed wood was almost entirely consumed by both mollusks and bacteria, while wood buried 43 cm (17 in) below the sediment was "highly protected" with minimal damage from bacteria (Bjordal and Nilsson 2008:862). Wood preservation through reburial is also being conducted at the wreck of the ex-slave ship *James Matthews* in Western Australia through an experimental combination of sand bags and sediment burial (Richards 2011).

Wood is primarily composed of cellulose and lignin, and certain microbes consume these materials as part of the anaerobic breakdown of organic matter that occurs in sediments (Blanchette 2000, Bjordal and Dayton 2020). Certain microbes that can consume cellulose or lignin were found in sediments at *Clotilda*. Sulfate reducing bacteria, such as *Desulfovibrio*, are able to degrade cellulose, but have yet to be directly shown to consume wood (Richards et al. 2009). Experimental work on archaeologically recovered timbers found microbes in the *Spirochaetaceae* and *Geobacteraceae* families, which are suspected to be acid degrader bacteria (Helms et al. 2004). These were found at *Clotilda* only in core B, in the more protected internal surface sediments, and not in the more buried conditions in core D. The family *Ignavibacteriaceae* in the phylum *Chlorobi* has also been found to consume plant biomass, including cellulose, and was also found only in core B (Su et al. 2020). Flavobacteria has been found to decay wood (Björdal 2011) but these were not found at *Clotilda*, possibly due to salinity fluctuations. Some research has indicated, however, that bacterial lignin degradation is an aerobic process, further supporting the observation that buried timbers were far better preserved (Khomyakova et al. 2022). Additional sampling and analyses of microbial communities at *Clotilda* in wood samples may help refine what microbes are active on buried timbers.

Pollen

The present analysis did not recover any pollen of confirmed African origin from site 1Ba704. Challenges surrounding the recovery of African pollen include the limited likelihood of a significant African pollen source on the ship before scuttling. In addition, the burning involved in scuttling is likely to degrade or destroy pollen on the ship, when "Seven cords of lightwood were placed in strategic locations. Foster lighted them up, and walked down the plank, and took one last look at his fine ship. The infamous *Clotilda* went up in smoke" (Diouf 2007:75). Last, the fluvial processes discussed in section 3.1 would likely deposit any pollen associated with the ship downstream.

Other challenges include identifying pollen to the resolution needed for a positive association with of African vegetation. The vegetation of Bénin consists of many plants within the same families as those in the Mobile-Tensaw River Delta, including those found in cores from site 1Ba704 such as grass, hemp (Cannabaceae), and fig (Moraceae) families. The high proportion of indeterminable (or degraded [5-13% in each sample]) also limits the chances of identifying pollen of African origin.

Nevertheless, the high pollen diversity in many of the samples, and a few remaining unidentified pollen types suggests that further analyses could result in the positive identification of pollen of African origin. Additional efforts should include focusing on samples with the best preservation and highest diversity (i.e. Core C), and those deepest in the wreck (i.e. Core D), and scanning all remaining pollen residue. Based on current vegetation surveys (Adomou 2005) and existing palynological work (Tossou et al. 2008) from Bénin, potential African pollen at 1Ba704 may include blackboard tree (*Alstonia*), spice tree (*Xylopia*), cocoplum (Chrysobalanus) and mangrove (*Rhizophora* and *Avicennia*).

The pollen samples in this study can be used to provide a snapshot of the vegetation surrounding the coring location in the Mobile-Tensaw River Delta. In general, the abundance of deciduous hardwood tree pollen indicates a wooded environment with adequate moisture. The abundance of disturbance taxa such as ragweed and amaranth, alongside grass pollen, indicate open spaces and disturbance. There is no definitive evidence for pollen from cultigens, but the current morphological resolution cannot rule out their presence within the pollen assemblage. Likewise, pollen of African origin was not identified, but targeted scans of this highest diversity and most spatially relevant samples may yield positive results in the future.

ENVIRONMENTAL CHARACTERIZATION

The wreck of *Clotilda* lies in a transitional environment that is at times estuarine and at other times a "tidal river". This environment is what has driven the site formation processes that saw the historic vessel's physical structure become the present day shipwreck site. This aquatic environment is driven by tidal influence and many of the processes ongoing at the wreck are governed by changes in river flow and in salinity. The fluctuations in river flow affect the salinity at the site through changing the ability of high tides to push salt water up the river. The flow of the river is dynamic, with seasonal strong flow and during weather events, but at other times low to zero flow, and in low flow periods, slight reverse flow. Such variability in flow conditions can be erosive or depositional, and changes in this dynamic has been seen at other wrecks in the Twelvemile Island Ships Graveyard (Grinnan and Burkhard 2022). The primarily sand component of the riverbed sediments indicates the flow at this section of the river is high enough to prevent fine sediment to settle with the exception of along the riverbanks and against structures in place there, such as the wreck.

The fluctuating salinity at the site, ranging from estuarine to entirely fresh, also influences the types of organisms that are present on site. The transition zone from fluvial to marine produces extremely variable conditions for biota because of "changes in salinity over individual tidal cycles and seasonally in response to variations in river discharge" (Dalrymple and Choi 2007:146). Species tolerant of such conditions are few, and diversity is lowest in salinities between 1-5 ppt. Organisms that do live in these regions are often marine with adaptations to protect themselves from fluctuations, such as burrowing into sediment and to colonize surfaces opportunistically (Dalrymple and Choi 2007). The meiofauinal analysis clearly showed the impact of salinity differences, as all species were tolerant of changing salinity. The *Sphaeroma terebrans* isopods

are wood boring and euryhaline, which are indicative of the salinity ranges at the wreck. Notably absent were *teredo* mollusks, which need marine level salinity. The influence of the *S. terebrans* isopods is apparent on the deteriorated exposed wood, but well persevered buried sections of timbers, as the isopods require oxygen. Certain microbes may have not been present on the site due to the salinity variations, but further work into the microbial community at the wreck is needed.

The sediment core sampling of the muds around *Clotilda* are indicative of the range of microenvironments the presence of the wreck against the riverbank creates. Primarily, the hull structure is stable enough that it creates a constant anoxic environment in the sediments within it. Burial of sediments within the wreck show the accumulation of heavy metals, suggesting stability below the mudline due to shield provided by the wreck structure; most heavy metals showed concentrations highest in core D. This is also apparent in TOC, with higher organic content within the wreck, highest in core B because the buried sediments lower in the hull have been decomposed. Microbes also indicate this. Sulfate-reducing bacteria were found in higher abundances in the core B samples due to the more stable anoxic environment provided by the wreck structure, but again were not present in core D because the processes had already been finished at the surface prior to burial. Microbes found in reduced envuironments and involved in the sulfur cycle were present in core D as well. While meiofaunal damage was present on exposed sections of timbers, those below the mudline were well preserved. While some of the bacteria present can degrade wood, this would occur over very long time spans, as indicated by the preservation of cut marks on timbers that had been partially buried. Burial of ship timbers in the anoxic sediments is highly conducive to preservation.

In summary, the transitional environment at the *Clotilda* wreck site favors its preservation. The decrease in salinity prevents organisms that would commonly consume the wooden structure, and periodic fluctuations to freshwater prevents constant colonization by other biota. Sedimentary processes show that the wreck structure remains stable and has created a microenvironment within the hull suggestive of long term stability. While the river flow conditions can at times be erosive, the tidal influence and location of the wreck within the deltaic system prevents the flow from being so strong that it is washing elements of the site from the riverbank. Below the mudline, wood and other ship elements are found to be best preserved where anoxic conditons have formed.

PART II: ARCHAEOLOGICAL CHARACTERIZATION

ARCHAEOLOGICAL ASSESSMENT OF *CLOTILDA* (1BA704)

Overall Observations of the Site: Bow Area

Working conditions on the wreck in May 2022 were marked by conditions that proved beneficial to project work and observation due to limited current and low turbidity. This allowed for visual inspection of the wreck at close range. The removal of trees and disarticulated vessel structure from the site also facilitated access to areas of the wreck not previously observed because of the diving hazards posed by the tangle of trees and timbers. The results were a more extensive level of archaeological assessment and documentation, and an improved understanding of the wreck site once it was accessible without risk to divers, as well as the favorable environmental conditions.

The wreck sits on the edge of the riverbank, sloping to port, with the bow facing upstream. The bow projects above the sediment into the water column. The stem rises to a level above the original waterline of the vessel, but the outer timbers, such as the cutwater, appear to have been compromised, possibly by floating tree impacts, and the lace-piece, filling chocks, gammoning piece and bobstay pieces that formed the flare of the bow as it met the bowsprit have been compromised and are largely missing, as is the bowsprit. **Figure 17** shows the form and structure of a typical bow of a 19th century wooden vessel.

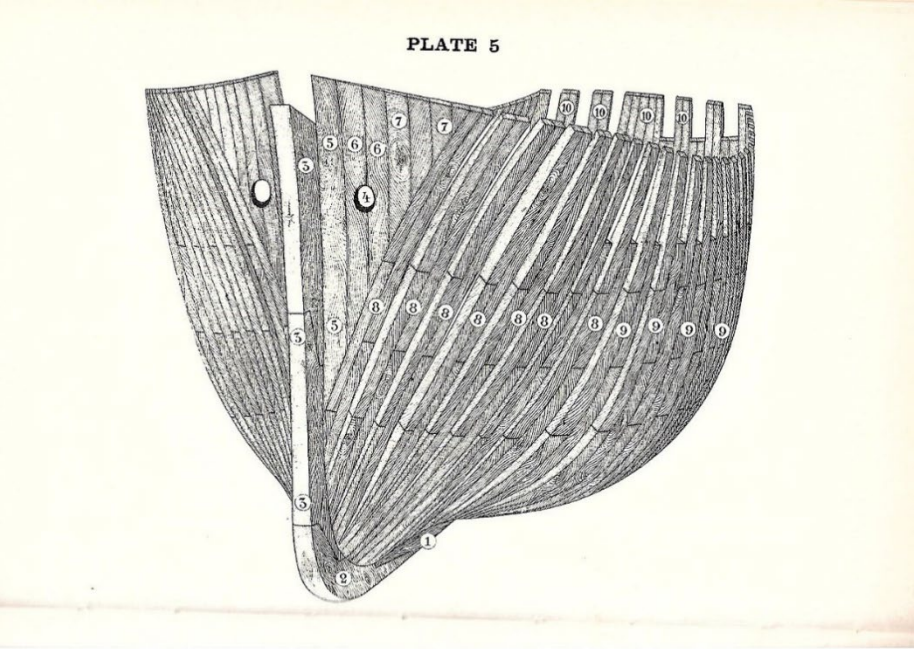


Figure 17. The bow structure of a typical wooden vessel of 19th century. Legend: 1: Keel, 2: Gripe, 3: Stem, 4: Hawse-hole, 5: Knighthead; 6: Hawse timbers, 7: Filling timbers, 8: Cant frames, 9: Square-body frames, 10: Stern timbers (From Paasch, Illustrated Marine Encyclopedia, 1890: Plate 5).

The hawse timbers and the filling timbers are also compromised from apparent impacts over time, and the hawse holes were not evident. A detached, single lead hawse pipe, presumably from that side of the hull, was located and recovered from the river bed surface off the starboard bow and up against the hull. The hawse pipe, which is more thoroughly assessed in the artifact discussion, is consistent in

materials and size for *Clotilda* and the deployment of a three-inch cable (rope) hawse for anchoring. There would have been two hawse pipes on each side of the bow for the deployment, if needed, of two bower anchors. No trace of the anchors has been observed on the site. Wear marks inside the hawse pipe, revealed while cleaning it during conservation, are consistent with those made by rope, not chain. As well, as previously noted, the vessel was built with attention to fine detail; the nails used to fasten the edges or lip of the hawsepipe to the bow timbers have star-shaped heads; we have not seen this type of nail previously. This reinforces the opinion we had voiced in earlier work on this wreck that the vessel was built to a high standard where even small details were important. This is consistent with period accounts of Captain Foster, as a master shipbuilder, being proud of the craftsmanship in the vessel.

Overall Observations of the Site: The Hull

Moving aft from the bow, the form of the hull is evident in the cant frames that remain in place, and trend aft to the square body frames that form the sides of the hull. The frames are doubled, in traditional 19th century wooden shipbuilding fashion, and retain outer hull planking and ceiling planking, although some of the planks are loose and have come detached along the port side. As previously documented, the planks are attached to the frames by counter-sunk iron spikes and treenails, and evidence of now missing copper sheathing is apparent on detached planks. Divers feeling below the mud line encountered smooth surfaces that suggest intact copper sheathing on the lower hull.

The forward hull appears to retain substantial portions of the main deck beam shelf and clamps on the port and starboard sides. Clamps are strakes, "worked round the interior of a vessel edgeways to the ship's sides, for the purpose of receiving and securing the ends of the beams…they are also called stringers" (Young 1863:32). Stringers were "bolted to the clamps and timbers, and are scarphed to each other. As they are put in edgeways to the ship's sides or to the clamps, and serve as a shelf to rest the beams upon, they are generally called shelf-pieces, or shelves" (Young 1863:397). Another more detailed description more closely matches the three-timber clamp style that has been observed on *Clotilda*: "the clamps are two or three thick planks extending the whole length of frame and located directly under each tier of deck beams, their use being to help support deck beams and add strength to the structure along point of joining a deck with side framing" (Desmond 1919:60).

On *Clotilda*, the clamps are for the main deck's beams. Wooden hanging knees (angular shaped, curved wooden structural elements that along with the shelf helped support the deck beams, had been named by shipbuilders because they resembled a human knee when the leg was bent) were placed to connect a deck beam to a vessel's wales and provided structural strength for the hull as well as bearing the weight of the deck and anything on it. The arm was the portion of the knee fitted against a deck beam, and the body was the portion of the end of the knee fitted against the clamps and the side of the vessel (Desmond 1919:61). Wooden warships, with the need to support decks with heavy cannon, required closely spaced knees on every deck beam; some merchant vessels would stagger the placement of knees, sometimes in threes, leaving gaps where the beams were not additionally braced by a knee.

The rule of thumb for smaller vessels like *Clotilda* was a minimum of four pairs of hanging knees for a vessel of 150 tons or less (Desmond 1919:62). This may have been the approach taken when building *Clotilda*. The remains of only one knee was observed below the level of the main deck on the starboard side in the main hold. The style is consistent with 19th century wooden shipbuilding practice; "hanging knees are fitted to underside of beams and to side of vessel and fastened with through rivets driven at varying angles" (Desmond 1919:62). A fragment of the end of a knee – either the arm or body – was recovered during field work in May 2022 and documented.

For comparative reasons, **Annex E** includes a photograph from the National Historic Landmark study for the wooden hulled, 1882-built *Grace Bailey*, an 80-foot long, 23-foot, five-inch beam, 58-ton, two-masted centerboard schooner (**Figure 2**); while built in Patchogue, New York, *Grace Bailey* is the closest extant, floating example of a schooner like *Clotilda*. The senior maritime principal investigator, Dr. Delgado, conducted the National Historic Landmark study of the vessel in 1990, and his experience with *Grace Bailey* includes inspecting the progress of its rebuild and restoration in 1990 and sailing the vessel in 2022. The key aspect illustrated in **Annex E Figure 2** is looking aft and clearly showing the centerboard trunk.

Overall Observations of the Site: Accessing the Interior of the Hull

Prior to the beginning of this phase of work, archaeological work on *Clotilda* from 2018 to 2021 was non-intrusive documentation with limited investigation of the wreck's interior. Although the visible lower hull appeared intact, a large amount of disarticulated and displaced material lay inside the hull and extended outside the vessel on both sides of the wreck and onto the riverbed. The scattered debris was not distributed in any discernible pattern. The characteristics of the disarticulated material (i.e., location and condition) were consistent with a type of destructive force applied to a vessel's interior such as an explosion. Natural processes of annual flooding, the rise and fall of river levels, variable currents, obvious but as of then unstudied phases of biological colonization and die off as a result of variations in fresh and salt water, suggested a site that was not environmentally stable, and at risk as a result of environmental and mechanical stresses.

Acoustic imagery also showed a substantial number of trees and tree fragments intermixed with and built up around the wreck. As a result, diver access was deemed too hazardous for any detailed assessment inside the wreck. Filled with sediment, the hold was inaccessible. As a result, in the absence of excavation, the bottom of the hold, keelson, and mast steps had not been reached and hence had not been observed. The structural integrity of the visible upper hull, however, indicated that they were likely in place and supporting the upper hull. The aft area of the hull was only partially visible in the sonar record, as the wreck is angled up at the bow with the stern angled down and extending into the mud. Because the rear end of the vessel was buried and was obscured, its size, shape, and location could only be approximated during previous site investigations.

In early 2020, the full form and shape of the hull, and much of its interior compartments, were exposed by flooding that accompanied the extreme rains of the winter of 2019-2020 and as a result exposed more of the interior. This exposure also indicated that the hold was not completely filled with mud, and that seasonal changes in the mud levels inside the wreck were probable. The shape of the hull's body was clearly outlined in the sonar data as that of a full-formed vessel. Although the stern could not be observed due to burial, the three-quarters exposed length of the hull, with the beginning of the curve toward the stern, indicated that the overall hull length, through a logical projection of the hull form, working with established length to beam ratios and wooden shipbuilding practice, and following the beginning of the hull's curve as it moved aft from midships on the port side, is approximately 85 to 90 feet long, consistent with the documented 86-foot length of *Clotilda*.

The most significant archaeological observations of 2020 were the result of both coring inside the hull and observations made of internal structure that was revealed as a result of scouring of some of that sediment. These were noted in the National Register of Historic Places nomination for *Clotilda*. The first was that a consistent fill of dense mud inside the hull pointed to the probability of organic survival inside the wreck. The structural remains also suggested a potential for survival of structural elements inside the hull. Of particular interest were three bulkheads inside the hull. These were further examined in May 2022.

Overall Observations of the Site: Internal Structure

The first bulkhead, closest to the bow, defines the area known as the forecastle. The forecastle bulkhead is 24 feet, 2 inches from the tip of the bow. This area is traditionally occupied by the crew, and is where they bunked and ate. At the extreme forward area of the forecastle, closest to the bow, a small locker for ship's gear and anchor cable was located. A narrow ladder from the deck provided the only access into the forecastle. This is an expected architectural feature common to wooden merchant vessels of the 19th century. If this area of *Clotilda* was excavated, among the features that could be expected would be the wooden bunks for the crew, the "mess table" where they ate, possibly a small wood-burning stove, and any personal or work items that would have been lost or left when the schooner was scuttled (Delgado et al. 2021:7.17-7.18).

Immediately aft (to the rear) of the forecastle bulkhead is the open space that was the schooner's hold. As defined by the sonar imagery in 2020, the hold terminated in a second bulkhead located fifty feet, five inches from the stem. The twenty-six-foot, three-inch-long hold is smaller than what would typically be expected for a vessel of this size. As a general cargo-carrying schooner of its period and engaged in coastal Gulf trade, *Clotilda* would have had a large, open hold containing only the centerboard, at least one or two of the masts, and the pump log. This "second" bulkhead, as suggested in earlier reports, is a deliberate modification made to subdivide the hold to create a separate compartment for the confinement of the captives taken aboard in Africa, and aft of that, a compartment where food and water were segregated from the captives.

The third bulkhead, aft of midships, is 63 feet, 5 inches from the stem. Its placement, and the commencing of the curve of the hull as it runs aft to meet the buried stern, indicated that it is

the original bulkhead that separated the aft cabin and lazarette from the hold. The proportions of the forecastle, the main hold (divided into two separate spaces in 1860 for the final voyage) and the stern are consistent with 19th century proportions for vessel compartmentalization. As will be discussed, the "new" space created in the hold by the placement of the second bulkhead also conforms to 19th century "standards" for the transportation of people for the purposes of enslavement.

This third bulkhead was spanned and possibly attached by a large beam to the bulkhead forward of it. The space between the two bulkheads was measured with sonar at 12 feet, 9 inches. Aft of it and completely buried in 2020-2021 was the gradually curving hull that terminates at the stern. This was the area where *Clotilda*'s "trunk cabin" and transom was located. Located beneath the main deck, with a small trunk or covered ladder leading to the deck, this compartment was where the captain and his officers slept and ate their meals. Aft of the cabin was the fantail of the schooner, where the steering gear was located directly above the sternpost and rudder assembly. Dive assessment in May 2022 reconfirmed the location of the bulkheads and documented that the first bulkhead survives to a level equal to the survival of the sides of the hull. The second bulkhead survives to a level of 1.5 m (5 ft).

The third bulkhead was not noted initially, as a dramatic change in the site took place between the sonar surveys of August 2021 and May 2022. The stern area of the wreck has been impacted in a fashion that appears to have broken the wreck into two pieces. As to whether this break extends to the lower hull, with the keel, keelson, and floors, as well as outer hull and ceiling planking is unknown. However, the structure of the hull aft had been compromised. There was no visible structure above the mudline on the port quarter. A substantial section of the hold beam shelf from the starboard quarter was found dislocated and largely buried in mud several meters inshore of the stern.

Dive reconnaissance noted and recovered a range of disarticulated timbers in this area that included deck beams, deck planks, a portion of the simple steering gear from the stern, and two tongue-in-groove planks from the aft cabin. An intact, cambered deck beam from the trunk cabin at the stern was also recovered. The section of hold beam shelf retained the impression of deck beams that had been resting on top of it; these impressions suggest that the aft quarter was substantially intact, with hull that survived up to the deck level, and with what may have been the survival of the trunk cabin.

Overall Observations of the Site: Evidence of Impacts to the Site

A critical observation from the May 2022 fieldwork is that clear evidence of impacts to the site post-scuttling are apparent in several areas. Previously noted was the presence of disarticulated structural elements from the probable centerboard trunk near the river's bank off the starboard side. That 3 m (13 ft) by 0.3 m (1 ft) structure, composed of three timbers, through-fastened with iron drift bolts, was consistent with another archaeologically identified centerboard schooner similar in size to *Clotilda* (see Delgado et al. 2019:81-82). The centerboard on *Clotilda* would have been located inside the main hold, just forward of the main mast, and it would have slotted in

alongside the keel and keelson. Diver probes inside the hull in this area found a gap in this area of the hull where the bottom of the ship was not detected. This was most probably the location of the centerboard, and confirms what appears to be extensive damage to the hull in this midships location at the bottom of the hull. *Clotilda* was was reportedly dynamited in the mid-to-late 20th century, as noted in our 2019 report (Delgado et al. 2019:70).

As well, and as noted in the section on changes to the site as observed from 2020-2022, mechanical damage from varying times has disarticulated and displaced the aft port quarter and the stern of the hull (**Figure 18** and Figure 18**Figure 19**). The aft structure of the wreck, other than its keel and lower hull frames, are no longer in place nor intact. This was one of the more profound discoveries made during the Phase III investigations. As will be seen in that later section of this report, we believe this to be the result of mechanical strikes on the wreck, probably dating back decades, and continuing to the present day. This damage is to an area of the wreck that projected more into the river channel, and it may be the reason for the 20th century navigational marker lights whose fixtures were observed attached to exposed and broken frames of the wreck in May 2022 (see the artifact discussion section of this report). Such lights would not have been placed to protect the wreck, but to warn off craft that might snag on or in it.

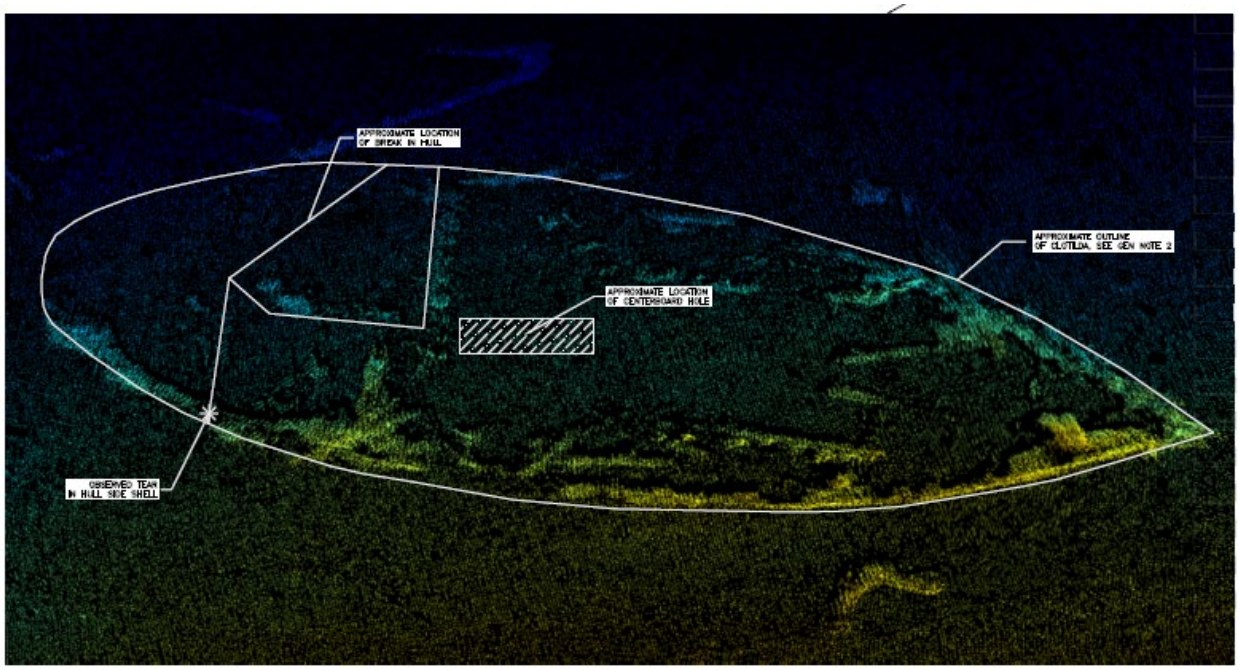


Figure 18. Drawing of *Clotilda* wreck indicating the location of the centerboard and the break at the stern.

Post-dive, the senior maritime principal investigator, Dr. James Delgado, made a series of sketches interpreting what he believes to be the surviving structure of the wreck (**Figure 20** and **Figure 21**).

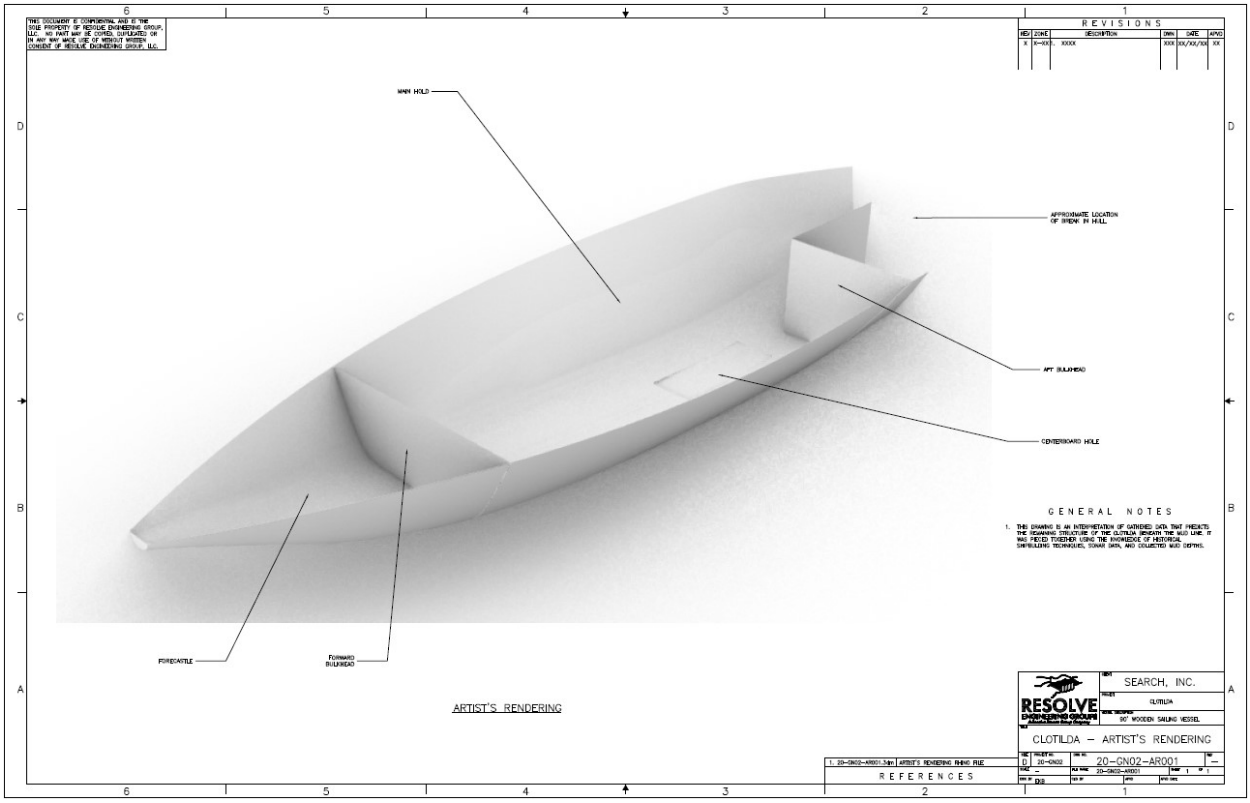


Figure 19. AutoCAD rendering of the *Clotilda* wreck indicating the forward bulkhead, the centerboard hole, and the break at the stern.

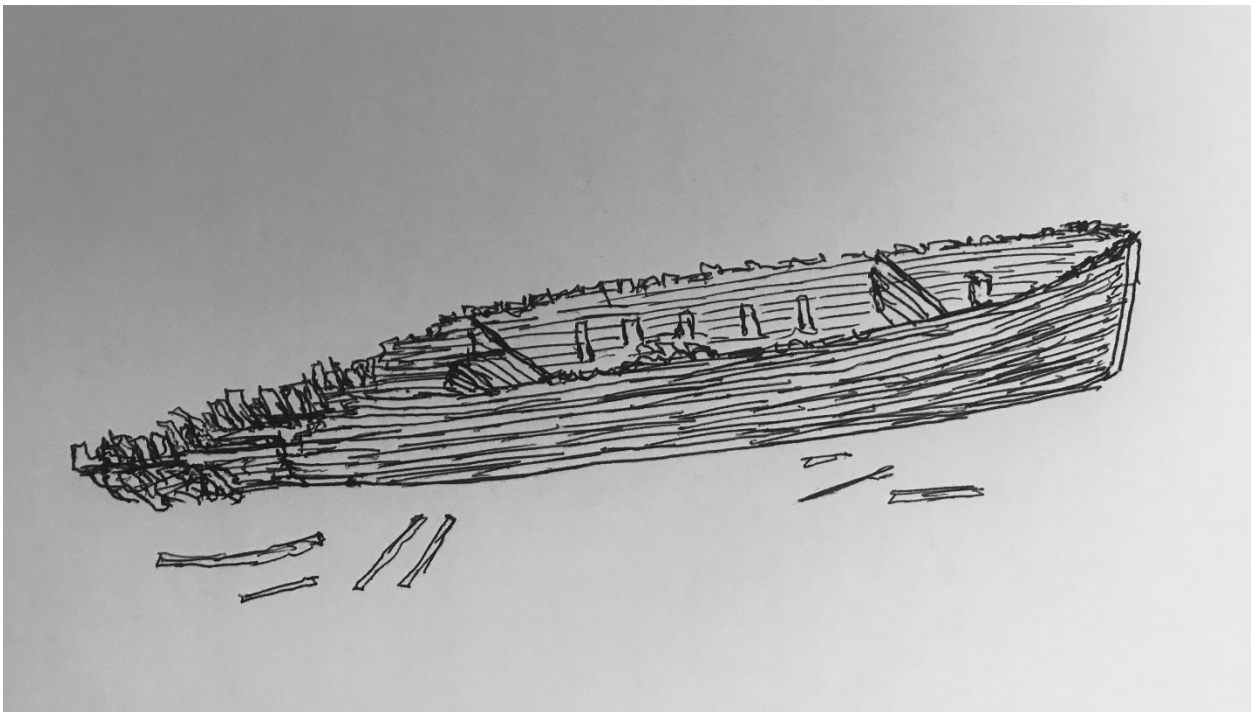


Figure 20. Inboard profile field sketch of likely hull survival post-scuttling in 1860 and as observed in 2022 (SEARCH, Inc./James P. Delgado).

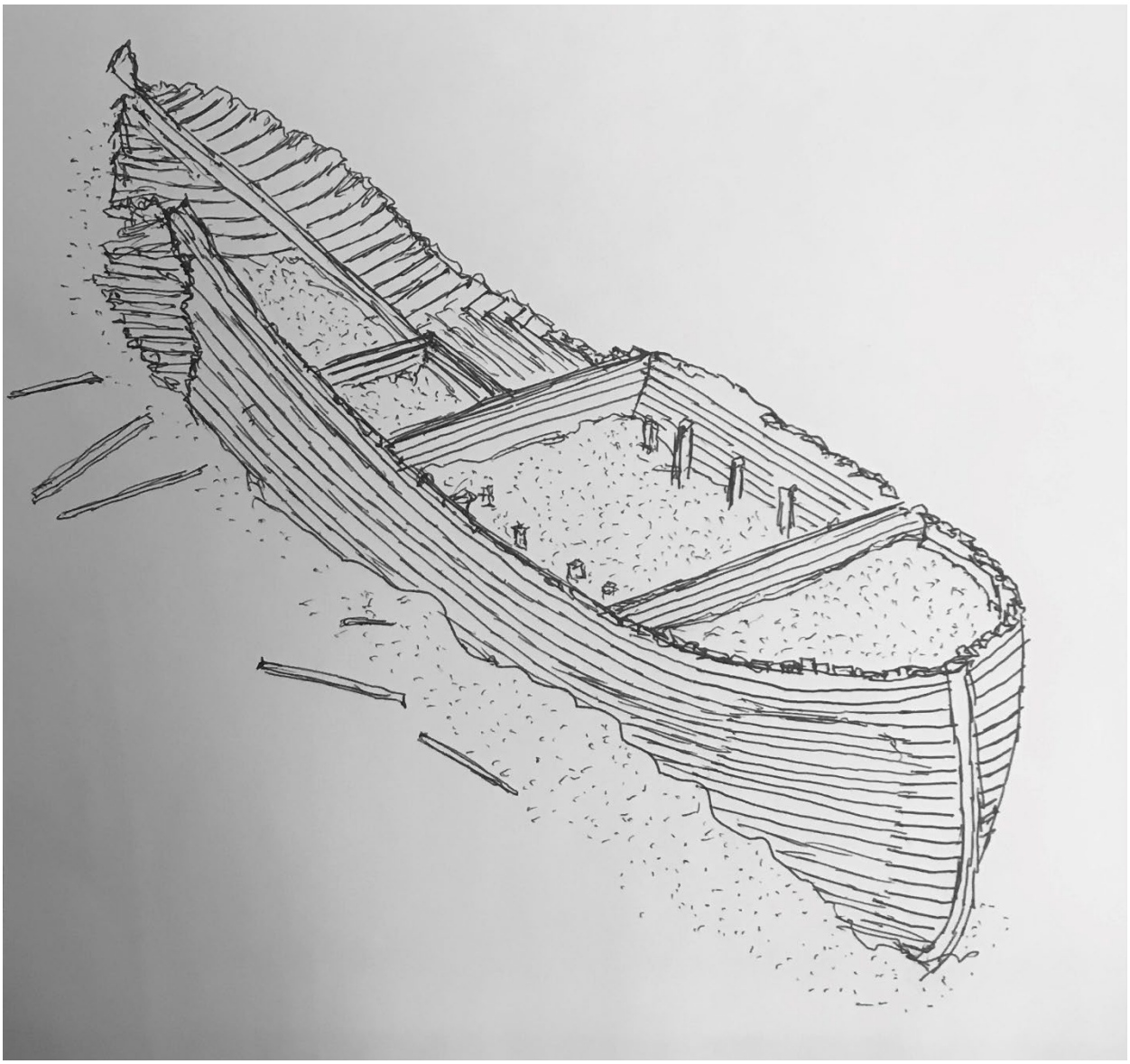


Figure 21. Starboard perspective field sketch of conjectural hull survival without depicting the sediment (SEARCH, Inc./James P. Delgado).

Overall Observations of the Site: Evidence of Confinement in the Hold

Direct archaeological evidence of structural modifications made to reconfigure *Clotilda*'s hold into a place of confinement for the diverse group of captives who had been taken against their will, assembled at Ouidah, and then transported from Dahomey has been suspected since the initial assessment. It is apparent that the hold had an additional bulkhead that separated the original space of this cargo stowing area into two separate spaces. The likely original length of the open hold was 12 m (39 ft) from the forecastle bulkhead (a permanent fixture) and the aft bulkhead that defined the beginning of the cabin and lazarette. The intermediate bulkhead at fifty feet, five inches from the bow is counter to standard industry practice in which a hold is an

open space, subject to modification for the stowage of specific types of cargo. A cargo hold is usually a larger, open space that can be modified to suit the cargo being loaded into it. Cargo in the pre-container era was stowed in bags, bales, barrels, cases, drums, hogsheads, tubs, in bulk, and as deck loads (Gavroche 1952:1-6).

A larger open hold was standard. A larger hold on *Clotilda* also makes sense when known cargoes carried on *Clotilda* whose sizes are known or can be estimated are assessed; in 1859, on voyages from Sabine Pass to New Orleans, *Clotilda* carried 232 and 284 bales of cotton respectively. A 450-lb bale of the time was compressed and bound into a rectangular shape for shipment, and was nominally 4.5 feet by 1.75 ft by 2.3 ft. A nearly six-foot deep hold that was at maximum breadth 23 feet and 39 feet in length would be needed to accommodate at least 200 and perhaps a few more bales below deck (a preferred method of stowage for cotton at sea, although deck cargoes were occasionally carried).

The same can be said for a 66,235-board foot lumber cargo carried from Mobile to Matanzas, Cuba in April 1858. Lumber cargoes on schooners at this range were loaded both into the hold and on the deck. A load of 2,271 pieces of one-inch thick, ten-inch wide, thirty-five foot long planks collectively measures 66,238 board feet. With those dimensions, *Clotilda*'s hold could have accommodated some 1,500 of those planks tightly packed into the hold and the remaining 771 planks would make a deck load that was fifteen planks wide and forty-eight planks high, or a roughly thirteen by thirty-foot pile on deck, four feet high and tightly lashed down. Simply stated, a larger hold was ideal for larger bulk cargoes. As previously noted, an open hold could also be readily modified for specific cargo.

Some types of cargo, when loaded in bulk, require proper distribution of the deadweight. Other cargoes required stowage to ensure that no leaks occur in the hold. One practice was the placement of dunnage, "pieces of wood, planks, mats or other articles (which cannot be injured by wetting) placed in the bottom, bilges and sides of a vessel, to prevent the water coming into contact with goods liable to be spoiled or destroyed by moisture" (Paasch 1890:247). In addition to dunnage, temporary bulkheads were also used as part of the task of lading a ship for a voyage. This persisted from the age of sail to steam and then diesel. Well into the modern era, for example, bulk cargoes such as grain were confined in spaces in a hold by temporary wooden bulkheads. The "temporary" nature of these bulkheads did not mean they were insubstantial.

An inquiry into the foundering of a grain laden ship, SS *Genoa*, in 1876, discussed these types of bulkheads in detail as their strength and integrity were integral aspects of the inquiry:

> There were also two temporary wooden bulkheads put up for the purpose of confining the cargo – one in the 'tween decks of the after hold, about 12 feet abaft the after hatchway, and from 20 to 30 feet aft of the aftermost bulkhead; the other just forward of the fore hatch in the lower fore hold, and about 14 or 16 feet from the collision bulkhead. In the spaces thus formed, i.e. from between the after bulkhead and the end of the ship, and between the forward bulkhead and the collision bulkhead, there was neither cargo nor stores. These temporary

> bulkheads were formed of planks 2½ inches thick, the upper ends being placed against one of the beams of the ship, giving a hold of 4 inches, and the lower end being secured by battens about 4 inches square nailed to the ship's ceiling with nails sufficiently long to give a hold of about 2 inches in the ceiling. Across the middle of the planks were nailed two others of the same thickness, extending from side to side of the ship, one on each side of the bulkhead. The other one served as a support from some stores, about 14 feet long, placed so as to withstand the outward thrust of the grain cargo (Squarey 1882:5).

What was needed for *Clotilda* to modify the hold into a slave ship was sufficient lumber, taken on as cargo that would be used to build what was required in the hold to transform it from an open space into a floating area of confinement.

For the final voyage to and from Africa, William Foster planned ahead to modify *Clotilda*'s hold once close to the African coast. His outward-bound manifest declared to U.S. Customs was 41,000 board feet of lumber, which would have more or less filled his hold and required some stowage of lumber on deck. However, a smaller amount was required and the alleged 41,000 board feet was essentially a veneer of planks laid on top of the incriminating evidence of what was required to be a slave ship. Historian Sylviane Diouf notes that "The tier that covered the compromising goods was covered with lumber that hid it from casual inspection and would be used later on to build platforms and partitions…the Africans' 'beds' but the source of this information is not clear" (Diouf 2007:25).

A smaller, more tightly controlled space worked for control and command of captives as well as for segregation of food and water, which is an aspect of command and control in situations of captivity and imprisonment. At the basic level, human needs in Maslow's Hierarchy begin with physiological needs (food, water, air, shelter and procreation). The industrial infrastructure of the ship, as adapted for the confinement and transportation of captives bound for enslavement, was the setting for a dark, enclosed, crowded space where access to food, water, fresh air, and facilities for proper waste disposal were the foundation on which the hierarchy of needs as denied took away other needs. The sense of safety was denied through the loss of a sense of physical safety and security, stability and familiar surroundings, belonging needs, with connections to home, family and friends denied, esteem needs, and self-actualization needs, with the prospects of self-fulfillment and the realization of individual potential curtailed if not lost.

Structural modifications for vessels engaged in the slave trade prior to the 19th-century American and subsequent British and Spanish laws making the trade illegal to those countries that are documented indicate low platforms which stowed chained captives lying on their backs for the voyage (Dow 1927:98-123, 261-281; Rediker 2007:9, 52-53, 61-65, 120, 332). In traditional maritime usage, "partial surfaces, which did not extend the full length, were known as platforms and did not always rest on cambered beams" (Crothers 2013:247). Platforms could be either partial decks, therefore, or another structure, i.e. a temporary arrangement that did not span the width of a hull. The structure visible in *Clotilda*, combined with Diouf's reference to Foster bringing lumber to create a "platform" in his hold, suggested to the archaeological team prior to

the May 2022 project that these were necessary structures that formed flat surfaces, possibly but not necessarily filling the entire hold, where captives would lay down or sit on in an otherwise rounded hold, whether or not they were chained or otherwise restrained, and kept tightly packed in a space that had been modified to confine them.

A key question in assessing what modifications Foster and crew made to *Clotilda* to confine and control their captives was whether it was either makeshift or unique, as in not conforming to what was known from the few accounts of other vessels engaged in the slave trade. A French slave ship, the brig *Vigilante*, captured by a British Royal Navy anti-slavery patrol off the African coast in April 1822, was illustrated in an 1823 broadside that depicted the conditions of that 240-ton's interior, packed with 345 captives, "found lying on their backs on the lower deck…those in the centre were sitting, some in the posture they are there shown & others with their legs bent under them, and resting on the soles of their feet," according to the legend on the document (**Figure 22**).

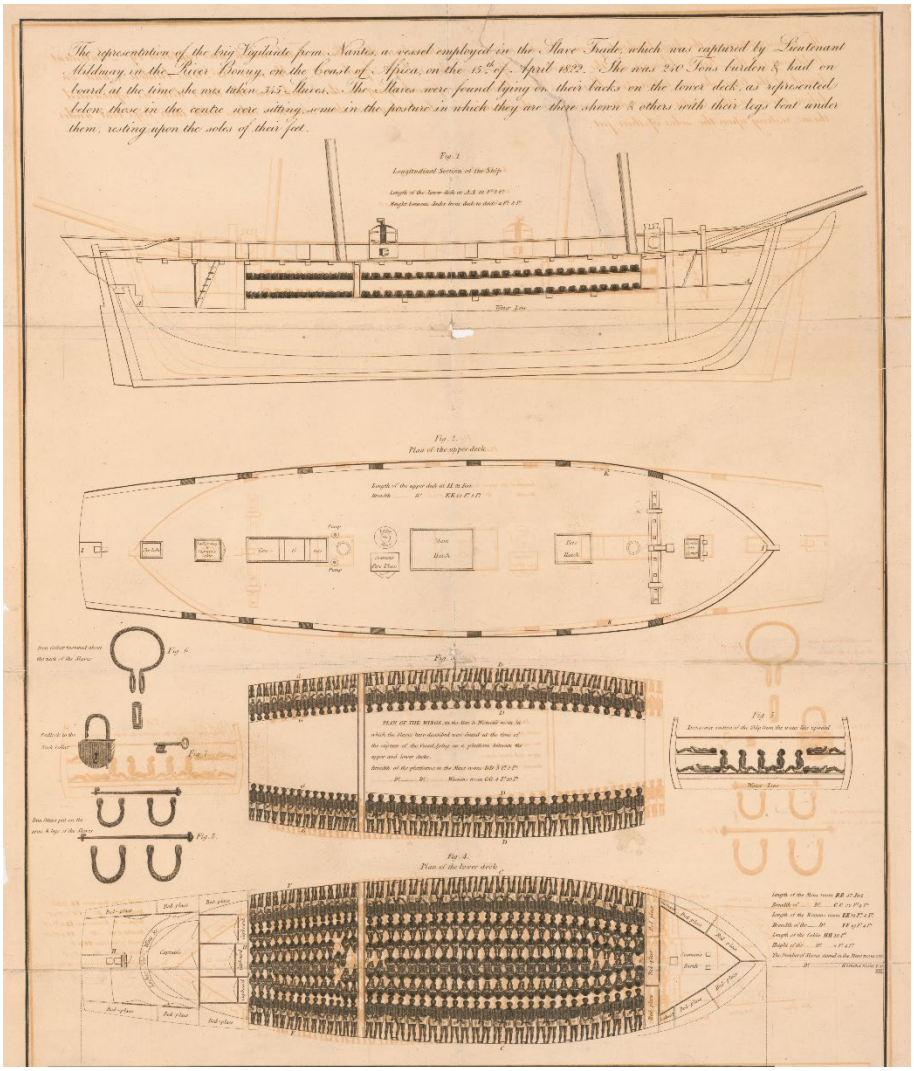


Figure 22. View of the brig *Vigilante*, a slaver similar in size to *Clotilda* (Library of Congress, control no. 2004667268).

Vigilante, while built three decades earlier than *Clotilda*, and with a fuller body (meaning more capacity) was within the same size as *Clotilda*, at 91 feet in length and a 22-foot, 4-inch beam and a 6-foot, 4-inch depth of hold, crowded the captives on it within a 51-foot long, tapered hold with what appears to be a two-tiered platform against the two sides of the hold and with people crowded in between. We suggest that this was effectively what Captain Foster and his crew did to confine the captives in *Clotilda*, based on the archaeological evidence observed to date.

Contemporary accounts and images of 19th

century slave ship holds are rare and often oblique, but that probably suggests that conditions of stowage of captives was common knowledge. Earlier accounts and images are more common as they date to a time when the slave trade was "legal." Drawing from some of these accounts, historians speaking to specific vessels and voyages have offered a sense of the basic architecture of shipboard confinement and carriage:

> The space between the decks was less than five feet high, and the carpenters reduced this further by building platforms along the sides in order to pack the people in a double decker fashion. Each captive would have about two feet of space between the wooden planks below and those above (Harris 2002:251).

Historian Herbert Klein noted "all but the smallest ships were converted with partial deck platforms and other spaces for transporting slaves," and "most of the ships were outfitted with partial decks and platforms in the space below the maindeck" (Klein 2010:134).

Historian Marcus Rediker, in assessing the general characteristics of slave ships, noted:

> The feature common to all slave ships, regardless of nationality, was the area "between decks," where the slaves were carried. On a regular commercial vessel, this passageway, situated on the main deck and the hold, was little more than a crawl space, two –or three-feet high. To accommodate the slaves on a slaver, the between decks area was often four or five feet high. This type of construction maximized the available space on a vessel and segregated the human cargo from the crew above and the supplies below. The capacity of the slave quarters was increased further by the construction of platforms midway between the deck and the overhead. These platforms extended out of the bulkhead on all sides of the vessel, and were about six feet long, or just long enough to accommodate a prone human being. ….a person entering a the slave quarters through a single hatch on the main deck was confronted with a narrow corridor, on either side of which were two rows of slaves, either lying down or squatting, one group on the deck and the other a few feet above them on the wooden platforms (Rediker 2007:375).

Based on this, archaeologist Jessica Glickman (2015) noted that physical aspects that set apart slave ships from other vessels, whether those purposely built as well as those that were converted for use in the slave trade, were "barricades…and temporary shelving and platforms" (Glickman 2015:76). With these accounts, as well as contemporary mentions and images, the presence of platforms on *Clotilda* is not surprising; what is noteworthy is the apparent archaeological survival of what may be a substantial portion of those platforms.

The space allotted to the captives in the modified hold of *Clotilda* was small. Based on the still visible bulkheads or partitions, it measures twenty-three feet in length, with sides that follow the curve of the hull from a width of some 18-23 feet, and from the bottom of the hold to the deck was just under seven feet tall. Dive assessment in May 2022 reconfirmed the location of the bulkheads, and as entry into the hold was now possible, for the first time a series of upright, 4 x

4-inch wooden posts were documented on each side of the hold. Reassessment of earlier sonar data shows the linear arrangement of these posts opposite each other along the port and starboard sides of the hull inside the hold. They continue for approximately twenty feet before stopping before the bulkhead inside the hold. Given that this is a disturbed area of the wreck site that evidences destructive interventions of the 20th century, it is possible that the structure the posts originally ran the length of the hold on either side. We interpret these as the likely archaeological evidence of platforms in *Clotilda*.

This would be in accord with a 19th century description of not only *Vigilante* in 1822, but another slave trading vessel from the 1830s. The brig *Tribune*, a 161-ton vessel roughly equivalent to *Clotilda* in size, was eighty feet long, with a twenty-three foot beam (Works Progress Administration Volume III, 1941: 211). *Tribune*'s hold was described by an abolitionist who toured it in 1834. "The hold is appropriated to the slaves, and is divided into two apartments. The after hold will carry about 80 women, and the other about 100 men." Running along each side of each compartment were platforms "about 5½ or of six feet deep." Each platform had two levels, one close to the bottom of the hold and other half the distance to the deck above, where "the slaves lie, as close as they can stow away" (*The Religious Intelligencer*, February 8, 1834: 578).

This is not dissimilar to the berths provided with more room for steerage class European immigrants in mid-19th century wooden hulled sailing packet ships (**Figure 23**). In the early to mid-19th century, shipping agents, owners and the general public in the U.S. largely held European immigrants with disdain. This was reflected in rough and crowded accommodations, although European immigrants of the time were never put into the conditions as were captives from Africa because of racist ideology and the systemic aspects of enslavement and the slave trade as a business that treated human beings as commodities to be exploited. There is no comparison other than the basic architecture of a ship's platforms or "berths" as they were termed for immigrants as opposed to more dehumanizing, racist term of "platforms."

Immigrant "berths" in the crowded conditions of "steerage," or open holds with bunks as opposed to cabins, were legally regulated starting in 1819 and again in 1855, and the space allotment for berths made based on "the assumption that each emigrant required a space measuring all of two feet by seven feet" (William H. Webb as quoted in Crothers 2013:322, 333). "The berths were installed fore and aft, in rows" (Crothers 2013:323). Crew berths for the seamen on packets of the period "in general, were about 24 inches in width, and about 6 feet maximum in length. They consisted of corner upright studs or posts, peripheral side pieces that acted as lee rails, and end pieces. The pan or bottom was made up of planks. The entire structure was made as strong as the purpose required. In all except the rarest cases they were arranged in two tiers" (Crothers 2013:323).



Figure 23. "Emigration vessel – between decks." The Illustrated London News, May 10, 1851 (New York Public Library Digital Collections, https://digitalcollections.nypl.org/items/510d47e1-3797-a3d9-e040-e00a18064a99).

Again, we stress that there is no comparison in regard to one group of people who voluntarily took passage and those who were made captive, stripped, abused and restrained in a hold. The point of this observation on the construction of bunks/platforms is the regulated, banal aspects of transatlantic passage that permeated aspects of life for all but a privileged few, with the worst aspects meted out with a casual callousness to those who had no choice but were entrapped in a Middle Passage voyage as a captive.

Historian Joshua Rothman, in his analysis of the slave trade of this time, noted that the abolitionist who toured *Tribune* noted that slavers "usually carry about one slave to a ton" (Rothman 2021:154). Tonnage was calculated in those times as a taxable measurement of how much cargo could be carried. For *Clotilda*, that would translate into 120 people for that 120-ton vessel. A sense of how human stowage was codified and normalized can be found in the detailed description of the British slave ship *Brookes*, which is probably the mostly commonly cited and noted exemplar of the banality of the slave trade and its ships.

The room allowed to each description of slaves in the plan already mentioned, is, as follows:

To the men 6 feet, by 1 foot, 4 inches,
To the women, 5 feet, 10 inches by 1 foot, 4 inches
To the boys, 5 feet, by 1 foot, 2 inches
To the girls, 5 feet, 6 inches, by 1 foot (Description of a Slave Ship 1815:11).

The dehumanization of people on both sides of the decks on slave trade vessels, and the banality of evil are clearly demonstrated in both statistics and in practice. As would later be noted in the aftermath of World War II and as war crimes were prosecuted, of those prosecuted, "many were neither perverted nor sadistic, that they were, and still are, terribly and terrifyingly normal. From the viewpoint of our legal institutions and of our moral standards of judgment, this normality was much more terrifying than all the atrocities put together" (Arendt 1994:276).

A 19th century lithograph, "Negres a fond de calle," (Negroes at the bottom of the hold), a famous antislavery image dating from 1835, depicts the hold of the French slave ship *L' Aurore*, based on sketches done by German artist Johann Moritz Rugendas (1802-1858), on a voyage that took place c. 1822-1825, and shows platforms on each side of the hold (**Figure 24**). While the image is allegorical, and intended for an abolitionist market (see Slenes 1989), it accurately depicts the basic architecture of the platforms, based on a surviving sketch he did on the voyage that survives in a museum collection. This demonstrated that Rugendas, when drawing the image for the lithograph based on his sketches (**Figure 25**), "raised the ceiling," giving "the imprisoned Africans in the scene considerably more breathing space" (Slenes 2006:55). This was done to show the central figure straining to reach life-saving water from the deck above.



Figure 24. J.M. Rugendes, "Negres a fond de calle," (Negroes at the bottom of the hold), 1835.



Figure 25. Rugendas' pencil sketch of L' Aurore, c. 1822-1825, used as the basis of "Negres a fond de calle," (Negroes at the bottom of the hold." Note the tighter spacing of the platforms and the crowded conditions (Biblioteca Municipal Mario de Andrade, São Paulo).

With this available contextual imagery and historic accounts, we conclude, as previously noted, that the posts in the forward hold of *Clotilda* are the likely remains of the platforms. Utilizing the formula noted for the slave ship Brookes, if *Clotilda*'s modified hold had a single row of double-tiered platforms on each side, that 26.3-foot length, multiplied by four, could have "accommodated" 105 people who were crowded into the space with all 105 lying down or on the platform. This suggests, as noted in the research design, that the material record may offer more insights into the conditions of the voyage from Dahomey to Mobile in *Clotilda*. This can add to the limited but evocative and powerful recollections of the voyage in the hold by surviving captives Kossola (Cudjo Lewis) and Redoshi (Sally Smith) later in their lives.

Roche, based on her discussions with survivors, noted that "the hole [which we presume represented mishearing the word "hold'] was deep enough to permit the men of lesser stature to stand erect. The top of the hole was shut down and the Tarkars were left in darkness to grieve and wonder" (Roche 1914:88). As recorded and noted by Hurston, Kossola's brief account of life in the hold noted that he and the others were made to lie down inside the hold, which was dark, for thirteen days" (Hurston 2018:55). Additional details come from Redoshi's account, as retold by S.L. Flock (Flock 1932), the reporter who interviewed her in 1931:

> Flock's article provides few specific details of the horrors of the Middle Passage, although it acknowledges, 'The hell-hole in which the captive slaves were stuffed to make the voyage to America was graphically described by Aunt Sally. Flock does at least record that the captives were 'locked in sixes and eights…and put in hold' where there is 'Water' – presumably a reference to the all-encompassing sound of the ocean, and which is 'dark – dark.' Redoshi intimates that the captives spent a lot of time on deck, which supports Kossola's remembrance that, unusually for human cargo during the illegal slave trade, they spent much time on deck after the first 13 days at sea (Durkin 2019:639).

The accounts, sparse as they are, offer a sense of the ordeal, of lying on the platforms, of fear, and with many of the conditions endured left unsaid to outsiders including interviewers in later years.

This speaks to a truth in the documentation of the realities of the Middle passage, including the voyage of *Clotilda*:

> The Black Diaspora does not come bearing narrative accounts and first-hand tales of the crossing. Instead, where such accounts exist, very little detail is offered upon which one might actively speculate about the horrific nature of entering and crossing the Middle Passage. The void is a time lag. Thus the inability to grasp the magnitude of the Middle Passage is always an event too soon and too late." (Walcott 2018:62).

Overall Observations of the Site: Changes to the Site, 2018-2022

Prior to the Phase II work in May 2022, SEARCH conducted a series of side-scan sonar and sector-scan sonar surveys of the wreck following the initial Mobile River survey in July 2018 that located the various targets that comprise the Twelve Mile Island Ships Graveyard. Then noted as Target 005, and designated site 1Ba704, this wreck, when dived and archaeologically assessed in December 2018 and January 2019, was covered with sediment, trees and disarticulated hull planks and other timbers.

Scouring of sediment from river current was evident along both the port and starboard side of the hull, but much of the structure aft of amidships was not visible while amidships was heavily obscured. Familiarity with the site based on the observations made over the course of this multi-year project allow for a slight reinterpretation of the sonar data of 2018; evidence of the forward bulkhead that separated the main hold from the forecastle is evident, as is scouring or evidence of disturbance in the main hold in the area of the centerboard, which as noted was observed in part in a fragmented condition near shore off the starboard side. As well, there are also sonar indications of the upright posts that were more clearly observed and documented in 2022. However, what is apparent in a 2022 review of the data, based on hands-on examination, was not readily apparent in 2018.

The aft bulkhead that enclosed the main hold was completely obscured by sediment, trees and disarticulated timbers in 2018. The beginning of the curve in wreck's hull lines that defined the run of the hull aft of amidships was faintly visible, and as noted in the May 2019 report, was sufficient to estimate that the visible remains of the wreck at 78 feet represented a partially buried hull that could not have extended based on the hull ratios and forms of contemporary vessels, to be greater than 90 feet in total length.

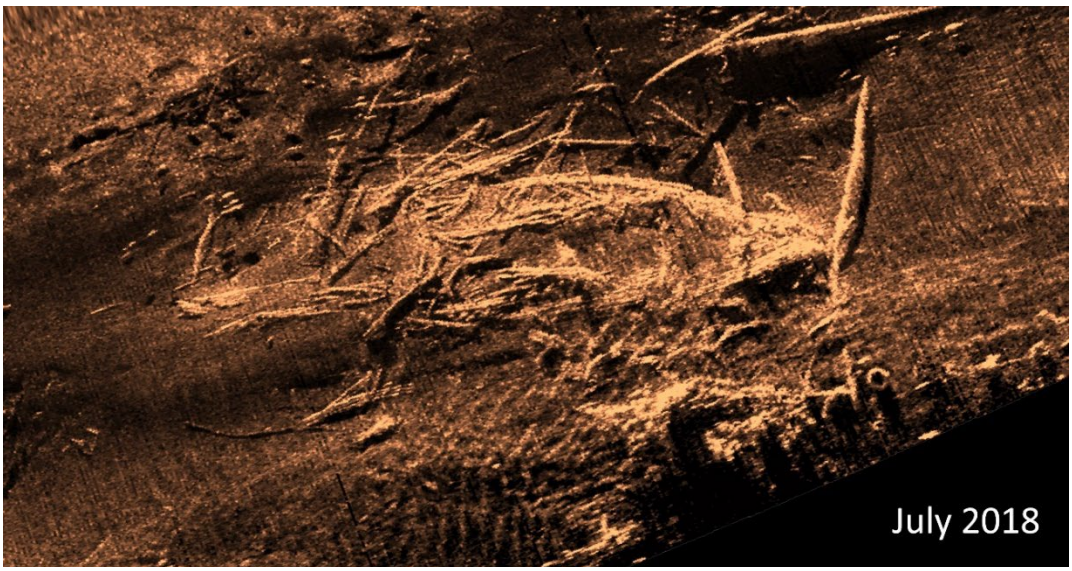


Figure 26. July 2018 side-scan sonar image of 1Ba704 (*Clotilda*) (SEARCH, Inc. for the Alabama Historical Commission).

Also visible in the sonar in July 2018 (**Figure 26**) on reexamination as part of the 2022 project is a large three-part timber feature off the starboard side, aft of amidships, that appears to be the hold beam shelf or clamp that was relocated in sediment, raised, documented and replaced on the site in May 2022. A subsequent survey in August 2019, utilizing a Kongsberg Mesotech MS-1000 Model 1171 Sector Scan Sonar, with the diver-guided instrument placed inside and on top of the wreck with 360 degree scans in six discrete areas, showed that sediment had moved off the wreck, exposing more of the main hold area and where a large mass of timber had accumulated amidships, articulated structure was for first time exposed and accessible to archaeologists assessing the site (Delgado et al. 2020a, 2020b).

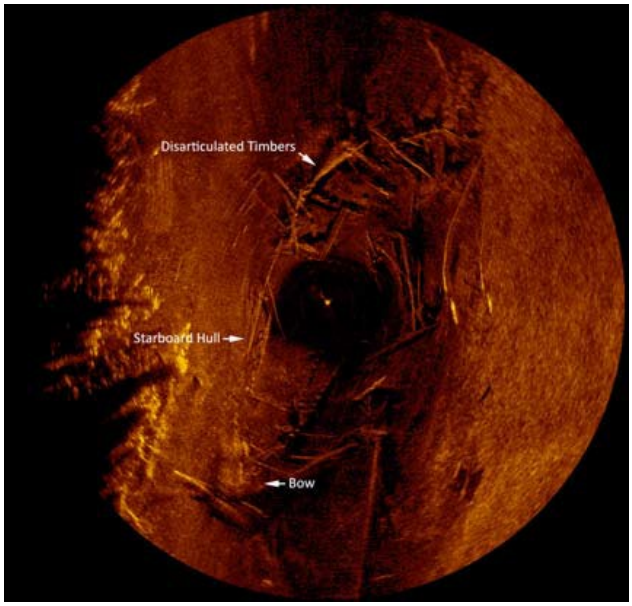


Figure 27. Sector-Scan Image of 1Ba704 (*Clotilda*), August 2019, with visible starboard hull amidships and disarticulated timbers aft of amidships (SEARCH, Inc. for the Alabama Historical Commission).

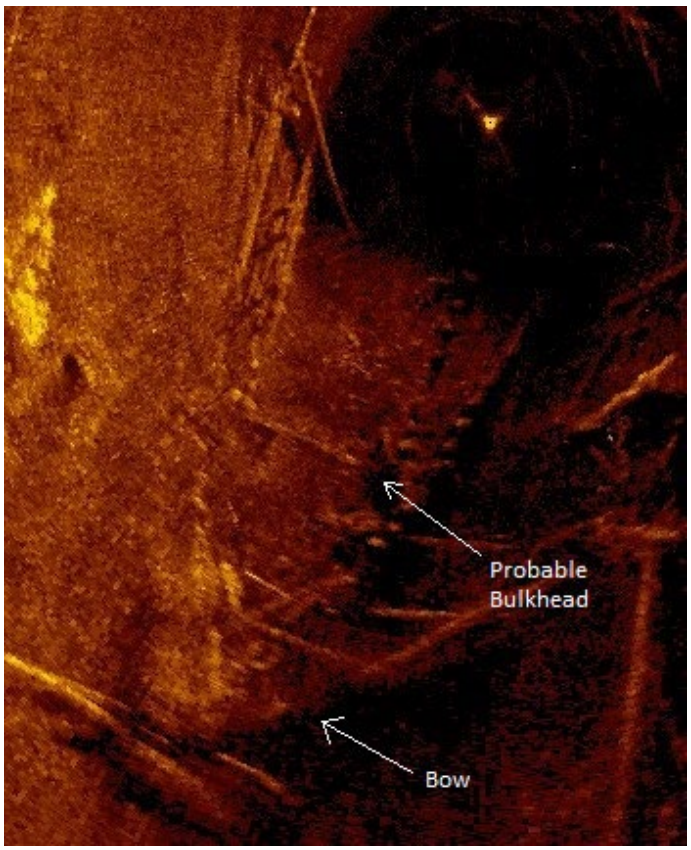


Figure 28. Sector-scan image of the bow of 1Ba704 (*Clotilda*), August 2019 (SEARCH, Inc. for the Alabama Historical Commission).

At the request of the AHC, SEARCH conducted another side-scan sonar survey of the site in March 2020. The processed side-scan sonar image of 1Ba704 from March 2020 mirrored the conclusions of the September 2019 sector-scan survey with additional and significant detail and in a format compatible for comparative assessment of earlier side-scan data as shown in detailed in 2019 (**Figure 27**).

Substantially more of the wreck was then exposed than has been observed by previous sonar surveys and through diver investigations at the site. A number of construction features were visible after winter erosion removed sediment to a depth of approximately two meters (6.5 ft) from the site, as well as scoured the area alongside the port and starboard sides of the hull.

A mass of mud and timbers, some of them vessel structure, had been removed from the top of the wreck and displaced. As a result, more of the vessel's interior was exposed in addition to more of the exterior of the hull being revealed. This included the first definitive evidence of internal structure, with bulkheads defining the segregation of the main hold into an area of confinement for the *Clotilda* captives.

A largely buried wooden bulkhead 7.4 m (24.2 ft) aft of the stem separated the bow area from the hold. This space, filled with sediment, defined the Sonar surveys delineated a faint line: in this area in July 2018 that suggested the presence of a bulkhead there; erosion noted in 2020 revealed it, as well as another (second) bulkhead 15.4 m (50.5 ft) aft of the stem. Aft of it, the river bed, no longer obscured by a mass of timbers as was the case in 2018 and 2019 surveys, was unobscured and additional architectural features of the wreck were for the first time apparent.

The port and starboard sides of the hull were more visible from amidships and started to curve back toward the still buried stern. The second bulkhead, located approximately in the area of where the mainmast would have been, essentially created a 53.9 sq m (580 sq ft) space; a second space, with a third bulkhead was also evident; this created a 3.9 m (12.9 ft) space that was surmised to have held provisions within a compartment with controlled access. This space had been apparent in the sector scan sonar with more definition than what appeared visible in the side-scan image (**Figure 28**).

Again reassessing this data from the perspective of the just completed, more direct "hands-on" assessment in May 2022, sediment obscures the port quarter, but the starboard quarter is clearly visible, with defined structure that includes the curve of the hull as it sweeps aft from amidships. At least three and likely four longer timbers, which do not appear to be natural (i.e. tree-related) but disarticulated structure) may be some of the deck beams with associated planks that were raised from this area of the wreck in 2022, as was a section of hold beam shelf or clamp. The sector scan image therefore offers a visual record of a site that had experienced formation processes including burning and scuttling, as well as naturally induced changes and likely mechanical impacts from both drifting trees and river craft in what has been both a regularly active and now semi-active industrial riverfront.

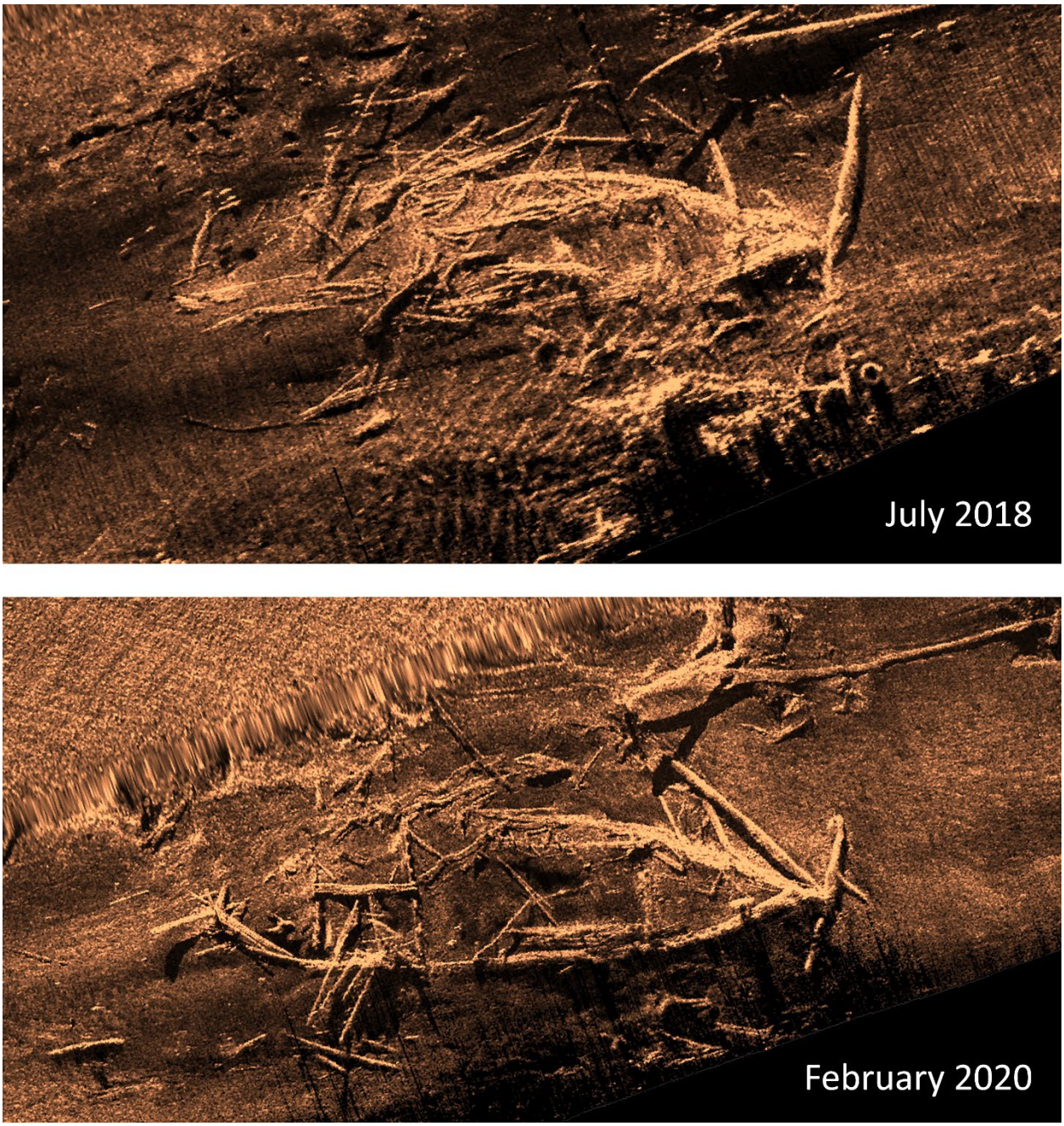


Figure 29. Comparison of the sonar data for 1Ba704 (*Clotilda*), 2018 and 2020 (SEARCH, Inc. for the Alabama Historical Commission).

As well, a review of publicly available river level data on the Mobile River over the preceding eighteen months, as measured by the U.S. Geological Survey, measured water discharge in cubic feet per second as well as river gauge heights in feet (USGS 2020). Gauge heights at Mile 31 of the river, located farther upstream from the wreck site illustrated how winter rain increases the amount of water in the river and, coupled with tidal fluctuation, introduced more water to the tidally-influenced location of 1Ba704. The increased height of river levels as shown in the USGS online data, indicated substantially higher water levels on the river in winter and spring months.

The amount of rainfall and increased water volume, translated into discharge at cubic feet per second, also suggested that increased water volume coincides with the periods of increased gauge height. The winter of 2018-2019 and 2019-2020 brought episodes of greater flow, at flow rates double or greater than earlier discharges, between November 2018 and May 2019, and from November 2019 through February 2020. The data showed peak heights in the winter and spring months of 2018-2019 and again in winter 2019-2020.

The sonar and river level data suggested that ongoing erosion posed a risk to the site; this issue had led to proactive efforts by the AHC to seek additional funding for an environmental and archaeological assessment of the wreck site to inform preservation planning and subsequent action (**Figure 29**). The March 2020 survey, completed as the Covid-19 pandemic started, was the last survey of the site until August and November 2021. In addition to trees that had snagged on the wreck since March 2020, the form of the hull aft, especially the starboard quarter, was visible, with disarticulated hull planking on the slope off the port quarter, as well as the starboard quarter.

Additional structure was exposed and defined the sediment filled space where the main (aft) trunk cabin had been located. The sonar also delineated in the main hold structure that in two-dimensional form had initially thought to be exposed hull planking. Instead, diving observation and assessment in 2022 identified this as the uprights and some of the structure of the platforms on which the *Clotilda* captives were confined. The 2020 sonar also indicated scouring in the same area of the main hold. This conclusively documented the lack of the centerboard and its trunk. The absence of the centerboard was anticipated, as its fragmented remains were observed and documented in the previous field work near the bank of the river off the wreck's starboard side (Delgado et al. 2019). In December 2021, a summary of observations made with sonar surveys noted that the wreck continued to have a substantial amount of tree debris built up and around it, but with less tree debris intermixed amidships. While the sonar imagery appeared consistent based solely on the acoustic imagery, "additional diver investigation would be necessary to confirm overall site integrity" (Grinnan and Burkhard 2021:15).

This was the case with the May 2022 work. What the exposure of the site in 2021 revealed, as is now apparent with new context because of the evidence of the 2022 dives, is that much of the sediment overburden that covered the stern area evidence in March 2020 was gone in August and November 2021 (**Figure 31**). The sediment overburden aft of amidships was removed, almost as it had either been "shaved" or compressed. This was the most dramatic change in the site since it had been initially documented in 2018 (**Figure 30**).

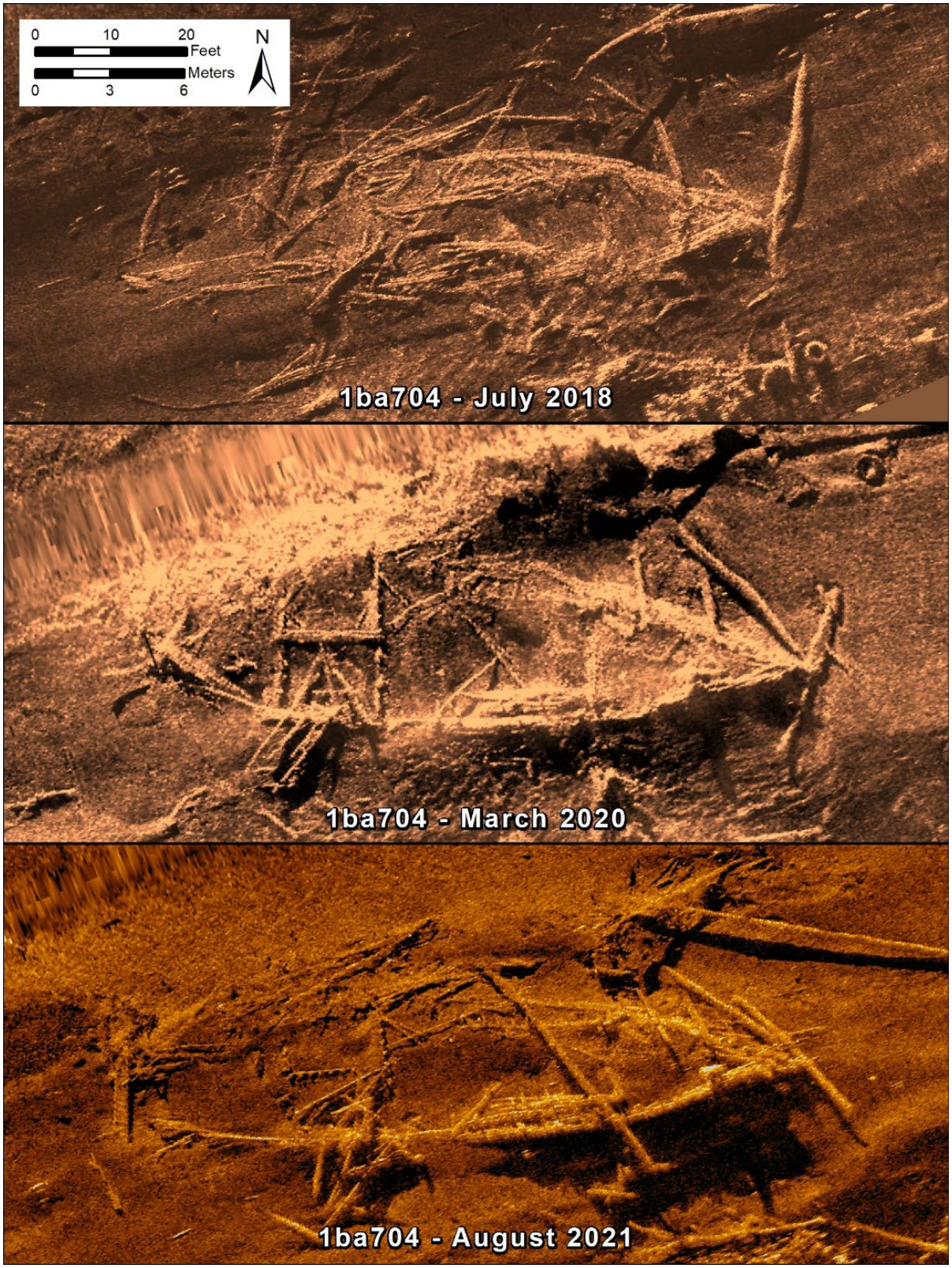


Figure 30. 2018-2021 comparative side-scan sonar image of 1Ba704 (*Clotilda*) (SEARCH, Inc. for the Alabama Historical Commission).

When the May 2022 fieldwork progressed to the point after the clearance of tree snags and a stump, SEARCH conducted the first of several sonar resurveys. **Figure 31**, undertaken during the project, with trees and some of the disarticulated timbers cleared (and stowed deeper off the site in the upper left corner of the image) there was no noticeable change in the site from 2021 and 2022.

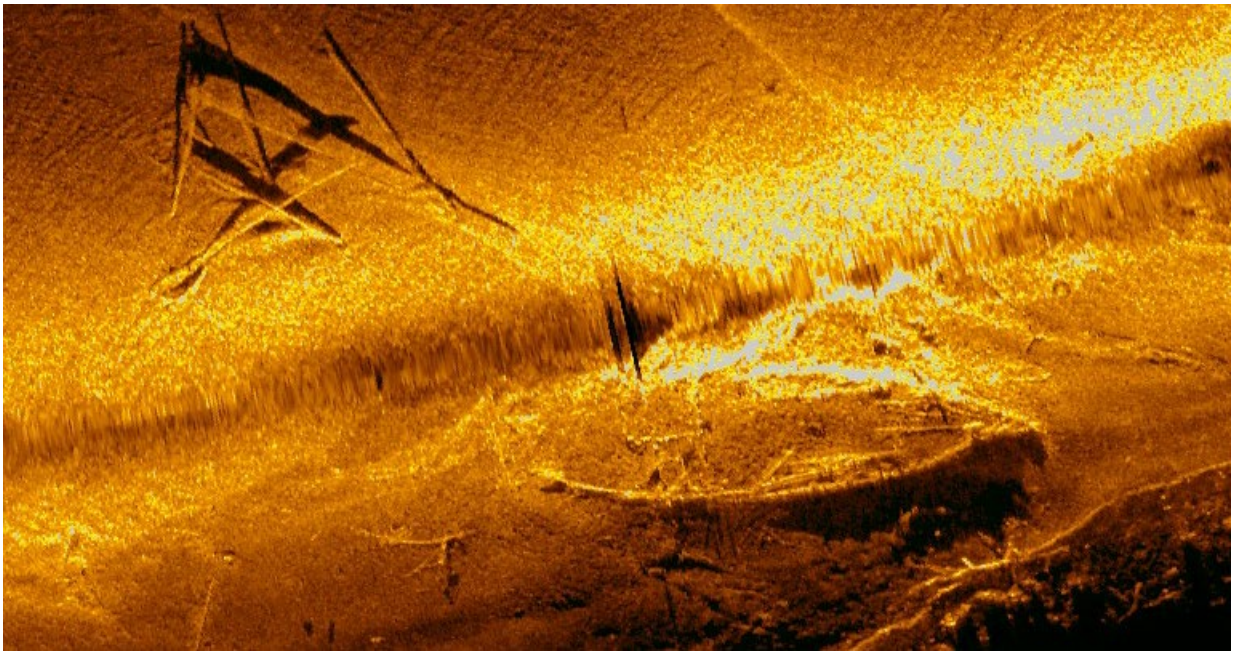


Figure 31. Processed side-scan sonar image from the May 2022 survey of 1Ba704 (*Clotilda*), 2020 (SEARCH, Inc. for the Alabama Historical Commission).

The possible reason for the change in the wreck site between March 2020 and August 2021 is not erosion or drifting trees; it appears to be an oblique "strike" from a large heavy structure that came into contact with the site at an extreme angle, riding over the wreck from amidships and either severing or crushing and compressing the port quarter deeply into the sediment, while missing much of the starboard quarter.

This type of activity may be the reason for the changes to the site; the angle is consistent with a large vessel, such as a barge, being pushed "nose in" to the bank to hold it to sit out tides or crowded vessel traffic. At the time of the 2018-2019 work, several large metal barges were moored on the eastern bank of the channel close to the wreck. The compressive force of a steel barge would be sufficient to both shear and compress the wooden hull of *Clotilda*. However, the extent of the apparent damage, and the fact that the March 2020 sonar both did not show visible structure from the port quarter aft of the amidships, and the presence of what could be disturbed sediment in that area, suggests a long standing pattern of probable strikes or groundings at or near the wreck site. Nosing into the bank was also a long-standing tradition for loading and unloading sternwheel, flat-hulled riverboats. At the same time, as part of the AHC's stewardship, it placed navigational marker buoys on the water through the assistance of the State Marine Police, and replaced them when winter flooding displaced them. Subsequently, in an apparent

strike, perhaps by a barge nosing in to hold position on the bank, visibility of what lies ahead of a bow would have been difficult if not impossible on a dark river in the evening. A barge's towboat would not see lighted water buoys hundreds of feet ahead of his position at the stern.

Noting the risk, the AHC proactively was able to negotiate and secure by donation the barge mooring rights at and directly over the *Clotilda* wreck site in 2021. Two years prior to securing the mooring rights, AHC had installed 24 hour video surveillance which documented a barge at an angle to the bank in the approximate area of Clotilda's stern on September of 2020 (**Figure 32**). NOAA tide chart data for the mouth of Chickasaw Creek, the closest station, documented a 5:24 AM high tide of 0.64 m (2.09 ft), falling to 0.06 m (0.19 ft) by 6:14 PM that day. This is noted as an example of a longstanding practice; the change in the site noted in the August 2021 survey **predates** this grounding.



Figure 32. Barge "nosed in" at an angle on the *Clotilda* wreck site (Alabama Historical Commission).

The obvious physical changes to the wreck are consistent with both natural erosional processes, drifting tree strikes, and a likely long-standing unintentional set of contacts by river craft such as barges. As this report is being prepared, the AHC has already acted on the preliminary data as the stewards of *Clotilda*, to contract for, seek permit approval and install fixed navigational markers to warn vessel traffic and alert barges not to nose in at this area of the river. As well, the results of this report are intended to inform the next set of preservation initiatives, which include as the preferred option and best-practices recommendation preservation *in situ*.

Overall Observations of the Site: The Previously Undocumented Stern

The position of the wreck on the bank and slope of the river, as previously noted, resulted in the stern, angled to port and lower than the bow, resting deeper both in the water and under more sediment. It was not exposed in 2018-2019 and the length of the vessel was determined through the application of standard length/beam ratios utilized in naval architecture and shipbuilding. Subsequently, in 2020-2021, more of the hull was observed through repeated sonar surveys, and revealed more of the structure of the stern area. The stern of a wooden vessel is a complex structure that is key to the overall structural integrity of the hull. **Figure 33** depicts the typical stern structure of a 19th century wooden vessel.

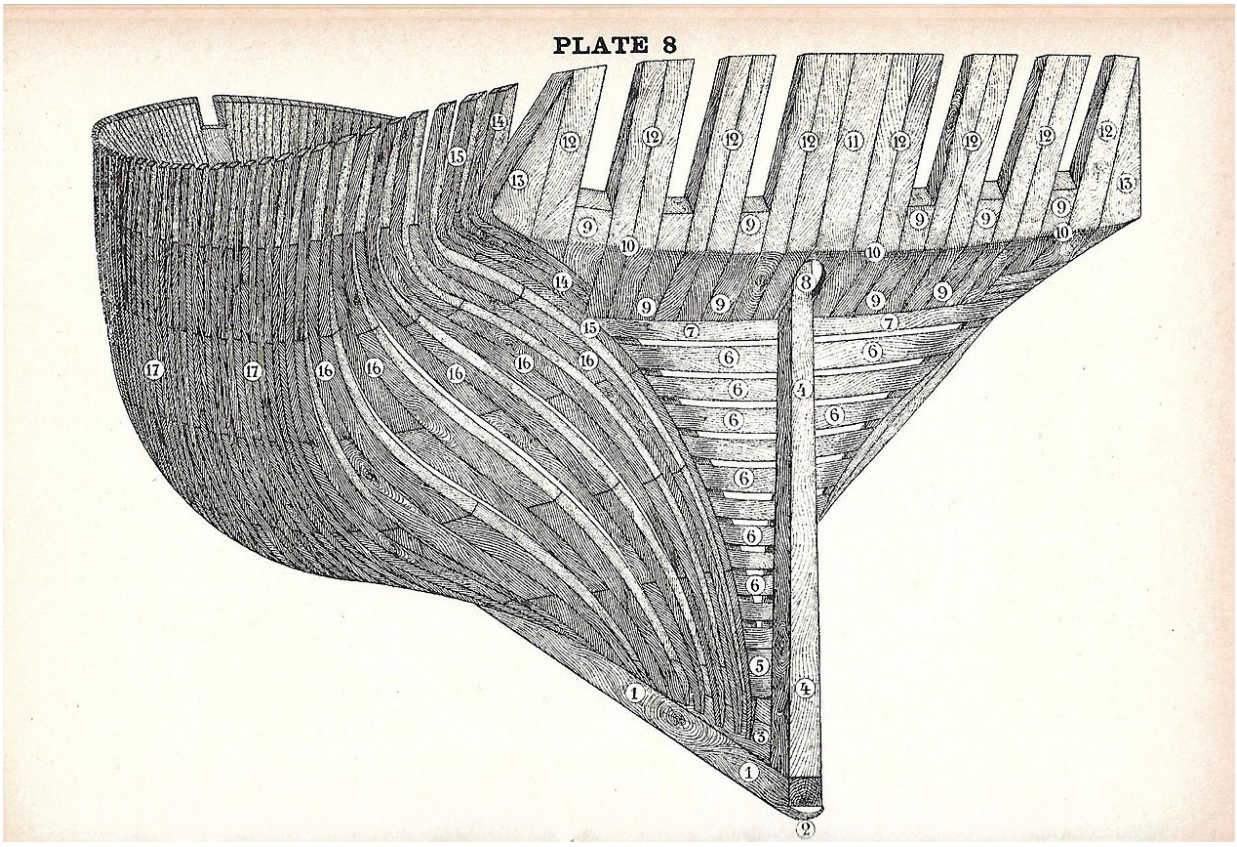


Figure 33. Stern view of a wooden vessel in frame (not planked) (from Paasch, *Illustrated Marine Encyclopedia*, 1890: Plate 8).

The stern likely survived the scuttling and sinking process, but as noted elsewhere in this report, it is now effectively gone, leaving only structural elements.

Clearly observed features of stern structure included the starboard quarter and the form of what hull remained there suggesting through its thickness the clamp or hold beam shelf for the deck, the third bulkhead, farthest aft, that separated the hold from the trunk cabin. This structure was observed in May 2022, and dive operations from the stern area recovered a range of disarticulated structure that corresponded to elements of the stern, including the port stern quarter hold beam shelf/clamp, deck beams, one with deck planking attached to it, individual

pieces of deck plank, a section of wooden beam with an iron pulley and rope that was part of the steering apparatus, a partial beam that may be from the deck that covered the trunk cabin, tongue-in-groove planking from the cabin, cast iron fittings on deck planking of an as yet unidentified nature, but which may be guides for the steering rope, and the non-provenienced sole of a leather shoe found by a diver off the starboard quarter . The shoe fragment, after analysis by Elizabeth Semmelhack, Director and Senior Curator of the Bata Shoe Museum, was determined to be nondiagnostic and yielded no information. The impressions of deck beams in the starboard clamp exhibited no marine growth and had a "fresh" appearance. This indicates that they were in place and supported by the clamp until recently, as no evidence of marine infestation was present, suggesting a short period of time.

The only survival of timbers identifiable as deck beams, as well as deck planking, is in the area of the stern (**Figure 34**). Deck planks recovered are all uniformly four by four inches and double-fastened with counter-set iron spikes at the end of each plank (**Figure 35**). These planks may be thicker ones located aft, as industry practice in the 1850s apparently employed deck planks that were three to 3½ inches thick and could be as wide as five inches (Crothers 2013:247). The deck planks on the 1895-built National Historic landmark schooner C.A. Thayer at San Francisco Maritime National Historical Park are 3 ¾-inch by 3 ¾-inch planks.

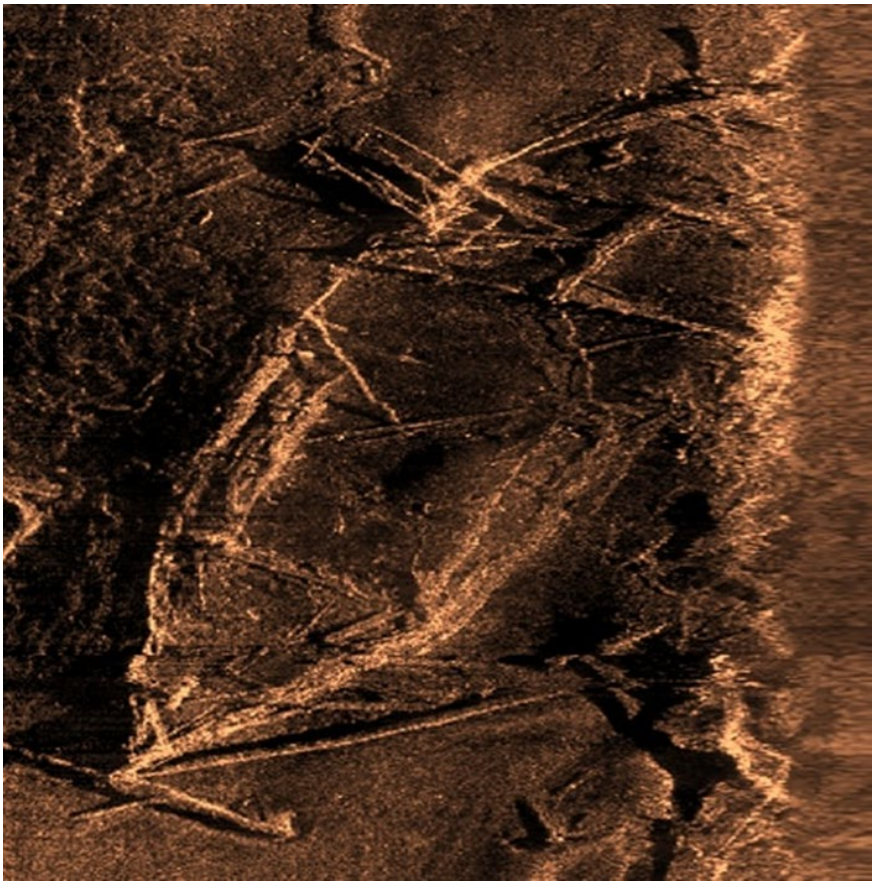


Figure 34. *Clotilda* sonar, 2020: The three linear timbers at the starboard quarter may be partially dislodged deck planks (SEARCH, Inc./Alabama Historical Commission).

This is in keeping with good shipbuilding practice as codified in the specifications for ship-building that would be certified by the New York Marine Register. *Clotilda*, surveyed under those rules, was given a Class 2½ rating. Deck planks "of all decks to be of white or yellow pine…two spikes at the end of each plank" (New York Marine Register 1858:8).



Figure 35. *Clotilda* deck beam with impressions of recently detached planks. Some of these were loose and fell off the beam when it was lifted (SEARCH, Inc./Alabama Historical Commission).

Another apparent conformity with the specifications is noted forward in the hold where a single knee suggested alternate of sparse spacing (i.e. not a knee under each deck beam). “All vessels of single deck above 100 tons, to have a hanging knee under the ends of alternate beams” (New York Marine Register 1858:8).

The partial remains of a deck beam with an attached eleven-inch diameter iron pulley with an intact piece of rope was also recovered from the stern area. This composite artifact was documented and retained for additional analysis and conservation treatment (**Figure 36**).

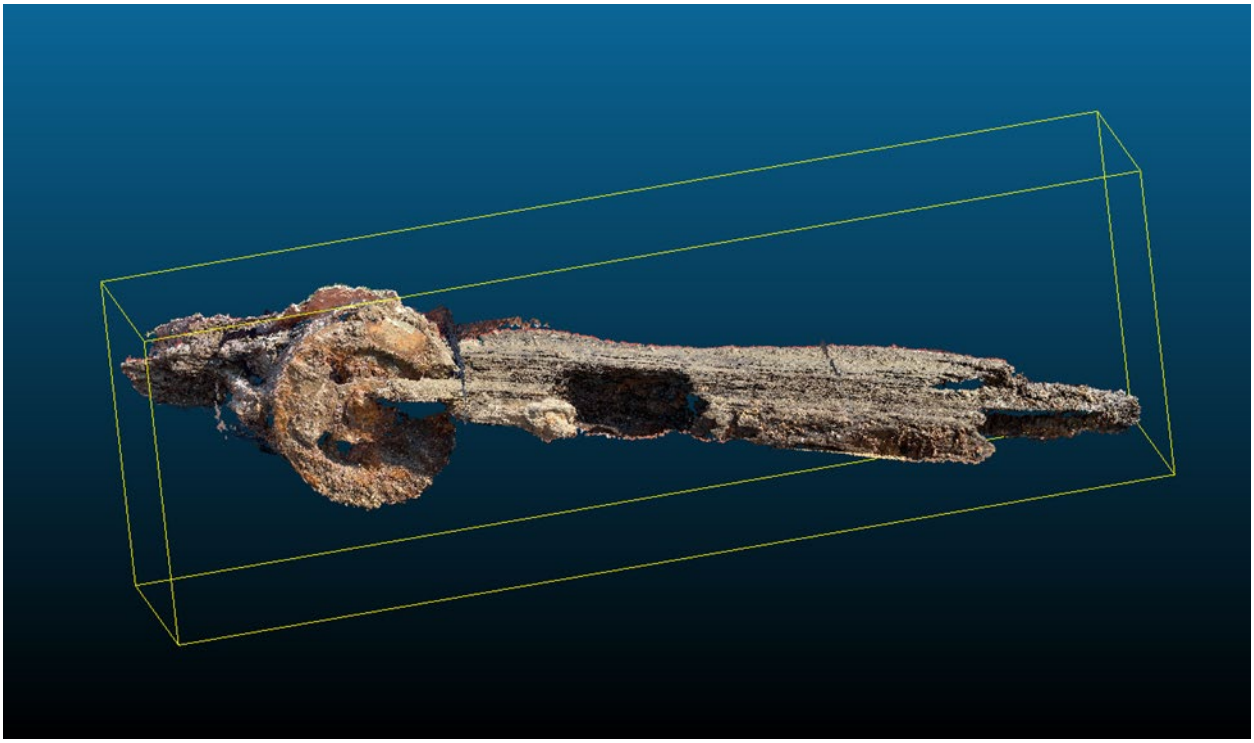


Figure 36. Artifact 7.1: Probable deck beam with pulley for a common steering apparatus (SEARCH, Inc./Alabama Historical Commission).

This appears to be part of a common steering apparatus, otherwise known by the 1850s as "the old-fashioned gun-tackle-purchase" as opposed to newly introduced geared mechanisms (Crothers 2013:314). The ship's wheel, with a wooden barrel, was located at the poop deck, and the gun-tackle-purchase linked directly to the rudder stock (**Figure 37**). It was rigged with "wheel ropes," "ropes rove through a block on each side of the deck, and lead round the barrel of the steering wheel" (Young 1863:443). This arrangement dates back centuries and as the name suggests, was also used to handle and move heavy ship's guns on their carriages in the age of fighting sail. Block and tackle was also used to hoist and lower heavy weights; a common usage was loading cargo and discharging it from a ship's hold.

The system worked when a line passing through a fixed block (when fixed, it mechanically functions as a pulley), was connected to moveable blocks that provided additional mechanical advantage (power) that when connected to the head of the rudder, usually by a short tiller, turned the rudder (and hence the vessel) in the direction the crewmember at the helm was steering for. The way the system worked then was to turn to port (left), the wheel was hauled over to starboard; this was the order given to the helmsman of *Titanic* – hard a starboard, in order to swing to port and avoid hitting the iceberg.

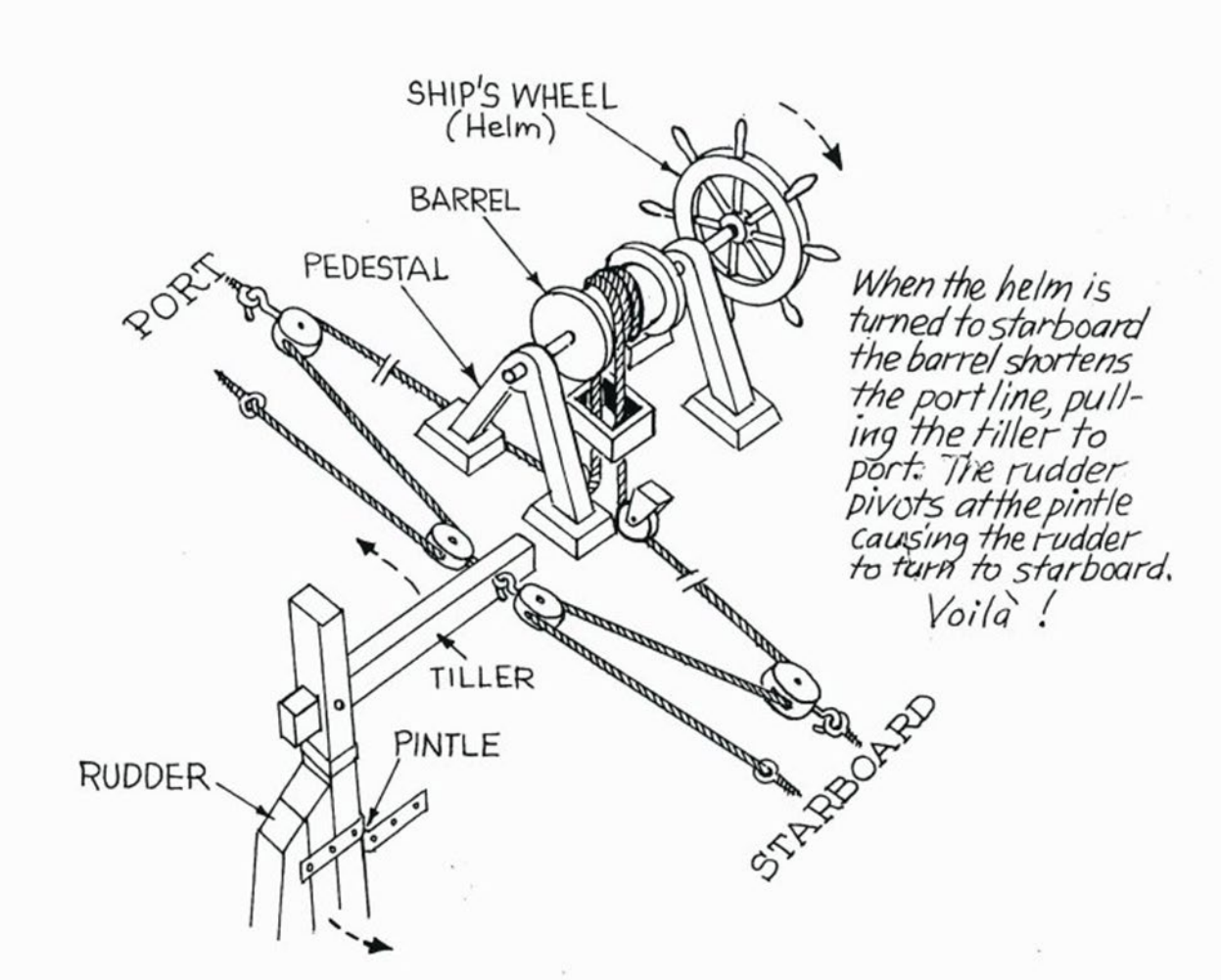


Figure 37. The type of steering gear employed on *Clotilda* (Ship Modelers Association) https://href.li/?https://www.shipmodelersassociation.org/research/Ships_Wheel.jpg

It is not surprising to observe this style of steering gear on *Clotilda*. Built well, *Clotilda* was the product of a veteran shipbuilder who was working in a small yard when he constructed his schooner. On a yet to be heavily industrialized coast, it was an easily enough repaired apparatus, even at sea. The gun-tackle-purchase or common style of steering, while passing out of use by the mid-nineteenth century, remained on older vessels and while preferred by some shipbuilders and captains, was replaced by geared patent steering mechanisms in the 1860s and 1870s (Crothers 2013:314). By 1863, it was noted that "chains are now more commonly used for this purpose than ropes" (Young 1863:443). Rope had a tendency to break, but chain and wire rope did not. The steering gear recovered from *Clotilda* is rigged with wire rope consistent with the mid-nineteenth century, with a hemp core.

Clotilda was insured and registered with the New York Marine Register, later known as American Lloyd's, and appears in the annual listing for 1858, 1859, 1860, and 1861. Details listed in 1859 including the notation "Tk Cabin" which indicate the schooner was outfitted with a trunk cabin (American Lloyd's 1859:306). A "trunk cabin," almost always placed at or near the stern, was a

cabin that was built projecting above the deck level to provide more headroom. The walls of a trunk cabin rise a few feet above the deck level, and the roof of the cabin is a small deck. The main deck is interrupted by the cabin, and to go aft the stern, crew would need pass on either side by way of a narrow space of deck on either side. Access usually comes through a companionway at the aft end which slides back to provide access to a ladder that goes below into the cabin. While a later-built vessel, the 1894 National Historic Landmark schooner *Ernestina*, documented for the Historic American Engineering Record (HAER) has a trunk cabin that gives a sense of what *Clotilda*'s might have looked like (**Figure 38** and **Figure 39**). The images were taken during restoration of the schooner.

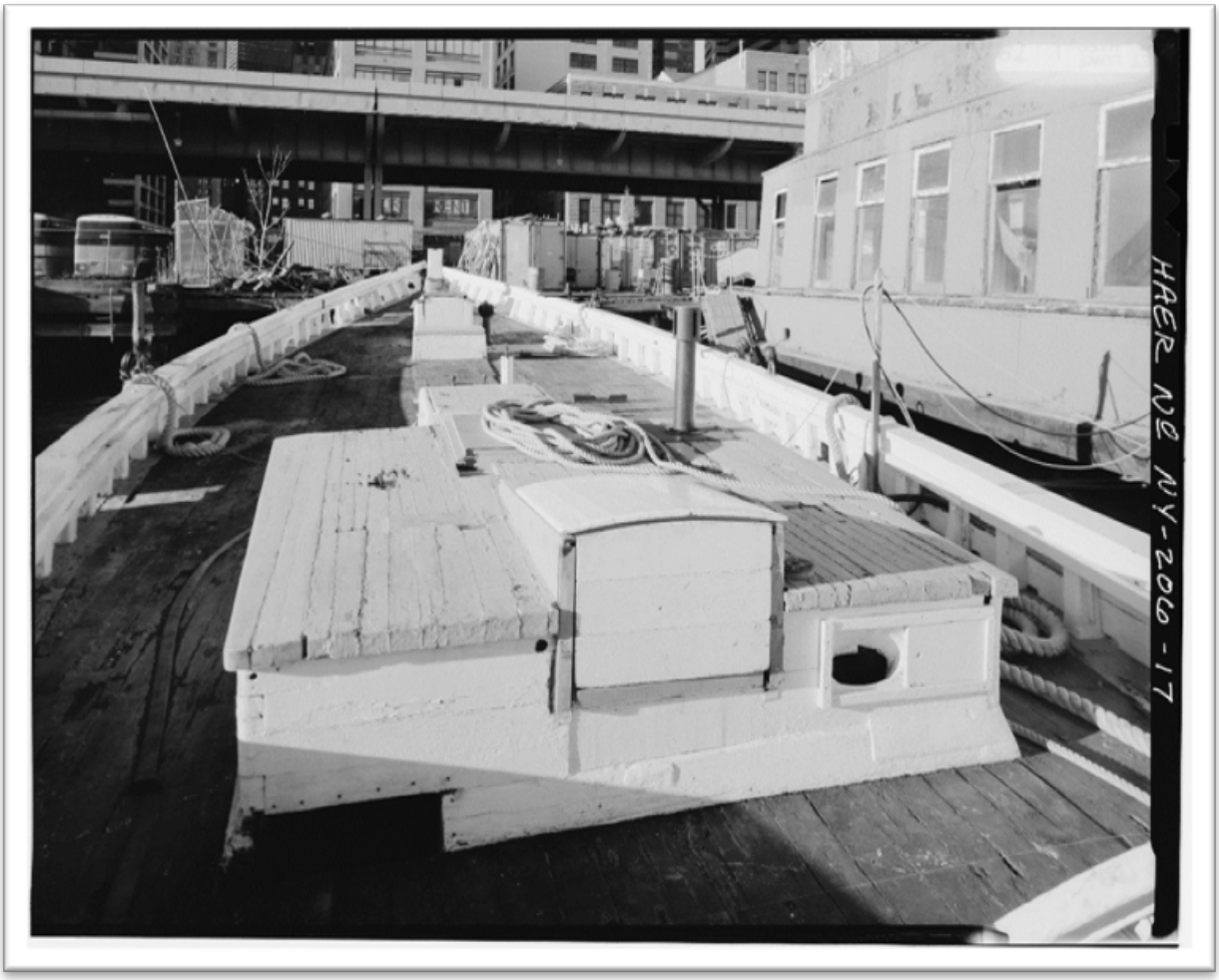


Figure 38. *Ernestina*'s trunk cabin, view forward showing the aft end with the hatch leading below (Historic American Engineering Record, HAER-MA-168, Library of Congress).

The trunk cabin was the compartment where the captain and his officers slept and ate their meals. This area was not accessible to the crew, provided ready access to the helm, and was usually fitted out and furnished to a captain's taste with furniture. The tongue-in-groove paneling recovered from the stern area of the site, one piece of which appears to have light patches of charring on it, would have come from this area. One of the planks (FS 3.3) is ten feet, six-inches

in length, three-and a quarter inches wide, and 5/8ths of an inch thick. The other (FS 4.1) has the same dimensions but is seven feet, seven inches long.

These appear to have been the planking on the interior of the trunk cabin. The space between the last bulkhead and the stempost would be twenty one feet, six inches. The ten foot, six-inch length would fit as a single plank defining the side to side dimensions of the cabin, leaving an average five foot open area of deck on either side, or could have run fore and aft as one of a group of planks that would make up what could have been a longer rectangular structure that might have been as long as 15 or so feet that would have left room for the wheel at the poop deck at the 86-foot mark of the schooner's length from stempost to sternpost.



Figure 39. The interior of *Ernestina*'s trunk cabin, during restoration, view aft, showing the ladder leading up the main deck, bunks lining each side, and the with the hatch leading below (Historic American Engineering Record, HAER-MA-168, Library of Congress).

One question that arose during recovery, given the proximity of the wreck of *Clotilda* with a later wreck, SS *Lake Ellijay*, which while a steel-hulled 20th century steamship, might have had planking in its interior cabins, was whether tongue-and-groove planking of this type was manufactured in the mid-nineteenth century. Hand planes for the manufacture of tongue-and-

groove planking date to the 18th century, and by the mid-nineteenth century, larger scale production of planking in greater lengths was made possible by the industrial revolution. Planing machines from Great Britain were introduced to the U.S. as early as 1827 for "extended practical use," with the U.S. Patent for a mechanical planer offered "the preparation of complete flooring boards with extraordinary dispatch, and in the most perfect manner; the several operations of sawing, planing, grooving, and tonguing being carried on at the same instant, by a set of saws, planes, and revolving chisels (Bale 1880:85). A universal technological dictionary of 1851 included the common mention of machines "to groove and tongue the planks" (Franke 1851:370). The tongue-in-groove planks from the site are more likely associated with *Clotilda* as they were intermixed with other disarticulated sections of the stern assemblage.

Overall Observations of the Site: Scuttling the Schooner in 1860

The act of scuttling *Clotilda* was simply described by Foster in two late nineteenth century accounts; in one, he simply "burned my schooner to the water's edge and sank her," and in another, "I burned her and sank her in 20 feet of water….." (Foster 1890, Slave Voyage 1860). Emma Langdon Roche goes into more detail: "The Clotilde was scuttled and fired, Captain Foster himself placed seven cords of light wood upon her" (Roche 1914:97). A modern cord is a four foot high, eight foot long, four foot deep stake that comprises 128 cubic feet; seven cords would be a twenty-eight foot high, fifty-six foot long, twenty-eight foot deep mass. That would be a considerable undertaking for a handful of individuals, assuming Foster was aided by the crew of the tugboat that had pulled it up the river to the scuttling spot. However, "light wood," which could be pine or brush if he took deadwood from the river banks and filled the hold with it, would make the task of filling the forward hold with brush easier and hence faster. The task would even be faster if the "light wood" was simply piled on the deck with some of it thrown into the hold.

As noted in the 2019 archaeological report:

> The process of burning a wooden vessel would involve setting a fire that would quickly spread and consume the entire craft. Although *Clotilda* was constructed of flammable material; essentially all-wood and painted, with tarred rope used as lines, seams sealed with tar, and with canvas sails, an accelerant was still required to generate enough heat to create a fire that rapidly spread to near-complete consumption of the schooner. The accelerant could have been anything from loose wood to lantern oil, set below deck and perhaps on deck in order to achieve sufficient combustion and rapid spread of fire. The hull was built of yellow pine and white oak. Pine generally ignites at 470 °F (243 °C) and oak starts to burn at 599 °F (315 °C) (Graf 1949:43–45). Temperatures get hotter as a fire accelerates and intensifies. One method of assessing ultimate fire temperatures is comparing them to the effects on other materials. *Clotilda* was fastened with iron, which reaches the white-hot stage approximately 2,192 °F (1,200 °C) and melts at 2,777 °F (1,525 °C). For *Clotilda* to burn, therefore, accelerants would need to cause the combustion of the hull, deck and spars to the minimal point of combustion for the pine, and that would then accelerate the fire to combust the oak. Several hours of

> sustained fire would consume the hull. The hull might also have risen as the fire consumed the upper works, exposing more of it to flames.
>
> Fires burn irregularly, and with hot and cold spots within the same burning structure. *Clotilda* most likely began to burn inside the hold, with flames traveling alongside the pine-planked sides of the hull as well as onto the pine deck to ignite it. The combustion of the deck would spread flames into the tarred rigging and onto the masts and yards, which would regain their canvas sails, which would spread the fire as burning canvas fell back onto the already burning deck. As the interior deck burned and exposed the hold, air would rush in and the fire would flash over. Inside the hull, particularly below the ship's waterline, even before the sea rushed in, the moist timbers of the hull would begin to steam, given the intense heat.
>
> Steam expands on a ratio of 1,700 to 1 (Wiseman 2004:2), so the volume of steam inside the hull, particularly in the enclosed spaces of the hold, would rapidly expand and drive out the oxygen, smothering any embers fallen into the hold through the open hatches or as the 'tween deck above was burned through. Moreover, heat is drawn into liquid. As the hull burned down to the waterline, the heat of the flames would conduct into the river, leaving the hull cleanly burned without extensively charred planks below the waterline, even inside the hold. And yet the timbers above the waterline, even those with high moisture content that sufficiently elevated above the sea, would be completely consumed (Delgado et al. 2019:69-70).

Previous archaeological evidence from the 2018-2019 investigations of the wreck showed signs of burning, and with significant consumption of oak frames that evidenced high heat (**Figure 40**). These artifacts, FS 9 and FS 13, exhibited signs of "saddling" from burning.



Figure 40. FS005, from the 2018-2019 field seasons (SEARCH, Inc./Alabama Historical Commission).

What the evidence now suggests is that the fire was primarily confined to the main hold, which would make sense if the goal was destruction of the focal point of the slaving voyage. The fire burned off the deck, some of the ceiling planking inside the hold, portions of the platforms, as well as the upper hull, notably the bulwarks. One of the artifacts (FS 12) recovered was a burned fragment of two timbers joined together by two iron fasteners (**Figure 41**). These are from the upper hull.

What the fire did not apparently do is totally involve or consume the aft section of the wreck, as articulated structure with deck beams, deck planks and unburned (one with possible light charring) planking suggests the stern did not burn – or burn much. This suggests that the stern sank before much of the fire had reached it. This is where a more careful look at what Captain Foster said

The work on the site in May 2022 offers a more detailed sense of the scuttling process. To impute that Captain Foster tried to destroy *Clotilda* is not logical. A shipboard fire, as noted, would not completely consume a hull. The point of the scuttling was to simply destroy the direct evidence of the final voyage. *Clotilda* would survive as a wreck as a result. Today's surviving archaeological evidence was once evidence of a capital crime in 1860, and so, as Diouf notes, Captain Foster burned *Clotilda* and sank it to destroy that evidence which would have included "the telling signs of a slaving voyage: the partitions, the platforms, the empty casks of food and water, the big pots, the tubs, the blood, the vomit, the spit, the mucus, the urine, and the feces that soiled the planks, the awful smell that always floated about slave ships" (Diouf 2007:75).



Figure 41. FS 12. A fragment of the burned upper hull (SEARCH, Inc./Alabama Historical Commission).

about the act of scuttling is needed. He wrote that he had burned and sank *Clotilda* to the waterline. That statement describes two separate results from his actions. This probability was noted in our 2019 report on the identification of the site. Records at the History Museum of Mobile compiled from Jack Friend's research include an interesting detail on the schooner's scuttling. A typed undated page states:

> The ship what from I can tell, was not too badly damaged by the fire. Augustine Meaher, says the sea cocks were opened on the Clotilde [sic] at the same time she was set on fire, so the ship probably sank before the fire did much damage. Mr. Meaher did say that it cost Capt. Tim over $7,000 to put copper on the hull back in 1858 when he outfitted the schooner for the trip to Africa. He says it is now worth in the neighborhood of $100,000 (Friend n.d.).

The archaeological record now more clearly demonstrates that Augustine Meaher was accurately conveying the condition of the wreck.

The only one location in a mid-nineteenth century wooden sailing vessel where a through-hull valve, or sea cock, would be located. That is at the stern, and it would be associated with a ship's head or marine toilet (**Figure 42**). The tradition in the nineteenth century was that heads, and later flushing toilets, were at the stern, where they had shifted between the fifteenth and seventeenth centuries except for large wooden warships (Simmons 1997:68-69). A wide range of marine "water closets" or toilets were available in the period with U.S. and English patents from the 1840s through the 1860s. They utilized, as marine toilets do today, a sea cock or valve that floods and drains the toilet with a hand pump alongside the toilet that utilized a diverter valve to flood the toilet bowl with water, and to then pump out the water and waste through the side of the hull through which the toilet drew the water and through which the waste was expelled.



Figure 42. Flushing toilet from the wreck of CSS *Alabama* (Naval History and Heritage Command).

RESOLVE divers recovered a three-inch diameter cast iron pipe at the stern area. It was not straight but curved, suggesting it was the soil pipe from a marine toilet. This toilet and its diverter valve would have been a simple means by which to start the process of scuttling *Clotilda* by simply opening the valve to flood the toilet – and thence by extension, the trunk cabin, dragging the schooner down by the stern, while also starting a fire in the forward hold. The fire would have consumed portions of the deck and portions of the interior at the bow, which would remained afloat longer as the bulkhead at the stern separating the aft cabin from the hold would have not allowed the water to freely enter the forward area of the schooner, especially as it was sinking on the edge of the channel, with the stern angled down. This is what we believe is what is represented in the archaeological record with a largely unburned stern, with surviving decking, and planks from the cabin that exhibit light charring, and the more extensive but localized fire damage forward of the bulkhead and in the area of the main hold set aside to confine the captives.

Overall Observations of the Site: "Hidden in Plain Sight"

The wreck of *Clotilda* was visible in the early 20th century (**Figure 43**), and was photographed in the ships graveyard and identified as "Wreck of the 'Clotilde'" in this image published in 1914 (Roche 1914:102-103). The image, in Emma Langdon Roche's Historical Sketches of the South, was noted with "Her hull still lies in the marsh…and may be seen at low tide" (Roche 1914:97). The position of the wreck in the photograph, angled away from shore with the hull curving toward offshore, is consistent with the site as ultimately surveyed and identified in 2018-2019.

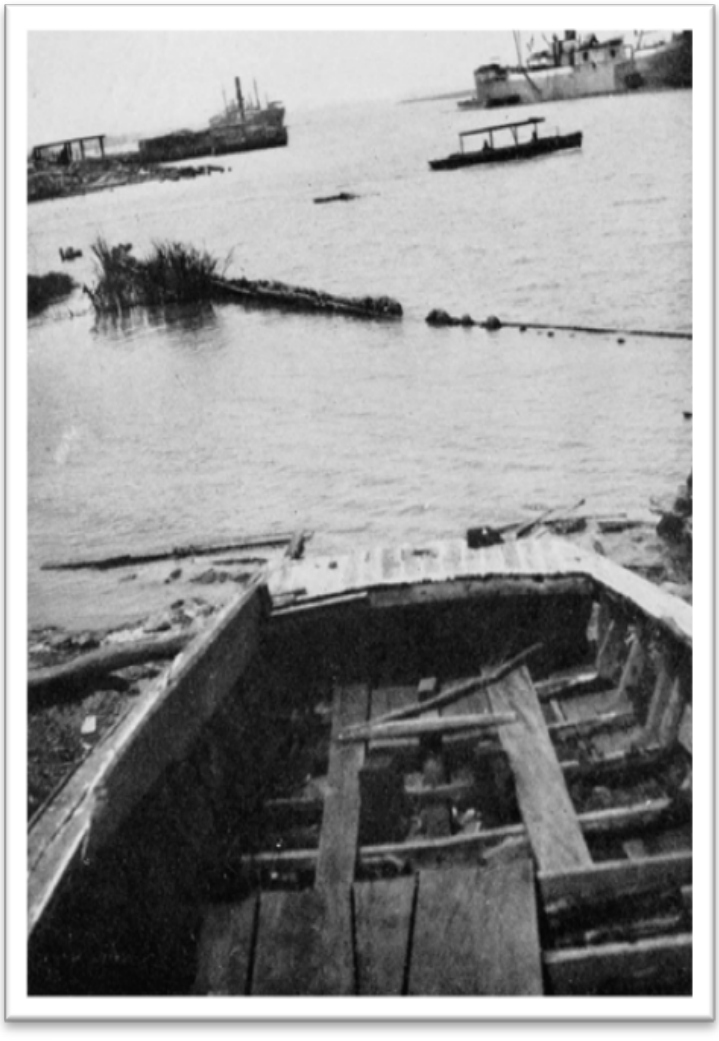


Figure 43. *Clotilda*'s wreck, c. 1914 (Roche 1914).

The wreck was first charted likely around World War II, and hence its presence was known, even if the identity was not known to all. It was very close to the mooring of hulks for scrapping by the Pinto Metals Company, and one wreck, the likely SS *Lake Ellijay*, is directly adjacent and upriver from *Clotilda* (**Figure 44**).

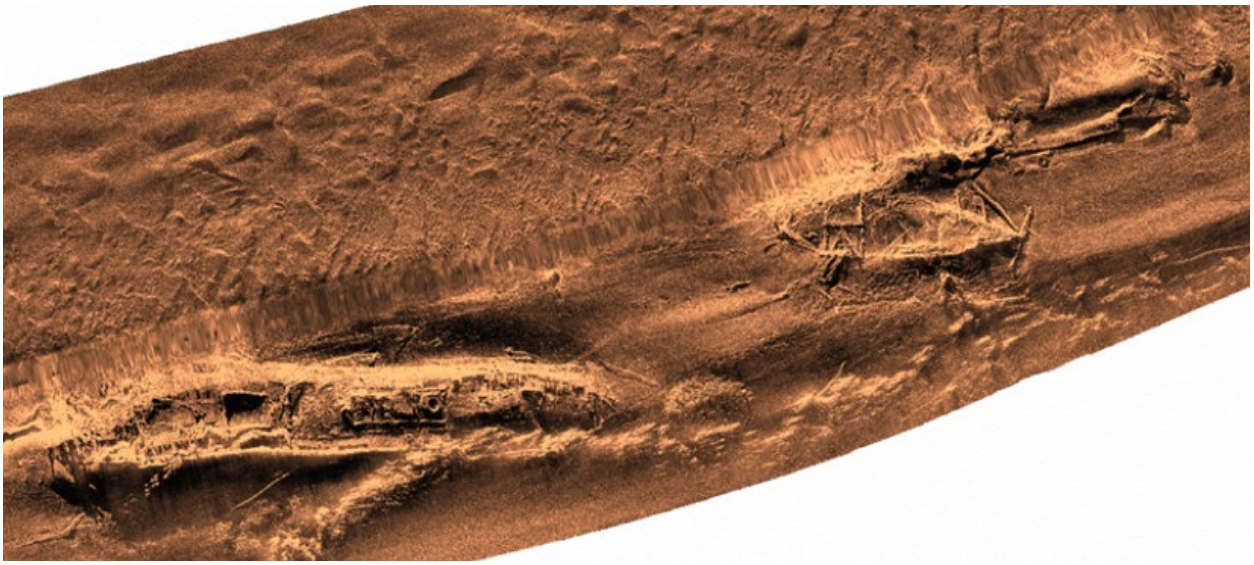


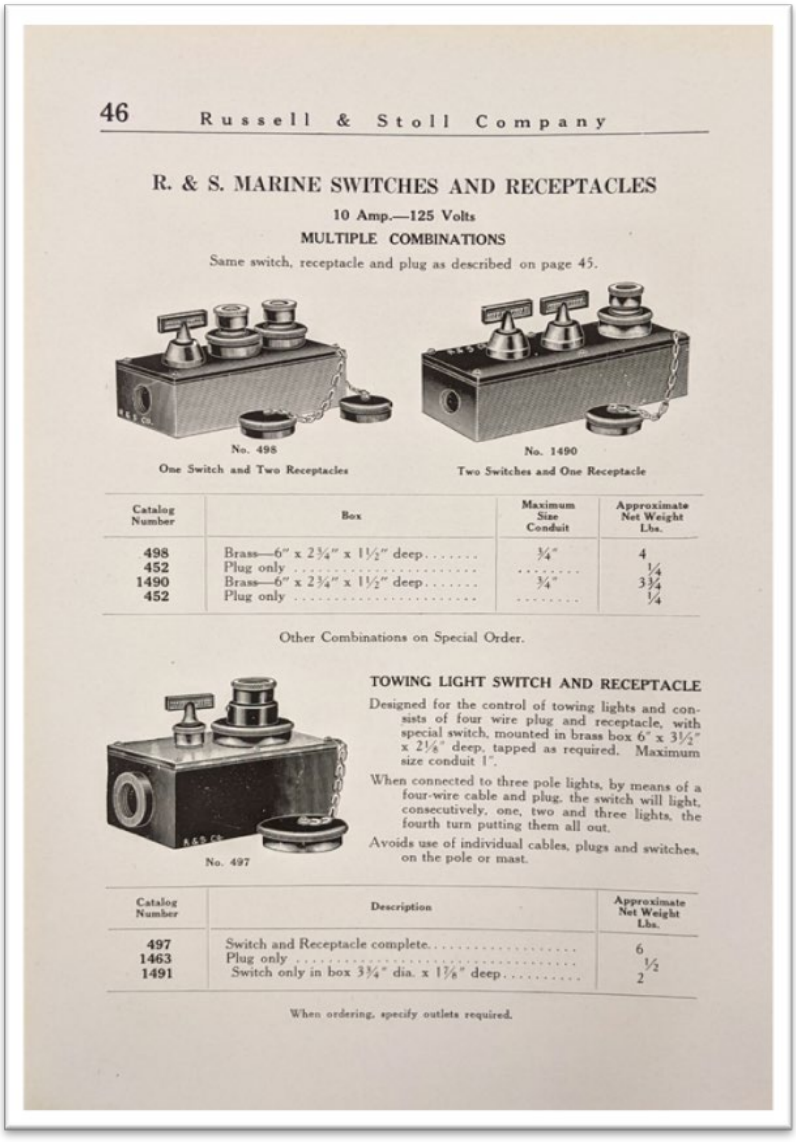
Figure 44. Side-scan sonar image of the wrecks of SS *Lake Ellijay* (L) and *Clotilda* (R), 2021 (SEARCH/AHC).

The two wrecks are so close that the presence of the older wooden wreck could not have been unknown to Pinto Island Metals Company crews working to strip and partially dismantle *Lake Ellijay*. A large steel porthole of early 20th century vintage was recovered in proximity to the location of the stern of *Clotilda*. The object was recorded as a single, isolated artifact. The object's proximity to the overall Pinto Island Metals Company scrapping debris field, its location within the Mobile River Ship's Graveyard (Lent, Delgado and Brennan, 2021), and it's positioning along the eastern bank of the river suggest it is the result of formation processes not associated with the *Clotilda* wreck site. The object likely came to rest within the concentration of the wreckage at a later date not associated with the historic vessel remains. It is likely from either *Lake Ellijay* or another wreck that was scrapped in the vicinity in the ships graveyard.

In addition, three brass marine switches and receptacles of the Russell & Stoll patent were found lightly screwed into the exposed frames, where ceiling planking was missing, on the port side midships on *Clotilda*, and close to the upper edge of the partially consumed hull. Attached to the damaged hull with short wood screws, their placement indicates that they were installed on the wreck at a time when the hull was more exposed. The fixtures were linked by a braided rubber insulated wire (a style first patented by Thomas A. Edison on March 15, 1892 as No. 470,924) that ran free (that is, it is not inside a conduit) and according to the diver, continued in the mud in the direction of the shore. This suggests that post 1926, and perhaps as late as World War II, if not later, the wreck was connected to shore by wires to place lights on it. This could have been done at the time of the mooring and partial scrapping of SS *Lake Ellijay* in 1946. Russell & Stoll, established in New York around 1902, were a leading manufacturer of marine electrical systems and lights through the mid-twentieth century. The firm was founded by inventor Frank J. Russell and was run in partnership with Theodore Stoll. The three receptacles and switches recovered from *Clotilda* are similar to those depicted in 1926 as a No. 497 and two No. 496 marine switches and receptacles for towing lights (**Figure 45**). That suggests that the wreck was lit at that time to avoid grounding on it as a navigational hazard at night.

While excavating mud midships on the lower, port side of the hull, RESOLVE divers encountered a mass of wadded fabric-like material in the loose sediments. This was forward of the area where the electrical switches and wire were observed lightly screwed into exposed frames. This area did not represent an archaeologically "sealed" area, as it had been previously observed as annually "cycling" sediment in response to river levels and the flow of the current. The material, described by the divers over helmet communications as a "dense, thick material," was also observed on the dive cameras by the archaeological team. It lay loosely up against the exposed planking inside the hull but was not fastened or attached to the planking. This is an area of the hull and in the hold that has been observed throughout the years of site investigations undergoing scouring due to changes in the flow of the river. The principal investigators, while suspected a secondary deposition of the material, requested a sample be cut from the wadded mass for subsequent analysis.

The sample (WP-26), a seven by nine-centimeter fragment of the thick fabric, was brought ashore and kept wet. Terra Mare took control of the sample, which was transferred to the National Museum of African American History and Culture in Washington for analysis by the Smithsonian Museum Conservation Institute (SMCI). Because there was a possibility that the fabric was related to *Clotilda*'s voyage, a working hypothesis was that it might have been a nineteenth century fabric that had been in the hold, strict protocols were followed to treat it respectfully and ethically. The other hypothesis, based on the field observations at the time of the discovery and recovery of this sample, was that it was intrusive material.



46 Russell & Stoll Company

R. & S. MARINE SWITCHES AND RECEPTACLES

10 Amp.—125 Volts

MULTIPLE COMBINATIONS

Same switch, receptacle and plug as described on page 45.

No. 498
One Switch and Two Receptacles

No. 1490
Two Switches and One Receptacle

Catalog Number	Box	Maximum Size Conduit	Approximate Net Weight Lbs.
498	Brass—6" x 2¾" x 1½" deep	¾"	4
452	Plug only		¼
1490	Brass—6" x 2¾" x 1½" deep	¾"	3¾
452	Plug only		¼

Other Combinations on Special Order.

No. 497

TOWING LIGHT SWITCH AND RECEPTACLE

Designed for the control of towing lights and consists of four wire plug and receptacle, with special switch, mounted in brass box 6" x 3½" x 2⅛" deep, tapped as required. Maximum size conduit 1".

When connected to three pole lights, by means of a four-wire cable and plug, the switch will light, consecutively, one, two and three lights, the fourth turn putting them all out.

Avoids use of individual cables, plugs and switches, on the pole or mast.

Catalog Number	Description	Approximate Net Weight Lbs.
497	Switch and Receptacle complete	6
1463	Plug only	½
1491	Switch only in box 3¾" dia. x 1⅞" deep	2

When ordering, specify outlets required.

Figure 45. Russell & Stoll Catalogue, 1926, Marine Switches and Receptacles.

The SMCI report was received on April 23, 2024 as this report was undergoing final edits after peer review (see **Annex F**). The analysis indicated that it the

fabric is chrysolite (asbestos) that had possibly been in contact with corroding iron or steel on one face (Webb et al. 2024). The iron corrosion staining is uniform, indicating a close and extended period of contact with the metal as it corroded. This is consistent with "asbestos cloth" used in a variety of construction projects, including marine applications, for heat insulation. As noted in a 1980 U.S. Navy study, "widespread construction applications were not developed until the latter portion of the nineteenth century" (Lory 1980: 5). "Chrysotile asbestos," or "white asbestos," accounts for 97% of all asbestos used in this country. The use of this material came about because of its natural fineness of fiber, high flexibility, good heat resistance and overall workability. Chrysotile asbestos is used in various textile products (Lory 1980: 3). The sample from the Clotilda site falls under "Category I – Friable insulating products and woven asbestos products... these can be woven, braided, or knitted into textile products. Usually, binding agents are not used in these textile products" (Lory 1980: 5). A 1920 description of asbestos cloth closely matches the sample recovered from the site. "Where operation at higher temperatures is essential... asbestos in the form of cloth, paper or tape is sometimes used. Unfortunately the asbestos fiber is so short and lacking in mechanical strength that it cannot be made into thin cloth or paper without the addition of some longer fiber... a tightly-woven, non-porous cloth" (Weightman 1920: 205)

The probable origin of this intrusive material is the nearby wreck of SS *Lake Ellijay* (1BA702), a World War I era steamship later converted into a training platform for training recruits in the loading and unloading of ships during World War II, and subsequently brought to Twelvemile Island by the U.S. Maritime Commission (now the Maritime Administration) as a war surplus vessel. *Lake Ellijay* along with other vessels was sold the Pinto Island Metal Corporation for scrapping in 1948. The partially scrapped hulk of *Lake Ellijay* rests within thirty meters of *Clotilda,* shown in **Figure 44**. Scattered pieces believed to be from the steamer rest near *Clotilda*, including the steel porthole recovered by RESOLVE divers during this project and returned to the river as a non-*Clotilda*, intrusive artifact.

Lake Ellijay was a standard "Laker" built to wartime specifications as one of 346 uniformly designed steamers constructed for the United States Shipping Board (USSB). We interpret the asbestos fabric as insulation from *Lake Ellijay* based on the following specifications from the USSB for its use in the steamships commissioned from various shipyards: "All steam and exhaust pipes in machinery space up to 6 inches in diameter will be lagged with asbestos or magnesia sectional covering and canvas" (Ferris 1917a: 63). Joinery (cabins and superstructure, will include "Insulation material of good quality pressed board, cork or asbestos" (Ferris 1917a: 30). "The boiler and engine casings, in way of living quarters and 'tween decks, will be insulated. Rake trunks and deck, over boilers, will be insulated at the underside with asbestos, protected with sheet iron or expanded metal" (Ferris 1917a: 29). "Radiators will have insulation of galvanized sheet iron and asbestos fitted back of them" (Ferris 1917a: 49).

Specific to the steel steamships such as *Lake Ellijay*, the USSB required that "the engine boiler hatch for its entire height will be insulated on the inside with asbestos board or pressed cork, the engine hatch insulated in similar manner where found necessary. Deck boilers, coal bunkers, and other woodwork will be insulated, where necessary, with asbestos, protected with galvanized

sheet iron" (Ferris 1917b: 25). "Radiators will have insulation of galvanized sheet iron and asbestos fitted back of them" (Ferris 1917b: 58). It also required for superstructure and joinery "Insulation material of good quality compressed board, board, cork or asbestos" (Ferris 1917b: 26). Therefore, this sample of asbestos material is believed to be an intrusive material from the *Lake Ellijay* wreck. The SMCI report on this analysis is included as **Annex F**.

Overall Observations of the Site: 20th Century Anthropogenic Impacts

A comparative view of sonar taken of the wreck between July 2018 and August 2021 shows a crater or depression in this area, which may represent the ongoing scouring of looser sediment that cycled through a disturbed area of the hull that was the result of the previously mentioned 20th century interference with the wreck. While the impact of the mid-to-late century dynamiting and removal of some hull planks and copper sheathing from the outer hull, and the removal of some or all of the cast iron bilge pump and centerboard indicate disturbance of the hold, the sonar imagery suggested a substantially intact interior space survives in the 21st century because Captain Foster quickly sought to burn and sink it and did not systematically and progressively strip it and burn it piece by piece.

Excavation against the bulkhead and the port side adjacent to it in two one-meter square units, combined with probing, followed the trend of the hull as it curved into the bottom of the wreck and toward the keel and keelson. As the centerline was approached, the probes no longer encountered buried wooden structure but defined an apparent "hole" in the bottom of the hull. This hole suggested that the centerboard was located in this area, directly forward of the main mast.

As previously noted, a section of centerboard trunk, a 13-foot long feature, was found in shallow water close to the bank off the starboard side in 2019. As well, a section of the ship's pump was also encountered in that area. This spoke to a latter and destructive process in which both of these internal structures were pulled out, perhaps after blasting, from the mud-filled hull. Either of these could have damaged the hull, resulting in the "hole" that was encountered in the bottom of the hold by probing. There are two possibilities as to why a gap in the hull would be present at this location:

1) The centerboard was there and took up half of the space in the hold as defined by the existing bulkheads.
2) The pumps were located there.

In either case, when blasting took place or these portions of the wreck were displaced, as documented in the initial work on the site in 2018-2019, both were integral features of the lower hull, especially the centerboard. The likely scenario, we believe, is that the gap is from the removal of all or part of the centerboard after blasting. The loss of a thirteen foot long section of the trunk and possibly the centerboard itself would account for the level of damage assumed through the probing inside the hull at this location.

At the time of the initial work on the wreck in 2018-2019, it was noted that:

> Oral history indicates that *Clotilda* was impacted by deliberate human actions. Mobile historian John Sledge related that a member of the Meaher family, which owned *Clotilda* at the time of its scuttling, told him that on two occasions in the 1950s Meaher family members dynamited the wreck (Sledge 2018). After the first event they purportedly pulled off its copper sheathing and sold it. After the second event they could not salvage any material (Sledge 2018). An undated page from the Jack Friend Collection includes that, "the copper IS still there" but it is unclear who was interviewed for this material and when the interview took place (Friend n.d.). As previously noted, 1Ba704 is distinguished by a concentration of disarticulated structural members, such as hull planks. The examination of the shipwreck shows that these wreck pieces lie not only outside the hull but the highest concentration lies inside the hull, at the mudline and beneath, with many sharp-edged pieces rising vertically from the wreck (Delgado et al. 2019:70).

Subsequent research and on-site observations in 2022 reveal that the location and identity of the wreck was known but are not clear on who did the apparent blasting and recovery of materials from *Clotilda*.

The Friend papers in the History Museum of Mobile include a copy of a memorandum, dated November 21, 1994, from Augustine Meaher III to his father. He wrote that he had been contacted by a diver named R.V. Williams from Pensacola, who had dived on the wreck and who had cleared mud from the wreck to examine it by swimming in from the aft (back) end. The bow was pointing upstream, portions of the wreck that Williams thought were the masts were visible above the river surface at low tide, the deck and part of the hull were gone, apparently burned, but the "cabin" was charred. Augustine Meaher III wrote that Williams "commented that it was too cold for him to dive beneath the hull and verify the condition of the copper bottom which you has discussed with him" (Meaher 1994).
Williams' dive in November 1994 was "too cold," and he told Meaher that he hoped to return in the Spring of 1995, but after speaking to his father, Augustine Meaher III wrote that "after speaking with you, I informed him that you felt the vessel simply should be left to rest in peace and he seemed to agree" (Meaher 1994; Tabor 2023:119, 212). A separate letter from Robert Meaher in the files, dated 2011, explained that he had held discussions with a "salvage man in Pensacola" who had dived on *Clotilda* and sought to recover the copper from the lower hull, and who offered to show Mr. Meaher the wreck, but that the man had died of a heart attack before that could happen.

Clotilda's *Structural Integrity and Considerations for Excavation and/or Recovery*

The structural integrity of a wooden vessel was defined and maintained by the complex interrelationship of the elements of the hull, with the strongest points being the keel and lower hull, the heavily reinforced bow and stern, and the transverse bulkheads and deck beams that created a water-resistant form that had both strength and flexibility to work on the sea.

Shipwrights built vessels to accommodate strains that tended to produce longitudinal bending of the whole structure, and strains tending to alter the transverse shape of the hull. As well, naval architects and shipbuilders, while building to insure that the weight and bulk of the ship immersed and the weight of the water it displaced were identical, also had to address the issue of local strains affecting particular parts of the ship that would tend to produce localized changes in the shape of the hull or damage it. Centuries of practical experience, and the rise of scientific naval architecture in the mid-19th century led to the state of the practice of shipbuilding when *Clotilda* was constructed and launched as a well-designed built vessel of its time. It is no longer the same vessel that it was in 1855, or in 1860 as a result of scuttling by fire, immersion in the Mobile River and its sediments for 162 years, and resulting mechanical, chemical and biological changes and degradation.

As a result of the Phase III investigations, a more detailed sense of *Clotilda*'s hull and structural integrity has emerged as a result of direct observation of previously inaccessible areas of the hull, from the clearing of obstructing trees and tree parts, and as a result of the erosion of sediment from the wreck that has taken place since 2019. While seemingly "intact" the as-built strength of *Clotilda* has essentially failed. The May 2022 work also provides a new sense of timber strength, infestation, and the condition of the iron fasteners, as well as scientific data on the bacteria and other organisms that are present at the site and inside the wreck. Environmental data has been collected; as a result, the overall condition of *Clotilda* is now understood in more detail than was previously known.

To better understand the structural integrity of *Clotilda*, as opposed to archaeological integrity or the overall condition of the site, RESOLVE's on-site naval architect Emily Benson was on-site throughout the field deployment for engineering, documentation and technological support. This was particularly important in coordinating diver observations with the archaeological team, and utilizing the field data to produce the various drawings of the hull. What has become apparent from that work and documentation, as noted previously, is a hull that has lost structural integrity aft of midships on the wreck. The sternpost, with the various structural elements that tied the hull into the stern post, is now gone. The remaining hull, with weakened and corroded iron fasteners, cannot consistently hold the remaining timbers together if raising is attempted.

The midship bulkhead for the main hold, an integral structure tied into the hull, is also either completely or partially compromised. The forecastle bulkhead, separating the crew area from the main hold, is intact and holding, but the next bulkhead, which as noted, is a temporary structure built to create the area of confinement. It is not a structural element that can tie into the sides of the hull to provide transverse bracing. There are no longer any transverse deck beams that remain in place. These beams, which spanned the width of the hull, tied the hull together because they were an integral part of a combined structure formed by the clamps and knees. All of the structures that were built in 1855 that strengthened the hull when the vessel was afloat and working are now either gone or seriously compromised.

Simply stated, with one end gone, and with only one bulkhead surviving breadthwise, there is nothing to hold the sides of *Clotilda* together other than the sediment that encases it. If excavated completely in and around the hull, it will collapse without major structural bracing outside, under and inside the remaining hull. Without this, *Clotilda* would break and open up along the keel line, with the port and starboard sides breaking away from the hull at or around the floors/first futtock level. The forecastle bulkhead would not be sufficient to hold the hull together at the bow, and the break would likely continue up to the stem, splitting the forward hull into two sides that would also partially disintegrate into fragments of hull.

An assessment provided by Larrie D. Ferreiro, PhD. is an appendix to this report (**Annex E**). Dr. Ferreiro is one of the nation's foremost experts on the forensics of historic wooden ships and a leading scholar internationally. Dr. Ferreiro also holds a BSE and M.Sc. in naval architecture and systems engineering, has worked as a naval architect and systems engineer for the Office of Naval Research, Naval Sea Systems Command, with the U.S. Coast Guard, and as Director of Research at the Defense Acquisition University; he is also an Adjunct professor of History at George Mason University. Dr. Ferreiro's work on the *Clotilda* project has been done *pro bono* and as an individual independent scholar. Dr. Ferreiro is the author of multiple books and professional journal articles, including *Ships and Science: The Birth of Naval Architecture in the Scientific Revolution, 1600-1800* (MIT Press, 2006) and *Bridging the Sea: The Rise of Naval Architecture in the Industrial Age, 1800-2000* (MIT Press, 2020).

CONCLUSIONS AND RECOMMENDATIONS

Overview

The overall condition of the wreck of *Clotilda* has changed since the wreck was first identified. As this report documents, detailed scientific, engineering and archaeological assessment indicates that the exposed portions of the wreck are at risk unless protective measures are taken. There are several factors that contribute to the assessment that *Clotilda*'s wreck faces ongoing threats of damage, loss of archaeological integrity, and the possibility of additional loss of structural integrity. There is also a clear sense that raising and recovering the wreck from the river would likely result in failure and loss of the wreck's remaining structural and archaeological integrity.

At the conclusion of the 2022 field work and subsequent analysis, it is observed that:

1. Additional evidence, both physical and archival, makes it clear that the wreck's exact location was known and documented, and that its identity was also known to some. The post-wrecking installation of electric lights to a damaged section of the hull's river-channel side as an apparent marker, likely in the first half of the twentieth century, speaks to this, as does the placement of the wreck on navigational charts and correspondence in the archives of the History Museum of Mobile that document apparent visits to and dives on to and into the wreck in the later twentieth century.

2. The stern section of the wreck, previously noted as archaeologically and likely structurally intact and buried in the mud, and comprising approximately 25 percent of the original lower hull, was subjected to a catastrophic mechanical event from a probable vessel strike and grounding – or more than one such event – that both struck and compressed this area of the wreck, which had been more structurally intact, and displaced and fragmented that area of the hull. From the bulkhead that defines the aft end of the area of the hold used to confine the captives to the rudder post, the hull is no longer present as an intact assembly. The sternpost, and the area of the hull comprising the port and starboard aft quarters, with the trunk cabin, are not in place. It is possible that the keel, keelson and floors as they fit into the keel/keelson assemblage remain in place, but it is also possible that the compressive force of what struck the wreck broke that schooner's "backbone." The disarticulated structural elements that comprised that portion of the wreck apparently remain in the mud, but on the wreck and off to what had been the starboard quarter and inshore of the hull.

3. The forward three quarters of the hull retains its form and survives to a level just below the main deck, as does the surviving clamps and strakes and at least one observed knee. Mechanical impacts to the bow from drifting log strikes have displaced some of the stem assembly and any structure that had been above the deck level which did not appear to have burned in 1860, as evidenced by the displaced lead hawsepipe on the starboard side.

4. Probing inside the main hold found that the area occupied by the centerboard, at the location of the mainmast is compromised with probable loss of lower hull structure as well as the previously noted removal of the centerboard trunk, as a thirteen-foot-long section of the trunk was observed in the shallows off the starboard side of the hull in 2019. This damage is attributed to the post-scuttling anthropogenic impacts from blasting and removing sections of the wreck during the 20th century.

5. Direct physical evidence of the modifications made inside the main hold for the confinement of the captives taken onboard at Ouidah is apparent in the hold despite this damage and forward of the centerboard area. This evidence as observed in May 2022 consists of at least the upright posts that formed the basic structure of the platforms on which the captives were placed. Excavation was limited to two one-meter square units, representing a small area of the hold, but it is suspected that given the survival of the posts, the platforms themselves may also survive in whole or in part in the unexcavated sediment that fills the hold. Other archaeological evidence may also survive in that matrix, as noted in the research design. The survival of this for now unique and unparalleled direct archaeological evidence of Middle Passage transportation of captives for the purposes of enslavement is a discovery of major importance.

6. Ongoing survival of the wreck as an archaeological site is probable *in situ*, even with ongoing biological degradation in a brackish environment, corrosion, fluctuations in river levels and currents, mechanical impacts from trees and vessel strikes, and the potentially unstable nature of the sediment that encapsulates the site.

7. The wreck rests on a riverbed that geotechnical coring offsite indicates is primarily composed of loose sand and gravel in mid channel, which is representative of the composition of the river bed directly beneath the wreck. However, cores were not collected from the riverbed directly adjacent to the wreck out of concern for potential damage from vibration. Mud from down-river transport of sediment that clings to the banks has also accumulated in and around the hull. What also should be considered is that the levels of mud covering the wreck have diminished during the time the wreck was first archaeologically assessed and been subjected to ongoing documentation by sonar. Scour by continued exposure to river flow and flood events risks eroding the wreck from the riverbank. Burial of the site will be required if the preferred option of preservation *in situ* is adopted.

8. The more recent and apparent mechanical damage to the wreck may have had an adverse effect on the structural integrity of the hull, but more likely a less significant but still notable impact on the archaeological integrity of the aft quarter and the space utilized by the officers and captain.

9. *Clotilda* is not resting in a stable environment, is subject to additional loss of structural and archaeological integrity, and is particularly vulnerable to changes in current, river levels, sediment transport and floating debris and trees, as well as inadvertent vessel strikes. This nationally significant, NRHP-listed archaeological resource is at risk.

Preface to Recommendations

In its 2019 report to the AHC, reporting on the identification of 1Ba704 as the wreck of *Clotilda*, SEARCH outlined a series of options for the wreck's future, with the recommended option of preservation *in situ*. "This will involve detailed study of both the natural and physical processes at the site, as well as detailed consultation with a conservator" (Delgado et al. 2019:110-115). That recommendation conformed to option 2 in the report's recommendations, which suggested limited archaeological excavation and condition assessment. What followed, even with the interruption caused by the COVID-19 pandemic, was a systematic approach by the AHC to protect and further document conditions on the wreck, and the wreck's condition in a best-practices demonstration of stewardship.

As noted in 2019, a long-established principle the management of historic shipwrecks is recognizing that these sites represent more than one inherent value (Delgado 1988). The Implementing Guidelines for the Abandoned Shipwreck Act of 1987 (Pub.L. 100-298; 43 U.S.C. 2101-2106) codifies it. The AHC codified it at the state level in the Alabama Underwater Cultural Resources Act (Alabama Code §§ 41-9-290, *et seq.*). Stewardship as practiced by the AHC has recognized the archaeological, historical, memorial and environmental significance of the wreck, with constant and consistent public consultation, openness and clarity in communication, and especially focused on the descendant community of *Clotilda*'s captives in Africatown.

In 2019, SEARCH also noted that the team's recommendations incorporated the advice of the 1996 United Nations Educational, Scientific and Cultural Organization (UNESCO)/ICOMOS Charter on the Protection and Management of the Underwater Cultural Heritage, which offers as the fundamental principles:

- The preservation of underwater cultural heritage *in situ* should be considered as a first option.
- Public access should be encouraged.
- Non-destructive techniques, non-intrusive survey and sampling should be encouraged in preference to excavation.
- Investigation must not adversely impact the underwater cultural heritage more than is necessary for the mitigatory or research objectives of the project.
- Investigation must avoid unnecessary disturbance of human remains or venerated sites.
- Investigation must be accompanied by adequate documentation (ICOMOS 1996).

While the ICOMOS Charter is advisory and has no regulatory authority in the US, this project under the guidance and direction of the AHC has followed these fundamental principles. One other aspect of the ICOMOS Charter that is relevant is the issue of the public. The Charter's guidelines offer a clear statement pertinent to this wreck and its future management:

> Archaeology is a public activity; everybody is entitled to draw upon the past in informing their own lives, and every effort to curtail knowledge of the past is an infringement of personal autonomy. Underwater cultural heritage contributes to the formation of identity and can be important to people's sense of community. If managed sensitively, underwater cultural heritage can play a positive role in the promotion of recreation and tourism (ICOMOS 1996).

Below SEARCH offered a series of management recommendations, as noted with option 4, *in situ* preservation, as the recommended alternative:

> The recommended alternative is preservation *in situ* after additional work on the site to stabilize it. That work includes more extensive archaeological excavation. In this process, the displaced elements of the wreck, such as the centerboard trunk, the pump log, planks, and other artifacts when encountered could be recovered, conserved and made ready for museum display. Reburial of 1Ba704, essentially encapsulating it in river bed, no longer exposed to current or to potential human disturbance, can stabilize the site. With the caveat of unknown conditions and costs, partial recovery of elements of the hull or structure as well as artifacts could be considered as part of Option 4 (Delgado et al. 2019:114).

The scope of work prepared by the AHC, the U.S. Army Corps of Engineers permit, and the activities conducted in accord with both during this project focused on minimal impact with an emphasis on maximum scientific results. Those results have yielded a far more comprehensive understanding of the wreck and its environment than that which was known in 2019. As will be seen in the narrative that follows, those results confirm our original recommendation in 2019 that *in situ* preservation is the best option for *Clotilda*.

If *in situ* preservation is the selected preservation approach for *Clotilda*, SEARCH notes that the general location of *Clotilda* is already known to the community and others. We therefore return to our 2019 recommendation that the wreck site, if encapsulated and protected, be designated as a memorial with some form of memorial structure that could span but not impact the site. There is much that can be done, as well, to draw on the detailed documentation to provide virtual access to the site. Especially for the *Clotilda* descendants, but also as physical reminder of the realities of the Middle Passage.

SEARCH endorses the idea that Africatown, as a community founded by and home to the descendants of *Clotilda*'s captives, as well as *Clotilda*, could be the setting for a national slave ship memorial. Alabama's precedent with the National Lynching Memorial is one factor that argues for a slave ship memorial in Africatown. It makes sense to place such a memorial at the community that is the legacy of the very last vessel to commit that crime. While a process of public consultation and much discussion will follow, SEARCH stands ready to assist in whatever way it can.

Retaining National Register of Historic Places Integrity

In considering options for the ongoing preservation and management of *Clotilda*, the National Register of Historic Places status of the wreck, while not placing restrictions, is a critical aspect in considering those options. This is especially true as the National Historic Preservation Act requires the U.S. Army Corps of Engineers, as the Federal agency that issued the permit for the work on the site to work with the AHC and other interested stakeholders to assess the effects of the project and its outcomes and seek ways to avoid, minimize, or mitigate any adverse effects on *Clotilda*. The wreck of *Clotilda* exists today as a shipwreck site and a component of a larger maritime cultural landscape of vessel abandonment and loss in the Mobile area. The vessel remains are one of a handful of slave ships located throughout the world which are accessible for archaeological study. To date (2022), *Clotilda* is the only American slave ship located, identified, and with a high degree of archaeological integrity, available to study not only as a vessel modified for use as a slave ship, but deliberately scuttled at the end of its slave trading voyage.

This suggests that direct physical evidence, both artefactual and forensic, is encapsulated within anaerobic conditions in thick mud. In this, *Clotilda* is also an archaeological site and an artifact with specific and powerful ties to the archaeology of the African Diaspora and the community members of Africatown. *Clotilda* is of exceptional national significance as an archaeological site and as such has been listed in the National Register of Historic Places under Criteria A and D. This most recent phase of work demonstrates that *Clotilda*, despite its fragility, due to the circumstances of its scuttling and post-scuttling changes over time, is the world's most archaeologically intact vessel known to have engaged in the transatlantic slave trade which is currently documented and available for scientific study and interpretation..

SEARCH's professional opinion is that *Clotilda* warrants study and likely would be designated a National Historic Landmark (NHL) by the Secretary of the Interior if such a study were pursued. There are only nine shipwrecks designated as National Historic Landmarks, all of them sunken military craft, one of which also lies in Alabama waters, USS *Tecumseh*. *Clotilda* is as far as is known the best-preserved and best-documented vessel in American waters associated with the four centuries of the transatlantic slave trade. Although not yet designated, the recommendation is to treat the resource as if it were a National Historic Landmark. Of the some three thousand National Historic Landmarks in the U.S., which collectively represent the most significant aspects of the heritage of the nation, the quality of exceptional significance is reflected by sites such as *Clotilda* that speak to the experience of African Americans, both in captivity, through forced enslavement, and on the road to freedom, as well as the long struggle for equal rights. The profound nature and critical aspect of that experience and *Clotilda*'s uniqueness and our strong belief that it is NHL-eligible not only form a recommendation for study but also underscore the recommendations for preservation *in situ*.[1]

[1] This assessment of significance and this recommendation is based on experience as the former director of the National Park Service's and the National Oceanic and Atmospheric Administration (NOAA)'s maritime heritage programs, as the Federal Preservation Officer (designate) of NOAA, and as co-author of the National Register

The fieldwork conducted in May 2022 has further refined an understanding of the wreck as an archaeological site and as a structure. What was presumed to be a more complete hull is now known to be less intact at the stern as the result of mechanical impacts to the wreck. The wreck is fragile, and yet encapsulated in its mud, it is more stable than it would be if excavated, cleared and an attempt was made to raise it. This revelation has not critically affected the overall integrity of the wreck as an archaeological site. While disarticulated, upper portions of the port quarter, deck beams and elements from the trunk cabin were archaeologically observed and remain a part of the overall archaeological site that is *Clotilda*. The opportunity to extract meaningful information from archaeological work on the site remains high, especially in the more substantially intact forward three-quarters of the vessel that remains an articulated, three-dimensional structure. The disarticulated portion of the stern area also offers an opportunity to extract meaningful information. *Clotilda* retains its eligibility under Criterion D, and the wreck site retains integrity under Criterion A.

Integrity for listing in the National Register is a factor in considering preservation options for *Clotilda*. The National Register was designed to be and is administered as a planning tool. While eligibility or listing places no restrictions on what non-Federal owners may do to their property, up to and including destruction (unless the property is involved in a project that receives Federal assistance, usually funding or licensing/permitting), Federal agencies in those circumstances must consult with the Advisory Council on Historic Preservation and State Historic Preservation Officers to consider and to mitigate impacts. State and local preservation laws also consider National Register eligibility, not only through the Section 106 process of assessing outcomes and seek ways to avoid, minimize, or mitigate any adverse effects, but also in the application of the Alabama Underwater Cultural Resources Act.

Would *Clotilda* retain integrity if the wreck site was completely excavated and raised from the Mobile River? The existing National Park Service policy, as noted in Bulletin 20, "Nominating Historic Ships and Shipwrecks to the National Register," explicitly states that "a vessel loses her integrity of association if she is removed from the water and displayed out of sight of the water (Delgado et al. 1987:9). The preciseness of the language in Bulletin 20 comes from the fact that as it was written in 1986-1987, there were a number of NRHP-listed shipwrecks that had been recovered and were displayed on land. However, these vessels were all added to the register once they had been recovered and conserved, at which point the assessment of their integrity was as conserved artifacts ashore, some under protective cover but in an open-air setting, and not as shipwreck sites; these included the Civil War ironclads CSS *Jackson* (NRIS 7000212) and *Chattahoochee* (NRIS 7000212) in Columbus, Georgia, CSS *Neuse* in North Carolina, USS *Cairo* (NRIS 71000068) in Mississippi, and the Great Lakes schooner *Alvin Clark* (NRIS 74000996) in

bulletin for nominating historic ships and shipwrecks, the co-author of the guidelines for administering the Abandoned Shipwreck Act of 1987, and the author or co-author of 43 National Register nominations and 49 National Historic Landmark studies for historic ships and shipwrecks, including *Clotilda*.

Menominee, Michigan. [2] Subsequently, NRHP-listed shipwrecks that were partially excavated but without the entire wreck being raised and artifacts and machinery recovered for additional study, conservation, and on-shore display included the NHL-designated USS *Monitor* (NRIS 7400229) and the Confederate submarine *H.L. Hunley* (NRIS 78003412) in Charleston, South Carolina. *Monitor*'s turret, engine, anchor, and artifacts from the captain's cabin have been archaeologically recovered and conserved, or remain in active conservation, at the USS Monitor Center at the Mariners' Museum in Newport News, Virginia. The NRHP-listed river steamer *Bertrand*, which sank in the Missouri River in 1865, remains listed after a complete excavation that recovered its content and then left the hull *in situ.*

Following *Bertrand*'s sinking, the river channel shifted, leaving the buried hull twenty-eight feet beneath the surface of the land. Legends of treasure led two local men to seek a permit in 1967 to salvage the wreck from the De Soto National Wildlife Refuge, administered by the U.S. Fish and Wildlife Service. The permit was granted, subject to the requirements of the Antiquities Act of 1906, and as the excavation commenced in 1968-1969, a brief National Register nomination was prepared for the General Services Administration (GSA), acting for the Fish and Wildlife Service as the "owner" in February 1969. The nomination stressed that

> The apparent discovery of this sunken boat and its contents is a major historical find. This steamboat is Nebraska's only substantial link of a tangible nature with the early steamboating era. This discovery may be unique; no other early

[2] CSS *Jackson* is an ironclad steam ram built in 1862-1864 that was partially destroyed by fire when it was scuttled at the end of the Civil War on April 17, 1865. The wreck, submerged in the Chattahoochee River, was known to locals through the early twentieth century. It was rediscovered in 1960 and raised in November-December 1961 after charges blasted it into two pieces. CSS *Chattahoochee* is an armored wooden-hulled gunboat that served from 1863 until it was scuttled on April 17, 1865. It was rediscovered and the stern with the engines was raised in 1963. Since their recoveries, both wrecks' remains have been stabilized and placed on display inside the National Naval Museum of the Civil War in Columbus, Georgia. As part of the process of restoration at the museum, both raised hulls were nominated to and listed in the National Register in 1970. The U.S. Navy ironclad gunboat USS *Cairo*, sunk by Confederate "torpedoes" (mines) in the Yazoo River, Mississippi on December 12, 1862, was buried in the mud of the Yazoo until its rediscovery by NPS historian Edwin C. Bearss and his associates Don Jacks and Warren Grabau in 1956. Following initial recoveries in 1960, an attempt to raise the intact hull failed in October 1964 as the steel cables of the lifting cranes cut into the wooden timbers and broke *Cairo* apart. The remains of the gunboat - wooden structure, iron armor, the steam machinery, cannon and thousands of artifacts – were ultimately transferred by Congress to the National Park Service with an appropriation to fund restoration and reassembly in an outdoor museum setting of as much of the gunboat as could be saved; prior to this transfer, in December 1970 the remains of *Cairo* were nominated and it was listed on September 3, 1971 (NRIS 71000068) as part of the process to facilitate further NPS involvement. *Alvin Clark*, a two-masted brigantine, later schooner-rigged wooden vessel built in 1846 and lost in a storm in June 1864. Rediscovered by divers in 1967 as an intact wreck, it was raised in July 1969 (Hoffman 1974; Boyd 2018). The 1961 NHL designation of the Continental Navy gunboat *Philadelphia* (NRIS 66000852) followed its acquisition that year by the Smithsonian Institution. *Philadelphia*, lost in the Battle of Valcour Island in September 1776, followed a 1960 assessment during the then NPS study of sites for an NHL study on the theme "The War for Independence." That in turn was further documented, albeit in less than two full pages of text, in 1966. The designation reflected the nominating study's assertions that "The United States Gundelo *Philadelphia* is the only surviving gun boat built and manned by American forces during the Revolutionary War" and "Considering the punishment it took in battle and its long years underwater, the *Philadelphia* is an exceptionally well-preserved survivor of this important Revolutionary War naval battle."

steamboats are known to have to have been discovered and excavated along the Missouri River outside of Nebraska (NRIS 69000138).

The nomination was completed on February 21 and the wreck was listed on March 24, 1969.

Another NRHP-listed historic shipwreck, the Revolutionary War privateer brigantine *Defence*, scuttled in Maine's waters in 1779, and the subject of a detailed archaeological excavation, was listed in 1975 (NRIS 75000205). The partially excavated hull, back-filled post-excavation, has been monitored since as the management decision was not to raise the hull but to opt for *in situ* preservation. Other National Register-listed shipwrecks that retain their listing after partial excavation and limited recovery of some structure but not the entire hull. These include the Emanuel Point Shipwreck, a Spanish vessel lost to storm in the ill-fated colonizing expedition to Florida's Gulf coast in 1559, a singularly rare type of wreck yet found in U.S. waters (NRIS 96000227) and the tragically lost steamship *Brother Jonathan*, which wrecked off the Northern California coast in 1865, and listed in 2002 after treasure hunters successfully litigated against the State of California and recovered treasure, a part of the steam machinery, and a trunk of cargo comprised of hardware and tools (NRIS 20000535).

Three National Register-listed shipwrecks in Alabama waters are preserved and managed in situ. They are the *Canonicus*-class monitor USS *Tecumseh* and the ironclads CSS *Huntsville* and CSS *Tuscaloosa*. *Tecumseh* was lost to a "torpedo," or undersea mine before engaging the Confederate defense fleet on Mobile Bay during the August 1864 Battle of Mobile Bay. Initially considered part of the larger designation of Fort Morgan as a National Historic Landmark in 1966, *Tecumseh* was separately listed in the National Register in 1975. A substantially intact wreck, lying capsized and buried in harbor mud in the bay, *Tecumseh* is a nationally significant historic and archaeological site as well as the war grave for ninety-four of its crew. Despite early plans to raise and restore the wreck in 1967 and subsequent discussions to do so, including a 1974 study by Jack Friend that estimated the costs of excavation, recovery and conservation at $80 million; calculated with 3.86 percent annual inflation in the past five decades, that cost would equal $531.2 billion dollars in 2024. Given the cost, the uniqueness of the site and its status as a grave, the ultimate decision made by the U.S. Navy and the State was preservation in situ.

The wrecks of the ironclads CSS *Huntsville* and CSS *Tuscaloosa*, both late-war built warships, retreated to the Spanish River after the end of the Battle of Mobile Bay on August 5, 1864. They remained there until their crews scuttled them at the junction of the Spanish and Mobile rivers on April 12, 1865 to block access to Union warships as Mobile fell to Union troops and ships. Surveys and test excavations sponsored by Jack Friend precisely located the wrecks and test excavations in 1985 disclosed that there were substantially intact, although one hull was broken into two major pieces. A resurvey of the sites by SEARCH in 2019 relocated the two wrecks, which are buried under a thick layer of river sediment, as well as a pre-war gabion constructed to control the flow of the river. *Huntsville* and *Tuscaloosa* were nominated by the Alabama Historical Commission after the survey, as the most intact examples of Confederate ironclad warships in the nation. They were listed at a national level of significance in July 2022. They are both preserved in situ.

Therefore, it is important to note that partial or complete excavation, if a site remains *in situ*, has not led to a removal of shipwreck properties from the National Register if it retains its integrity in most aspects, especially integrity of design, workmanship, materials sufficient to reflect Criteria A, C and D. Loss of integrity of setting and association by itself, in practice, therefore, has also not led to a removal of shipwreck properties from the National Register. The exception is *Alvin Clark*, which is instructive as a study. Preservation of the raised hull proved too difficult, efforts made to preserve were inadequate, and the original discoverer and the key figure in raising the wreck of *Alvin Clark* ultimately committed an act of vandalism that burned the raised hulk. When its remains were demolished, that led to its de-listing in the National Register.

Subsection § 60.15 of the National Historic Preservation Act, "Removing properties from the National Register," notes that the grounds for removing properties from the National Register are:

> **(1)** The property has ceased to meet the criteria for listing in the National Register because the qualities which caused it to be originally listed have been lost or destroyed, or such qualities were lost subsequent to nomination and prior to listing.

The question left unanswered when assessing a site like *Clotilda* is the degree to which raising a vessel and losing the integrity of setting and location impacts the integrity of design, workmanship, materials, and impacts on the impacts to the wreck retaining significance under Criterion D.

The questions to be considered for *Clotilda* are therefore two-fold. Would removal for conservation and preservation ashore lead to de-listing because it has lost the qualities that led to the listing? And, would removal, if there was not a compelling need to do so, be advisable given the uniqueness of *Clotilda* as a site where one could argue that the integrity of setting and location are critical to not only listing but also the potential for designation as a National Historic Landmark?

It is SEARCH's opinion that full recovery of the wreck **and** the requirements for conservation ashore would negatively impact the integrity of the site. Archaeological integrity refers to the context that allows an archaeological site to tell its story through scientific investigation. Structural integrity refers to the physical strength of the vessel's component parts and to the soundness of the structure as a whole. While *Clotilda* retains exceptional archaeological integrity, this study has revealed that *Clotilda's* structural integrity is far more fragile than previously understood.

An attempt to raise the *Clotilda* using existing technology would likely result in the hull collapsing or breaking apart. Even following an archaeological excavation of the interior of the vessel, such a collapse would result in the loss of archaeological deposits contained in the bilge, the space between the inner and outer hull. Moreover, such a collapse would utterly destroy the integrity of the design and workmanship of the vessel itself. In the highly unlikely scenario that a portion of *Clotilda* could be raised intact, on-land conservation would require the complete dismantling

of the hull for separate conservation of the timbers, all iron and copper fasteners, and copper or Muntz sheathing which would destroy the integrity of design and workmanship.

If the wreck could be raised in one piece – which even if technically possible has the potential for the hull to collapse or break apart, and regardless of how much excavation had taken place, in a limited visibility environment – a collapse or break up at the surface would lose archaeological material lodged in the space between the inner and outer hull, including any DNA evidence, and effectively destroy the integrity of design and workmanship. On land conservation of *Clotilda* would require the complete dismantling of the hull for separate conservation of timbers and all iron and copper fasteners and sheathing; this would destroy the integrity of design and workmanship.

In a case like this, even the seeming exception of the previously raised wrecks is immaterial; *Clotilda*'s environment is different than that of the purely freshwater sites where conservation in the 1930s and 1960s and into the early 1970s was treated as matter of drying and not addressing questions of salinity, biological and bacteriological changes to the wrecks. *Hunley*, where the iron artifact that is the submarine has not been completely dismantled, and which will be reassembled for display in an environmentally safe environment, will arguably retain integrity of design and workmanship, but it will have irreparably lost integrity of association and setting. That was known and considered in the decision to recover the submarine.

With *Clotilda*, the question of integrity in all aspects has been a key aspect of how it meets the criteria for listing at a national level. As summarized in the NRHP nomination that led to *Clotilda's* listing:

> The schooner *Clotilda* (1Ba704) is a substantially intact, submerged and partially buried shipwreck and archaeological site that is the last vessel known to have transported captives to America to enslave them. The story of this vessel, and its destruction to avoid prosecution, the resistance and resilience of the people forcibly brought to America in it to be enslaved, and their post-Civil War forming of Africatown, itself a National Register historic district of national significance, became an important touchpoint in collective memory. The 19th and 20th century accounts of the surviving *Clotilda* captives in newspapers and magazines shared their story with a larger American audience. The ongoing survival of Africatown is a highly significant cultural touchstone with great meaning. As such, pinpointing the exact location of *Clotilda*, the initial *foci* of that involuntary voyage that in time led to the creation of this African American community, takes on additional significance.

The landscape surrounding the wreck site remains much as it was in 1860; undeveloped, forested and the banks lined with canebrake, with the only modern intrusions being a dilapidated fishing cabin on the bank, the cast concrete property marker belonging to the Meaher family, who own part of the shoreside property near the wreck, and the occasional modern steel barge temporarily "parked" by the Harbormaster of Mobile Port Commission in this "backwater" of the

river. There is little perceptible change to the setting; and *Clotilda* rests in the same location, lying exactly as Foster wrote in 1890 that he had sunk his schooner thirty years earlier, "in twenty feet of water" (Foster 1890:n.p.).

The NRHP nomination for the wreck directly addressed this aspect:

> The wreck of *Clotilda* is substantially intact, resting exactly where it was and scuttled, burned, and sunk at the end of its illegal slave trading voyage in July 1860. As a near "time capsule" site, it has **a high level of integrity of association**. That scuttling, a necessary solution to the risk of arrest, seizure of the vessel by Federal officials, and the possibility of conviction of a capital offence, was a hastily conducted event. The vessel, now devoid of its crew and the captives, was run into the bank, possibly holed to commence its sinking, and then set on fire by the ship's Captain. At the time of this nomination, archaeological investigations have focused solely on understanding the basic characteristics of the wreck and determining its identity (Delgado et al. 2020b:22).

SEARCH is also of the opinion that the integrity of setting and association are linked to more than National Register criteria. The response to the wreck at the site where it has rested since the end of the 1860 voyage by descendants has been profound to witness and humbling. It is not for us to address the reasons why or how. That aspect has as it should be conveyed by the community, not the archaeologists. We note this with respect as well as the reactions to the site and in the wreck, by our colleagues from the Slave Wrecks Project, Diving With a Purpose, and the Society of Black Archaeologists and noted by and reflected elsewhere in this report by them. The integrity of setting and location at the *Clotilda* site has powerful spiritual and cultural significance.

Assessing *Clotilda*: Insights from DWP, SBA, and SWP: Jay Haigler and Kamau Sadiki

There is a powerful and important perspective to this site as to what it means for African Americans, past, present, and what will become of the site in the future. The project team included co-principal investigators from The Society of Black Archaeologists (SBA) and The Slave Wrecks Project (SWP), and the continued participation of Diving With A Purpose (DWP), who have been involved in investigations of the site since the beginning of *Clotilda*-related work, beginning in 2018. This is reflected in the Research Design, but also and importantly, the following perspectives and narratives are included in this report.

It is important to connect science, culture, and human experience. They are all interrelated.

Clotilda represents all three areas and capturing the human experience of diving this historic wreck from an American-American perspective is critical to presenting a holistic view of this important submerged cultural heritage resource.

Preparing to explore *Clotilda* is about being in a mental, emotional and psychological space to collect scientific data while bestowing reverence and respect to the 110 individuals that were aboard the ship.

As my dive buddy, Kamau Sadiki and I prepare to enter the water, we check the gauge on our regulators to make sure that we have a full tank of air, make sure that our regulators are properly connected. As we enter the brackish water, I think about the human beings who arrived on this ship as well as their descendants. While these ancestors were last part of the greatest known forced migration in human history, they represent one of the greatest examples of human resilience. The people aboard *Clotilda* experienced capture, horrific transport conditions, enslavement, emancipation and empowerment. These people not only survived their experience, they thrived after liberation to create Africatown, a community that has sustained for over one hundred and sixty years. As we concluded the dive, the words of abolitionist Frederick Douglass come to mind. In an 1889 speech called, *The Nation's Problem*, he said:

> Our past was slavery. We cannot refer to it with any sense of complacency or composure. The history of it is a record of stripes, a revelation of agony. It is written in characters of blood. Its breath is a sigh, its voice a groan, and we turn from it with a shudder. The duty of today is to meet the questions that confront us with intelligence and courage.

- **Jay Haigler, Diving With a Purpose**

Diving the *Clotilda* – An Ancestral Journey

This is a story about a horrendous crime committed 162 years ago and my experience as a scuba diver and underwater archaeology advocate diving on what is an extraordinary artifact of that crime. It is a story about ancestral memory, connectivity, resistance and the resilience of the human spirit. It is a story about our collective history across the African diaspora.

On July 9, 1860, the *Clotilda,* a two-masted schooner, sailed into Mobile Bay in Alabama after a three-month journey across the Atlantic Ocean from Whydah, Dahomey (present day Benin) with 110 men, women and children in its hold. Fifty-two years prior, a law was passed that prohibited the importation of human beings into the USA with the intent to enslave them. However, a wealthy Alabama businessman named Timothy Meaher made a bet that he could import captives from Whydah regardless of the prohibition. He hired a captain by the name of William Foster to pull off the illicit deed. Once the captives disembarked, Foster sailed the *Clotilda* up the Mobile River and set it on fire in a futile attempt to destroy the vessel and thereby avoid prosecution. Instead, the *Clotilda* sank into the murky waters of the Mobile River.

I am affiliated with an organization called Diving With a Purpose (DWP) which is a global partner with the Slave Wrecks project, a program of the Smithsonian National Museum of African American History and Culture. One of the missions of DWP is to document and bring back into

memory the remains of shipwrecks that participated in the Transatlantic Slave Trade. More than 12,000 ships participated in the trade with an estimated 1,000 of these vessels meeting their fate in a wrecking event. However, very little is known about any of these shipwrecks that had such a tremendous impact on world history. I am humbled to have participated in the search for and/or archaeological survey and documentation of five known slave shipwrecks. These are the *Guerrero* off the coast of Key Largo, FL, the *São José Paquete de Africa* that sank off the coast of Cape Town, South Africa, the *Fredericus Quantus* and the *Christianus Quintus* in the Cahuita National Park in Costa Rica and the *Clotilda* in the Mobile River. Diving on each of these shipwrecks brought about an intense palpable emotional response, none more so than diving on the *Clotilda.*

My first dive on the *Clotilda* took place during a field mission in May of 2022. At times there is a stiff current flowing over the wreck site but this morning the river was relatively calm with what I would call a gentle flow. The waters of the Mobile River are mostly brackish and murky. Visibility was near zero. So, under these conditions, I knew that I would have to rely heavily on touch. There is an archaeological process for evaluating artifacts to collect critical information about the wrecking event and the ship itself as well as vast historical information concerning the people who interacted with the artifact. However, there is another dimension to inferring information from artifacts, particularly artifacts such as slave shipwrecks.

As an artifact, the wreck of the *Clotilda* is largely intact. About 80 percent of the vessel's hull can be seen from sonar images of the wreck. The actual hold, 23x18 feet, where the 110 captives were imprisoned, is clearly visible. There is no other slave shipwreck in the historical record that exists, in whole or in part, in which the actual structure that captive human beings touched and experienced such unconscionable horrors is accessible. As part of our human experience, the emotional and physical domains - while distinctive - are very much connected. The threshold is variable for evoking powerful reactions. Coupled with my many travels to Africa, years of studying African history, and associated life experiences, I realized that preparation for this dive - beyond conventional scientific diving protocols - was keenly necessary.

With this first dive I anticipated intense feelings and memory, perhaps catapulting me into an emotional state that I've never experienced before. Given the intensity of my dive journey to touch and connect with the past, I also knew that before entering the water I had to prepare my mind, body, spirt for the experience. So, along with my dear friend, Sabrina Johnson, I composed an ancestral prayer that I recited before beginning my first dive on the *Clotilda*:

> An Ancestral Prayer for the first dive on the *Clotilda:*
>
> *Beloved Ancestors. Your voices have been quiet for 162 years. But your silence ends now!*
>
> *Your voices and memory are lifted now from this wretched vessel – through us – and we welcome you to speak through us.*
>
> *Our connection will never be broken. We are because of you!*
> *Thank you for reaching out to us. Blessings to your Spirits – always!*

Reciting this prayer brought somewhat of a calming state over me. I entered the water and, along with my dive buddy, did a short surface swim over to the wreck and descended onto the bow of the *Clotilda.* I was anticipating my first visual of the wreck but the visibility was about an inch or two. So, relying on touch alone, I embraced the *Clotilda* and began to "listen" with my hands in order to hear the voices of those 110 victims that endured so much terror, pain and misery. As I worked my way down the starboard side of the wreck, I was searching for the forward bulkhead or wall that indicated the hold of the ship. Once I felt it, I paused, knowing that I was only inches away from a space like no other in the world. With a few fin kicks I went up and over the gunwale into the hold! As mentioned, there was no current but I immediately began to tumble about, off balance. Then stillness came about me and I vividly recalled feeling an embrace of my upper body. I allowed the experience to play out without any reaction until I remember feeling a tug on my right fin, not really sure if I kicked a part of the wreck. Then I began to explore the hold, the inner hull, the short posts that supported the now non-existent flooring and the thick sediment that has almost filled the lower portion of the hold.

The slave shipwreck as an artifact can inform and transform us in powerful ways if we know how to listen with our hands and hearts, removing the separation between the tangible and intangible. Archaeologists and conservationists traditionally probe and interrogate the materiality of the Transatlantic Era of African Enslavement (TEAE), seeking insight and meaning of objects, or the context in which the material exists. This physical approach is intensely tactile and, in some cases, can cause disturbances to the very context that is trying to be understood. There is another compelling and critically important dimension to acquiring knowledge and information about artifacts, particularly those related to the TEAE. Understanding this dimension of these cultural materials, you will be able to gain deeper insight and meaning beyond the physical realm, particularly cultural materials or artifacts that is related to massive historical traumatizing experiences, such as human beings stolen from family, homeland and culture, forced into floating concentration camps called "slave" ships and then forced to provide uncompensated labor to strangers for the remainder of their lives. You can even sense it if you approach it correctly. Intangible experiences involving artifacts of the TEAE can "speak" to interrogators, revealing deeper insight into their meaning and humanizing the people that were terrorized and traumatized by the events in which the artifacts were involved.

My dive experiences on the *São José Paquete de Africa* and particularly on the *Clotilda* have given me deeper insight and meaning to my work on slave shipwrecks and enriched and strengthened the connection to my ancestors. Why do I do it? I have no other choice!

- **Kamau Sadiki, Slave Wrecks Project**

This narrative was subsequently published in *Alert Diver,* August 2022 and is reproduced with their permission (Sadiki 2022).

Conclusion

In conclusion, our recommendation, coming from various perspectives, of *in situ* preservation is based on science, engineering, and the certainty of exceptionally high cost with uncertain results even if carefully executed, given the difficult environment, complex logistics, and severely compromised structural condition of the wreck. While excavation and selective recovery of artifacts or some structure might be considered, and not effect a loss of integrity sufficient to de-list the site, we believe that complete excavation and recovery would lead to de-listing. Public consultation and discussion, as has been the AHC's approach since the beginning of this project, is the only way to address the question of what is the right thing to do moving forward.

Recommendations Following the Phase III Investigations

1. The number one concern for the *Clotilda* shipwreck site is the material strength of the vessel and whether it could be safely raised without destroying it, in addition to the question of what the conservation of the hull and ship remains would require. The report by Terra Mare Conservation (**see Annex C**) concludes:
    a. Mechanical damage of the wood is extensive and the structural integrity of the wreck may be significantly affected if this type of damage is widespread.
    b. Biological damage on exposed disarticulated timbers is widespread and will continue unless the ship is reburied in an oxygen-free environment.
    c. The stability of the wreck depends on the state of the connections between all the elements of the hull.
    d. Corrosion of metal fasteners varies from moderate to severe to total loss.
2. Additional stabilization and protection is essential. At the conclusion of the May 2022 fieldwork, all loose timbers were collected, assessed, and documented, and returned to the interior of the wreck for *in situ* storage in the mud-filled area of the forecastle (crew area) and the hold was capped with mud-filled sandbags. Periodic sonar resurvey of the wreck to assess the site's condition should be undertaken. As well, we recommend that steel pilings be driven at a distance from the wreck to fend off both potential tree impacts and collisions with the wreck by vessels. The extensive damage from a probable and likely more than one vessel strike and grounding in the stern area, and the loss of the State's marker buoys is indicative of what will likely continue to happen to the wreck if unprotected. The placement of any piles needs to be carefully coordinated with engineering to ensure that the placement of the piles does not adversely affect the wreck, either from vibration from pile driving or changes in current flow that may affect the deposition or removal of the sediment that covers the wreck.

3. Active monitoring of the site should include regular visits to the wreck; these could be done in coordination with ongoing sonar surveys.

4. Creating a marked navigational exclusion zone along the bank and out to mid-river in this section of the river in coordination with the U.S. Coast Guard and the Harbor Master.

5. The State should proceed, with the National Park Service, in submitting a National Historic Landmark study for *Clotilda* for designation by the Secretary of the Interior. The site retains a high level of archaeological integrity, with research questions answered through this phase of work and a clear and persuasive argument for designation. The listing of the wreck at a national level in the National Register of Historic Places is a major step in the process of NHL assessment.

6. The State, if it considers the possibility of complete archaeological recovery of the wreck will face engineering and conservation challenges. It is unlikely that the wreck can be recovered intact. If the keel remains intact, with attached floor timbers and lower hull, severing that section of the hull for separate removal is one option. The more intact forward three quarters of the hull would require near-complete excavation of sediment inside the hull, extensive bracing internally and externally, including under the hull, and then lifting onto an immediately adjacent barge with a cradle to support the hull if the fasteners would still retain sufficient strength to continue to hold the timbers together, which is consisdered highly unlikely. In water replacement of all fasteners, as was done prior to the raising of *Vasa* in Sweden in 1959, might be required. Even then, survival of the hull when raised could not be guaranteed. As noted, raising destroys the integrity of location and setting, which for *Clotilda*, we argue, is a key aspect of its significance and meaning. There are also the spiritual and cultural meanings of the site as it rests to consider, as discussed in this report.

7. If the wreck is archaeologically recovered, conservation of the wreck and its artifacts should be planned for, completely funded and a *Clotilda*-specific and specialized maritime conservation facility would need to be built, equipped, and staffed. The long-term conservation of the hull and artifacts will take years if not decades. As well, the long-term curation and display of the vessel and the artifacts will require perpetual funding at adequate levels to maintain them at a standard consistent with their national significance. The estimated costs would be at least an estimated thirty million dollars as a specialized facility would be required and maintained. Once recovery takes place, there is no turning back for what would be needed next for *Clotilda*.

8. Archaeological recovery of *Clotilda* from the site would not necessarily preclude the placement of a memorial or on-water marker at the site. However, as noted elsewhere in this report, the presence of *Clotilda* at the site, where the voyage ended, has provided its nationally significant integrity of setting and location important in its listing in the National Register of Historic Places, and which would also be a factor in designation as a National Historic Landmark and/or a World Heritage Site.

9. *In situ* preservation, incorporating reburial in an anoxic (near zero oxygen) environment and physical protection of the wreck, is an appropriate strategy for *Clotilda* and is the most ethical and scientifically responsible strategy at this time. Preservation *in situ* adheres to current best practices in archaeological site preservation and stewardship for the protection of underwater cultural heritage. Implementing *in situ* preservation

methods is a complex process requiring coordinated planning across a multidisciplinary team of specialists in maritime archaeological conservation, maritime archaeology, civil engineering, environmental science, as well as collaboration with project partners.

10. This report presents an overview of preliminary options for *in situ* protection and preservation; however, further investigation is required to determine the most appropriate method for the wreck site. Reburial may be challenging if subsurface soils close to the wreck are loose. This should be investigated through a broader and more comprehensive geotechnical engineering study than we were able to conduct in Phase III. The next steps should include developing an *in situ* preservation master plan integrating a comprehensive risk assessment of the archaeological site. The full report by Terra Mare Conservation is presented in **Annex C**.

These recommendations are respectfully submitted with appreciation for again being entrusted to work on this nationally significant shipwreck, and for the opportunity to again work with partners and with the community who make this unique and powerful shipwreck the reason why archaeology should be done and why archaeology matters.

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ANNEX A:

US Army Corps of Engineers
Nationwide Permit SAM-2018-01100

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, MOBILE DISTRICT
P.O. BOX 2288
MOBILE, AL 36628-0001

March 31, 2022

South Alabama Branch
Regulatory Division

SUBJECT: Department of the Army Application, File Number SAM-2018-01100-LET, Archaeological Investigation, Mobile River, Baldwin County, Alabama

Alabama Historical Commission
Attention: Ms. Stacye Hathorn
Email Address: stacye.hathorn@ahc.alabama.gov
Post Office Box 300900
Montgomery, Alabama 36130-0900

Dear Ms. Hathorn:

This letter is in response to your request for verification of Department of the Army Nationwide Permit (NWP) authorization to conduct archaeological investigation activities on the Nineteenth Century shipwreck Site 1BA704 in Mobile River. The project has been assigned file number SAM-2018-01100-LET which should be referred to in all future correspondence with this office concerning this project. The project is located adjacent to Baldwin County Parcel 05-30-01-42-0-005-001.000; at Latitude 30.787917° North, Longitude -87.997319° West; in Baldwin County, Alabama.

Department of the Army permit authorization is necessary because your project involves work in waters of the United States under our regulatory jurisdiction. The project activities include the following:

High-resolution sonar survey of the wreck, installation of a hydrologic flow logger, biological assessment of the site's benthic zone, structural assessment of the vessel's hull, targeted artifact excavation within the hold, collection of wood samples, and removal/relocation of tree debris snagged on the wreck. Structural assessment work would involve collection of approximately 20 loose hull planks or other vessel structure displaced by previous disturbances for documentation, analysis, and stress testing to determine structural integrity of the hull for possible in-situ preservation of the shipwreck. The work also involves collection of a maximum of 10 timber samples from within the hull to assess chemical, biological, and physical deterioration as well as evaluate environmental DNA. Excavation of the hold inside of the shipwreck would involve excavation of seven (7) one-meter units with an average depth of 0.75 to 1.0 meters using a small volume suction dredge. Excavation is expected to result in dredging/removal of 8 cubic yards of silt and artifacts within a 170-square-foot area of the hold. Following excavation of the hold and analysis of the recovered materials, approximately 10 cubic yards of dredged material and formerly displaced vessel structure will be returned within the hold for archaeological storage in-situ, including up to 5 cubic yards of sandbags to be placed on top of the hold for stabilization and conservation of the wreck. Dredging and filling activities are limited to a maximum of 25

cubic yards of material removed and discharged into open waters of the United States. This permit does not authorize the dredging or discharge of dredged and/or fill material in wetlands or areas containing submerged aquatic vegetation. Tree debris removed from the wreck shall be placed within the debris spoil area as depicted in the attached plans. Temporary stabilization measures may be utilized for diver/site safety, including installation of wooden shoring, rigging, and strapping plates.

Based upon the information and plans you provided, we hereby verify the work described above, which would be performed in accordance with the attached drawings, is authorized by NWP 5, *Scientific Measurement Devices*, NWP 6, *Survey Activities,* NWP 18, *Minor Discharges,* and NWP 19, *Minor Dredging,* in accordance with 33 CFR Part 330 of our regulations. This NWP and associated Regional and General Conditions are attached for your review and compliance.

This verification is valid until the NWP is modified, reissued, or revoked. All of the existing NWPs are scheduled to be modified, reissued, or revoked prior to March 14, 2026. It is incumbent upon you to remain informed of changes to the NWPs. We will issue a public notice when the NWPs are reissued. Furthermore, if you commence or are under contract to commence this activity before the date the relevant NWP is modified or revoked, you will have 12 months from the date of the modification or revocation of the NWP to complete the activity under the present terms and conditions of this NWP.

Your use of this NWP is subject to the following special conditions:

a. The activity shall be conducted in accordance with the information submitted and meets the conditions applicable to the NWP, as described at Parts B and C of the NWP Program and State Regional Conditions.

b. The permittee understands and agrees that if future operations by the United States require the removal, relocation, or other alteration of the structure or work herein authorized, or if in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the U. S. Army Corps of Engineers (USACE), to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

c. In order for the Coast Guard to give proper notice to the maritime community, the permitted owners, contractors, or responsible party shall contact Coast Guard Sector Mobile Waterways Management Branch (spw), 1500 15th Street, Mobile, Alabama 36615, (251) 441-5166 or (251) 441-5940, 60 days prior to performing the proposed action. The permitted owners, contractors, or responsible party must also install and maintain, at the permitted owner's, contractor's, or responsible party's expense, any safety lights, signs and signals required by the USCG, through regulations or otherwise, on the permitted owner's, contractor's, or responsible party's fixed structures. To

receive a USCG Private Aids to Navigation marking determination, at no later than 30 days prior to the installation of any fixed structures in navigable waters, you are required to contact the Eighth Coast Guard District (dpw), 500 Poydras Street, Suite 1230, New Orleans, Louisiana 70130, (504) 671-2124 or via email to D8oanPATON@uscg.mil. For general information related to Private Aids to Navigation, please visit the Eight CG District website at www.atlanticarea.uscg.mil/District-8/District-Divisions/Waterways/PATON/.

d. Authorized construction activities shall not infringe upon navigation on the waterway. These activities shall be in compliance with 33 CFR Part 163, which states in part: "A clear channel shall at all times be left open to permit free and unobstructed navigation by all types of vessels and tows normally using the various waterways."

e. The permittee shall adhere to all stipulations of the executed Memorandum of Agreement (MOA), signed on March 29, 2022, and developed between the U.S. Army Corps of Engineers (Corps), the Alabama Historical Commission (AHC), and State Historic Preservation Officer (SHPO). The issuance of these permits only authorizes the work outlined in the executed MOA.

f. The permittee must implement and maintain appropriate, effective Best Management Practices (BMPs) for prevention and control of nonpoint sources of pollutants during and after project implementation. The permittee, at a minimum, must implement applicable effective BMPs as provided in the current “Alabama Handbook for Erosion Control, Sediment Control, and Stormwater Management on Construction Sites and Urban Areas” published by the Alabama State Soil and Water Conservation Committee.

g. No building materials, tools or other equipment associated with project construction shall be stockpiled in wetlands or other waters of the United States. All excess materials, tools, and equipment shall be removed immediately upon completion of the activity.

h. The attached yellow Notice of Authorization sign must be posted prominently at the site and/or work vessels during construction of the permitted activity.

i. Within 30 days of completion of the work authorized, the attached Compliance Certification must be completed and submitted to the USACE.

j. It is the permittee's responsibility to ensure the contractors working on this project are aware of all general and special permit conditions.

Nothing in this letter shall be construed as excusing you from compliance with other federal, state, or local statutes, ordinances, or regulations which may affect this work. Revisions to your proposal may invalidate this authorization. In the event changes to this project are contemplated, it is recommended that you coordinate with us prior to proceeding with the work.

You are receiving an electronic copy only of this verification letter. If you wish to receive a paper copy, you should send a written request to this office at the following address: U.S. Army Corps of Engineers, Mobile District, Regulatory Division, Post Office Box 2288, Mobile, Alabama 36628. Electronic copies of this letter are also being sent to the Alabama Historical Commission, Attention: Ms. Lisa D. Jones, Director, at lisa.jones@ahc.alabama.gov and Ms. Clara N. Nobles, Deputy Director, at clara.nobles@ahc.alabama.gov; your agents, Stantec Consulting Services, Inc., Attention: Mr. Carl Ferraro, at carl.ferraro@stantec.com, Resolve Marine Group, Attention: Mr. Aaron Jozsef, at ajozsef@resolvemarine.com, and SEARCH Inc., Attention: Mr. James P. Delgado, at james.delgado@searchinc.com; the Alabama Department of Environmental Management, Mobile Branch / Coastal Section, Attention: Mr. Scott Brown, at coastal@adem.alabama.gov; and the Alabama Department of Conservation and Natural Resources, State Lands Division, Attention: Mr. Will Underwood, at DCNR.Coastal@dcnr.alabama.gov, and Mr. Jeremiah Kolb, at jeremiah.kolb@dcnr.alabama.gov.

Please contact me at 251-694-3772, or at Dylan.C.Hendrix@usace.army.mil if you have any questions. For additional information about our Regulatory Program, visit our web site at http://www.sam.usace.army.mil/Missions/Regulatory.aspx, and please take a moment to complete our customer satisfaction survey. Your responses are appreciated and will allow us to improve our services.

Sincerely,

Dylan C. Hendrix
Senior Project Manager
South Alabama Branch
Regulatory Division

Attachments

When the structures or work authorized by this nationwide permit (file number SAM-2018-01100-LET) are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

_____ _____

(TRANSFEREE) (DATE)

COMPLIANCE CERTIFICATION

US Army Corps of Engineers
Mobile District

Permit Number: **SAM-2018-01100-LET**

Name of Permittee: **Alabama Historical Commission**

Date of Issuance: **March 31, 2022**

Upon completion of the activity authorized by this permit and any mitigation required by the permit, please sign this certification and return it to the following address:

U.S. Army Corps of Engineers
Mobile District
Regulatory Division
Post Office Box 2288
Mobile, Alabama 36628-0001

Please note that your permitted activity is subject to a compliance inspection by a U.S. Army Corps of Engineers representative. If you fail to comply with all terms and conditions of this permit, the permit is subject to permit suspension, modification, or revocation and you are subject to an enforcement action by this office.

I hereby certify that the work authorized by the above-referenced permit has been completed in accordance with the terms and conditions of the said permit including any general or specific conditions, and the required mitigation was completed in accordance with the permit conditions and documentation required by 33 CFR 332.3(l)(3) has been provided to this office.

_____ _____

Signature of Permittee Date

US Army Corps of Engineers®

This notice of authorization must be conspicuously displayed at the site of work.

A permit to perform work authorized by statutes and regulations of the Department of the Army at

Mobile River, east of Twelvemile Island, Baldwin County, Alabama

has been issued to Alabama Historical Commission **on** March 31, 2022

Address of Permittee: PO Box 300900, Montgomery, AL 36130-0900

PERMIT NUMBER

SAM-2018-01100-LET

Dylan C. Hendrix, Senior Project Manager
South Alabama Branch, Regulatory Division

For the **District Commander**

ENG FORM 4336, Jul 81 (33 CFR 320-330) EDITION OF JUL 70 MAY BE USED

Proponent: CECW-O

Figure 1: Vicinity Map



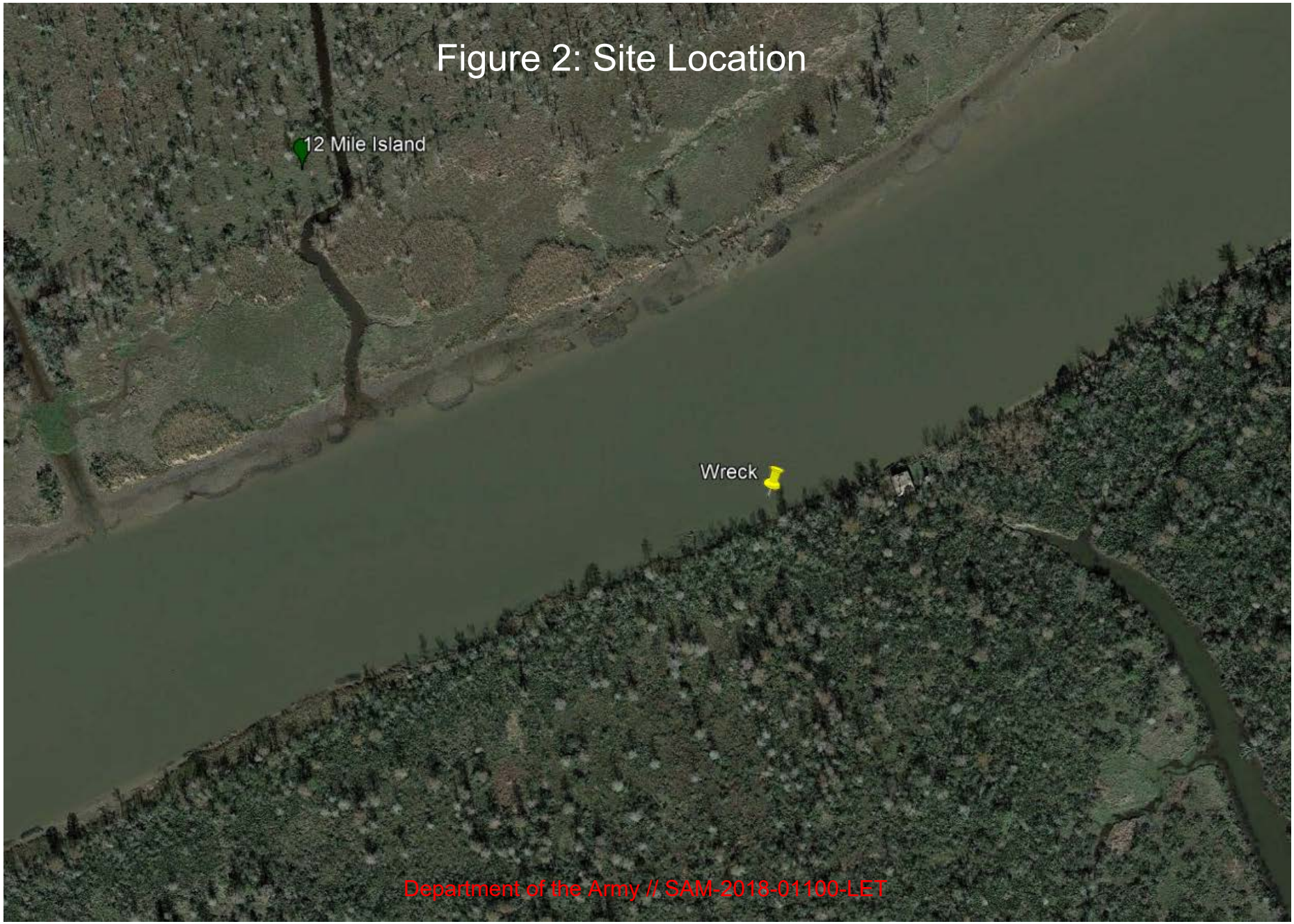

Figure 2: Site Location
12 Mile Island
Wreck
Department of the Army // SAM-2018-01100-LET

Figure 3: Side Scan Image of Site

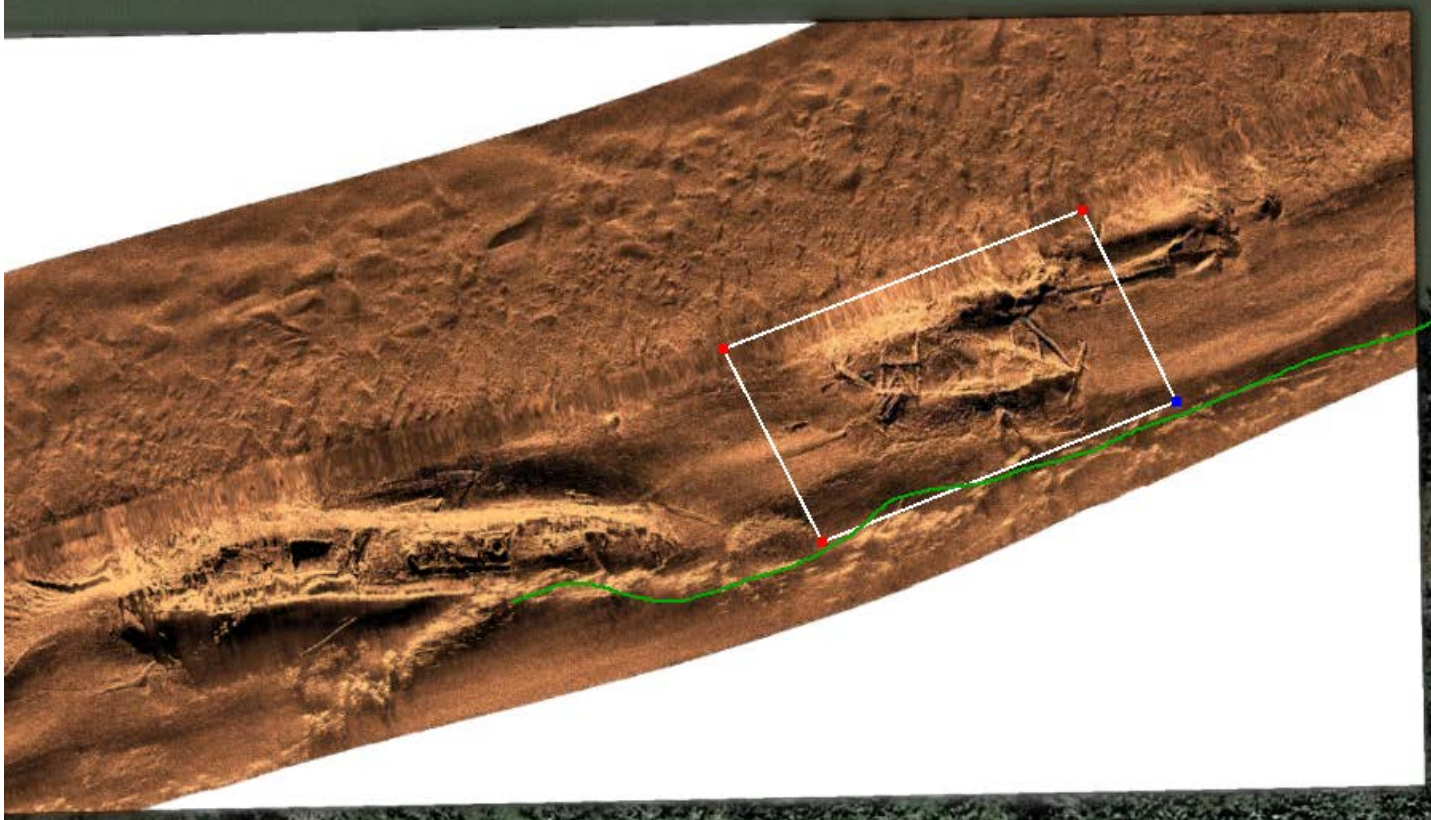


Figure 4:

Barge Mooring Location

Note: Spuds will be located offshore



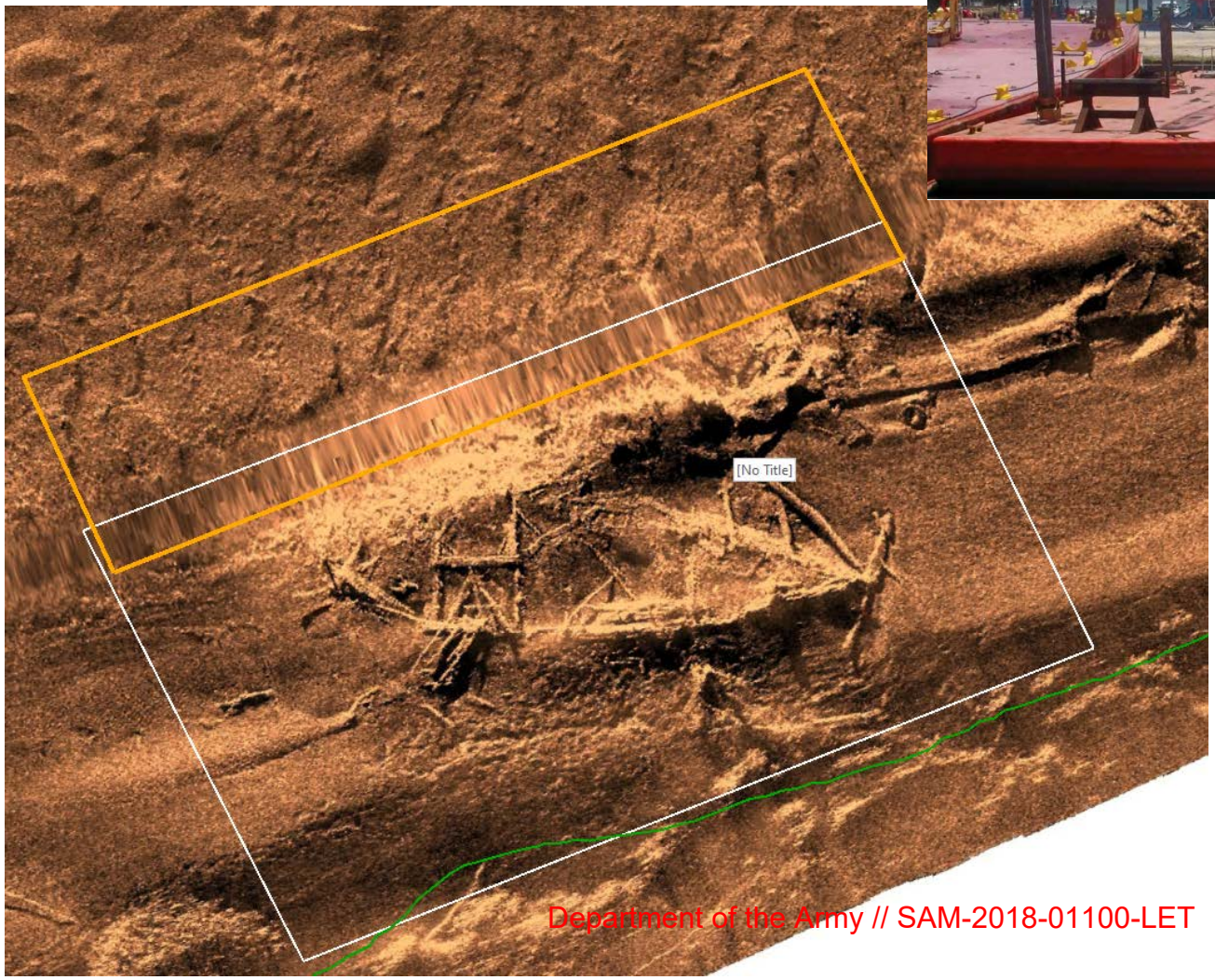


Figure 5: Trees to be Removed from Wreck

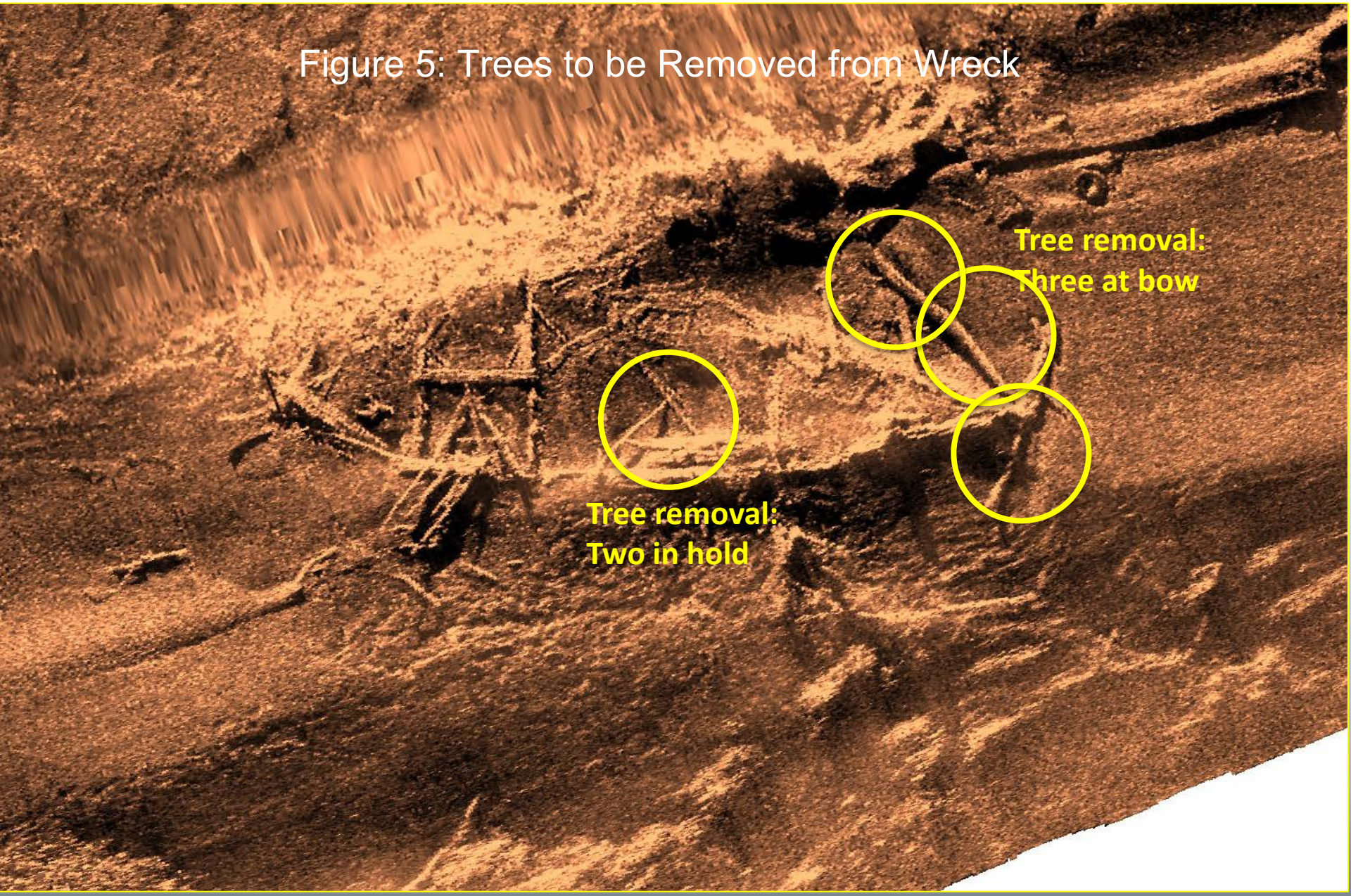


Figure 6: Areas to be Investigated

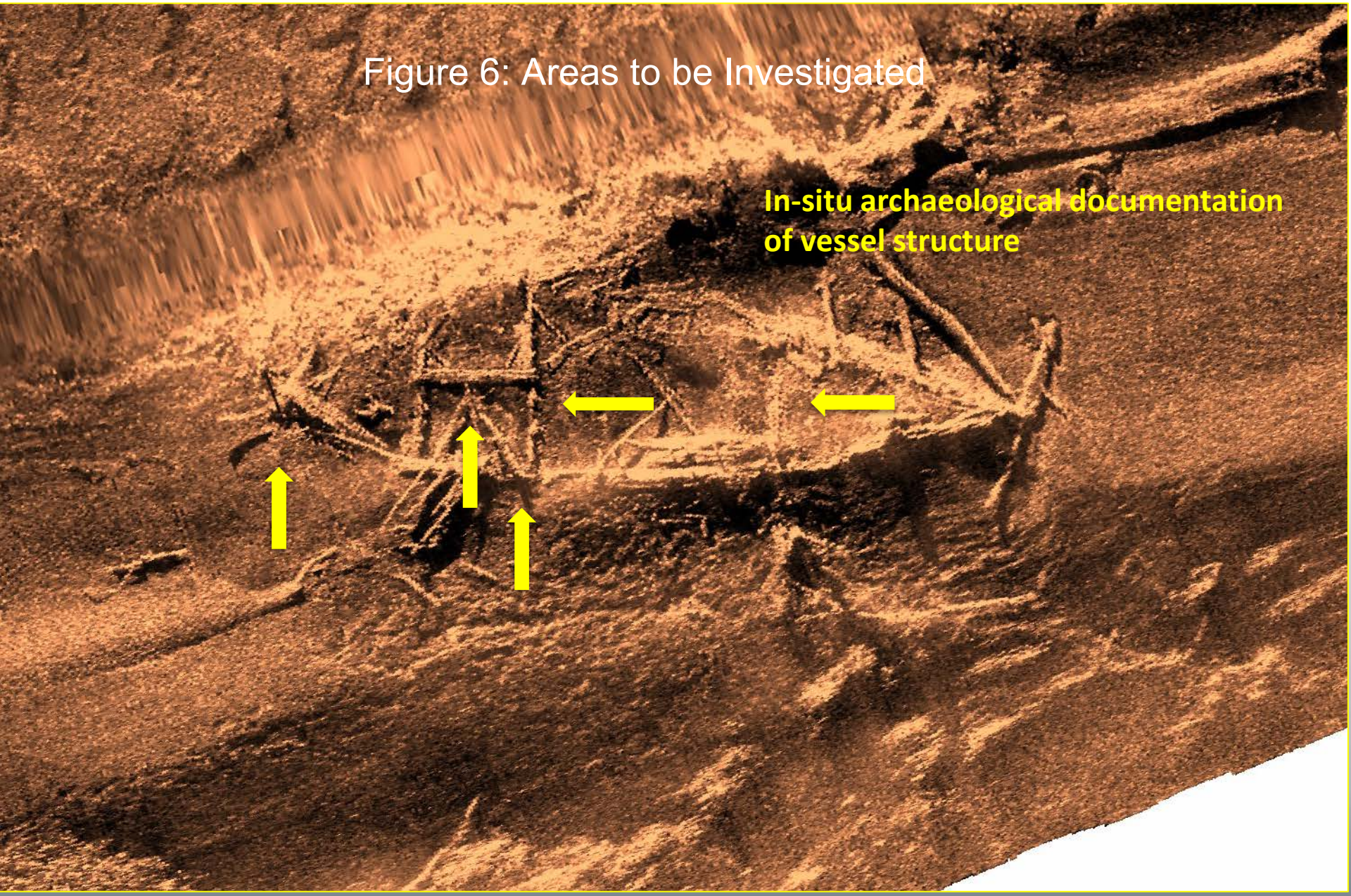


Figure 7: Artifact/Timber Recovery Area Landward of Wreck

Mapping and recovery of isolated vessel structure along starboard (right) side of wreck: c. 40 timbers and iron pump log segment.

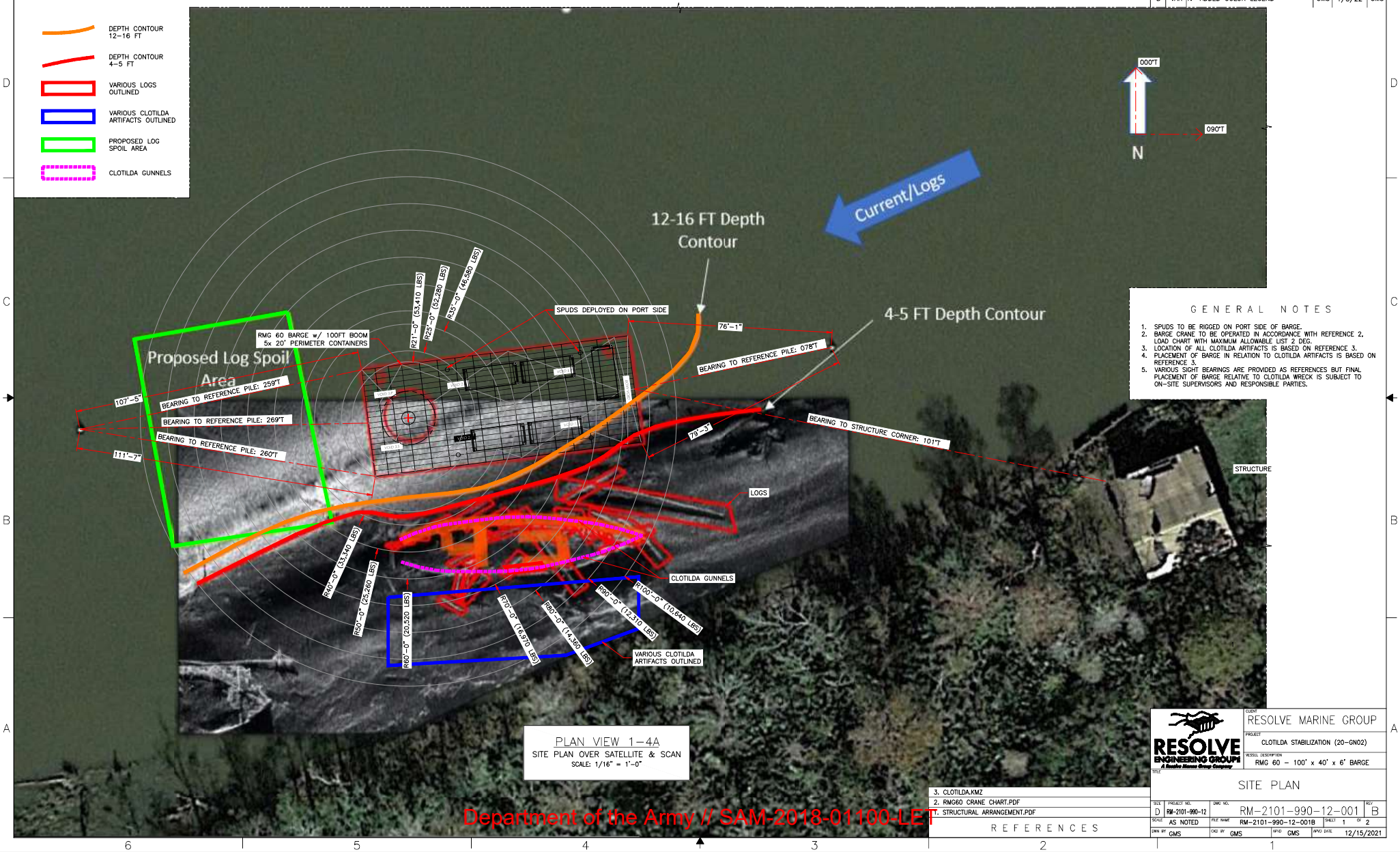


Figure 8: Hold where Captives Were Held



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REVISIONS					
REV	ZONE	DESCRIPTION	DWN	DATE	APVD
A	VAR	1. ADDED CLOTILDA DEBRIS BOX.	GMS	12/16/21	GMS
B	VAR	1. ADDED COLOR LEGEND	GMS	1/3/22	GMS



GENERAL NOTES

1. SPUDS TO BE RIGGED ON PORT SIDE OF BARGE.
2. BARGE CRANE TO BE OPERATED IN ACCORDANCE WITH REFERENCE 2, LOAD CHART WITH MAXIMUM ALLOWABLE LIST 2 DEG.
3. LOCATION OF ALL CLOTILDA ARTIFACTS IS BASED ON REFERENCE 3.
4. PLACEMENT OF BARGE IN RELATION TO CLOTILDA ARTIFACTS IS BASED ON REFERENCE 3.
5. VARIOUS SIGHT BEARINGS ARE PROVIDED AS REFERENCES BUT FINAL PLACEMENT OF BARGE RELATIVE TO CLOTILDA WRECK IS SUBJECT TO ON-SITE SUPERVISORS AND RESPONSIBLE PARTIES.

PLAN VIEW 1-4A
SITE PLAN OVER SATELLITE & SCAN
SCALE: 1/16" = 1'-0"

REFERENCES

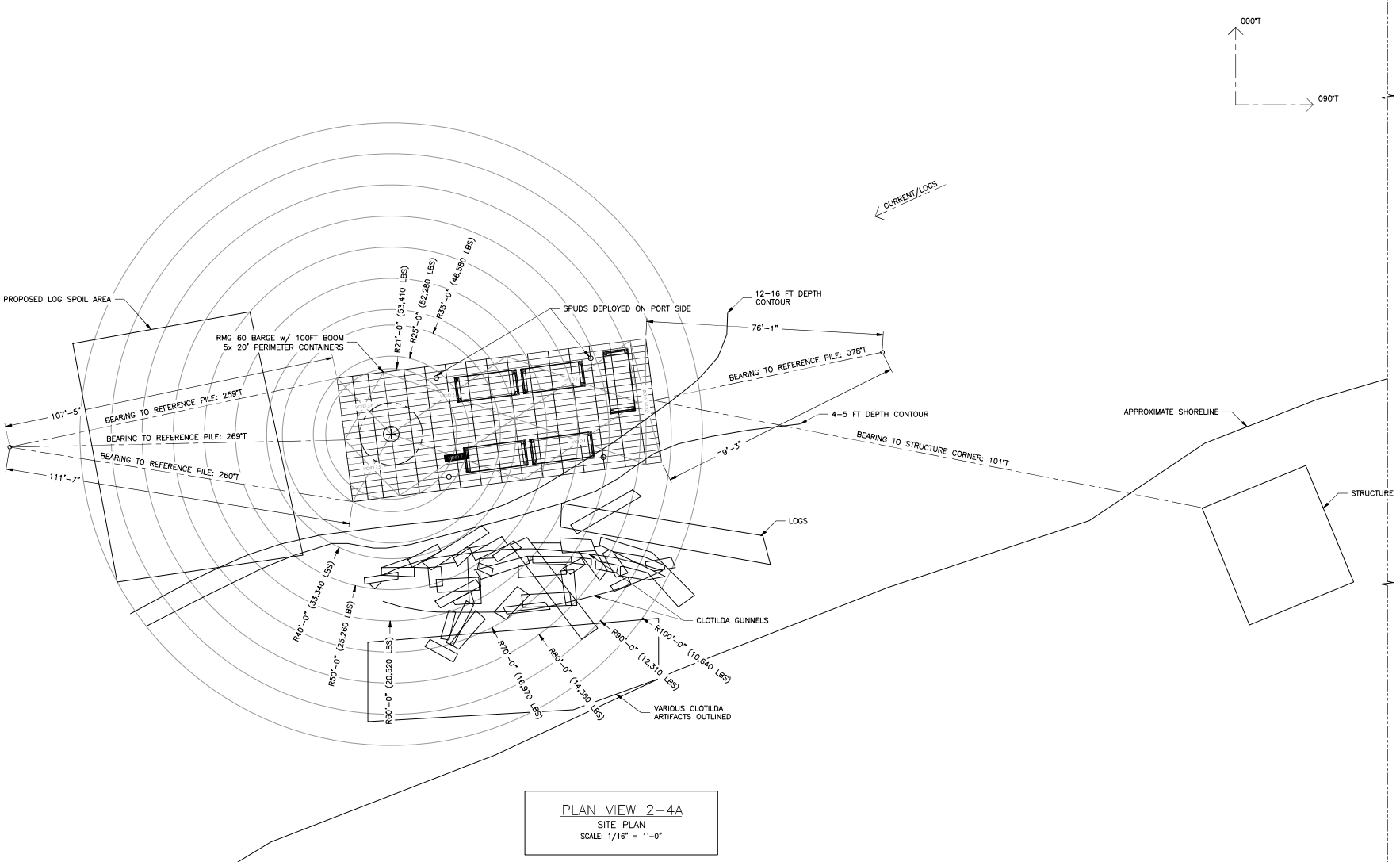
3. CLOTILDA.KMZ
2. RMG60 CRANE CHART.PDF
1. STRUCTURAL ARRANGEMENT.PDF

Department of the Army // SAM-2018-01100-LET

RESOLVE ENGINEERING GROUP
A Resolve Marine Group Company

CLIENT: RESOLVE MARINE GROUP
PROJECT: CLOTILDA STABILIZATION (20-GN02)
VESSEL DESCRIPTION: RMG 60 – 100' x 40' x 6' BARGE
TITLE: SITE PLAN

SIZE	PROJECT NO.	DWG NO.	REV
D	RM-2101-990-12	RM-2101-990-12-001	B
SCALE: AS NOTED	FILE NAME: RM-2101-990-12-001B	SHEET 1 OF 2	
DWN BY: GMS	CKD BY: GMS	APVD: GMS	APVD DATE: 12/15/2021



PLAN VIEW 2–4A
SITE PLAN
SCALE: 1/16" = 1'–0"

Department of the Army // SAM-2018-01100-LET

SIZE	PROJECT NO.	DWG NO.	REV
D	RM-2101-990-12	RM–2101–990–12–001	B
SCALE	AS NOTED	FILE NAME RM-2101-990-12-001B	SHEET 2 OF 2
DWN BY	GMS	CKD BY GMS APVD GMS	APVD DATE 12/15/2021

Standard Manatee Conditions for In-Water Activities

The following conditions are recommended for any in-water work occurring between June 1 and December 31.

1. All on-site personnel will be responsible for observing water-related activities for the presence of manatees.

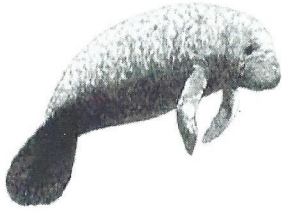
2. If a manatee is spotted within a 50-foot radius (buffer zone) of the action area, all work, equipment, and vessel operation **must** cease. Manatees must not be herded or harassed into leaving the active work area. Once the manatee has left the buffer zone on its own accord, and after 30 minutes have passed without additional sightings of manatee(s) in the buffer zone, in-water work can resume under careful observation for manatee(s).

3. If a manatee(s) is sighted outside of, but near to the action area, all vessels associated with the project should operate at "no wake/idle" speeds within the action area; and at all times while in waters where the draft of the vessel provides less than a 4-foot clearance from the bottom. Vessels should follow routes of deep water whenever possible.

4. If used, siltation or turbidity barriers should be properly secured and be monitored to avoid manatee entrapment or obstruction to their movement.

5. Temporary signs concerning manatees **must** be posted prior to and during all in-water project activities and then removed upon completion of in-water activities. Each vessel involved in construction activities **must** display a temporary sign at the vessel control station or in a prominent location, visible to all employees operating the vessel. The temporary sign must be at least 8½" x 11" reading language similar to the following: "CAUTION: MANATEE AREA. IDLE SPEED IS REQUIRED IN ACTION AREA AND WHERE THERE IS LESS THAN FOUR-FOOT BOTTOM CLEARANCE WHEN MANATEE IS PRESENT". A second temporary sign measuring 8½" x 11" **must** be posted at a location prominently visible to all personnel engaged in water-related activities and should read language similar to the following: "CAUTION: MANATEE AREA. EQUIPMENT **MUST** BE SHUTDOWN IMMEDIATELY IF A MANATEE COMES WITHIN 50 FEET OF VESSEL OPERATION".

6. Collisions with, injury to, or sightings of manatees **must** be immediately reported to the USFWS's Mobile, AL (251-441-5181) or Panama City, FL (850-769-0552) Ecological Services Office. Please provide the nature of the call (i.e., report of an incident, manatee sighting, etc.); time of incident/sighting; and the approximate location, including the latitude and longitude coordinates, if possible.



CAUTION:
MANATEE HABITAT



IDLE SPEED IS REQUIRED IF OPERATING A VESSEL IN THE CONSTRUCTION OR EVENT AREA

All equipment must be SHUTDOWN if a manatee comes within 50 FEET of operation

Report any collision with and/or injury to a manatee immediately to:

Dauphin Island Sea Lab's Manatee Sighting Network:

1-866-493-5803

and the U.S. Fish and Wildlife Service in Daphne, AL:

(251) 441-5839 or (251) 441-5181

MEMORANDUM OF AGREEMENT AMONG THE U.S. ARMY CORPS OF ENGINEERS, MOBILE DISTRICT, THE ALABAMA STATE HISTORIC PRESERVATION OFFICER, AND THE ALABAMA HISTORICAL COMMISION PURSUANT TO SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT CONCERNING THE ADVERSE EFFECTS TO HISTORIC PROPERTIES AS A RESULT OF PROPOSED SCIENTIFIC AND ARCHAEOLOGICAL INVESTIGATIONS (SAM-2018-01100-LET)

WHEREAS, the U.S. Army Corps of Engineers, Mobile District (Corps) plans to issue Department of the Army Permit(s) to the Alabama Historical Commission (AHC) to perform various investigations on the wreck *Clotilda* and authorize the dredging and discharge of dredged material into waters of the United States (WOTUS) pursuant to Section 404 of the Clean Water Act (33 U.S.C. 1344) and Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403); and

WHEREAS, the undertaking consists of the installation of water level meter(s) that will be left in place for the period of one (1) year following the 2022 field work; a biological assessment of the site's benthic zone; a structural assessment of the vessel's hull; a limited, targeted artifact excavation to recover diagnostic and/or exhibit-quality artifacts within a small area of the hold; a collection of wood samples for scientific analyses; the removal of trees caught or snagged on the wreck; and the development of an in situ Site Conservation Plan of the wreck *Clotilda* (1BA704). The wreck is located along the eastern bank of the east channel of the Mobile River which curves around Twelvemile Island, approximately four miles upriver from downtown Mobile in Baldwin County, Alabama; and

WHEREAS, the Corps has defined the permit area under Corps jurisdiction. This area included the WOTUS that will be temporarily and permanently impacted by the proposed work. The limits of the permit area are depicted on maps of the Project area (Appendix A); and

WHEREAS, the Corps has previously issued a Nationwide Permit (NWP) 6 in 2018 that allowed for the AHC to perform an exploratory survey that identified the *Clotilda* and other historic properties within and near the permit area; and

WHEREAS, the Corps also previously issued a NWP 5 & 6 in 2021 for the authorization to conduct environmental sampling in Mobile River in support of further investigations and coordinated with the Alabama State Historic Preservation Officer (ALSHPO) to reach a No Adverse Effect to historic properties determination (Appendix B); and

WHEREAS, in consultation with the ALSHPO, the Corps has determined that the *Clotilda* (1BA704) is eligible for listing in the National Register of Historic Places (NRHP) under Criteria A and D; and

WHEREAS, on November 8, 2021, the *Clotilda* (1BA704) was listed in the NRHP with national significance under Criteria A and D; and

WHEREAS, the *Clotilda* (1BA704) is located within The Twelvemile Island Ship Graveyard Historical and Archaeological District was listed in the NRHP on December 6, 2021 with statewide significance under Criterion D; and

WHEREAS, the Corps has determined that the proposed investigations and issuance of permit(s) would cause an adverse effect to the *Clotilda* (1BA704) and has consulted with the ALSHPO pursuant to 36 C.F.R. part 800 of the regulations implementing Section 106 of the National Historic Preservation Act (54 U.S.C. 306108); and

WHEREAS, the Corps has determined that the proposed investigations and issuance of permit(s) would not be an adverse effect to The Twelvemile Island Ship Graveyard Historical and Archaeological District and has consulted with the ALSHPO pursuant to 36 C.F.R. part 800 of the regulations implementing Section 106 of the National Historic Preservation Act (54 U.S.C. 306108); and

WHEREAS, in collaboration with the AHC, their contractor Resolve Marine Group (RESOLVE) and ALSHPO, the Corps has consulted with known descendants of the captives transported in the *Clotilda* (Descendants), identified community members of Africatown and other Stakeholders (Appendix C); and

WHEREAS, the Descendants, identified community members of Africatown and other Stakeholders have been invited to sign this document as Concurring Parties; and

WHEREAS, the Signatories and Concurring Parties, collectively will be considered the Consulting Parties for this MOA; and

WHEREAS, in accordance with 36 C.F.R. § 800.6(a)(1), the Corps has notified the Advisory Council on Historic Preservation (ACHP) of its adverse effect determination with specified documentation and the ACHP has chosen not to participate in the consultation pursuant to 36 CFR § 800.6(a)(1)(iii); and

WHEREAS, the AHC will ensure reasonable and prudent measures are implemented to prevent looting during the course of the studies for both on and off hours within USACE jurisdictional areas; and

WHEREAS, while onsite, the AHC, RESOLVE and the Corps will take action to prevent unauthorized boat traffic and onlookers to come within the previously established “No Boats Zone” (Appendix D); and

WHEREAS, no third-party observers outside of State or Federal oversight authorities shall be present without the express written permission of the AHC; and

WHEREAS, on site personnel will be limited to those with site specific safety training, personal protective equipment and skill sets directly related to the scientific assessment of the *Clotilda* (1Ba704); and

WHEREAS, outside inquiries, interests or visits must be coordinated with AHC and receive written approval at least 7 days of notice (operations permitting) and shall not interfere with onsite schedules or archeological activities; and

WHEREAS, a dive safety zone adhering to relevant Federal, State and Local ordinances shall be observed/enforced at all times while commercial/archeological divers are in the water;

NOW, THEREFORE, the Corps, AHC and the ALSHPO agree that the undertaking(s) shall be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking to historic properties.

Stipulations

I. Investigations

The Corps shall ensure that the following measures outlined below are carried out by RESOLVE on behalf of AHC.

A. Water Level Metering

A Hydro-Logic Flow Logger (HLFL) will be temporary mounted on either a pipe or small piling that will be environmentally neutral near 1Ba704. The HLFL is a precision flow meter that will transmit real-time measurements to a website through cellular data for live tracking of water movement in the river. The Hydro-Logic Timeview is a cloud-based server access where flow data is uploaded for real time monitoring. This system will allow archaeologists and AHC staff to view river conditions at the wreck site in real time throughout the course of a year.

B. Biological Assessment

The goal of the biological assessment is to determine the specific nature of biological colonization and the impacts these organisms have had on the shipwreck. Biological sampling and analysis will be conducted to establish a baseline understanding of the faunal factors impacting the site that will influence how artifacts and sections of the hull recovered during excavation will be conserved and curated. These data will help determine rates of chemical and physical deterioration, and what factors have influenced and impacted the site. Macrofauna will be sampled from the timbers on the shipwreck and meiofaunal analysis will be conducted from sediment cores. The cores collected for meiofauna will be preserved in ethanol while the cores collected for microbiology

will be frozen on site in a cooler with dry ice. Pollen analysis will also be conducted to determine the presence or absence of pollen species native to Africa in the samples from within the shipwreck.

C. Structural/Naval Architectural Assessment

Prior to field work commencing, an initial new high-resolution sonar survey will be undertaken at and in the shipwreck, inside the hold and off the bow and stern, and along the exposed port and starboard sides to map the condition of the shipwreck. That will be followed by an assessment by RESOLVE's commercial divers, with helmet-mounted cameras and surface communication to the consulting naval engineer and historical naval architect. If required, in consultation with the AHC and the Corps, the assessment will inform a plan of action by the project team to introduce temporary stabilizing elements to provide site and Diver safety. Methods may include wooden shoring, rigging for hold backs or physical connections such as a strapping plate.

Loose hull planking displaced from the hull by previous intrusion and or current (estimated to be c. 20 planks c. 4/5-in. thick and 14-in wide at varying lengths of 4 to 12 ft. in length) will be collected and will undergo stress testing while wet to determine the remaining structure integrity of the submerged hull. The recovery of these planks will also allow project conservators to assess the chemical and physical properties of the shipwreck's components through laboratory analysis; salinity, the process of the water-logging, and chemical deterioration of the cellular structure of the wood, the interaction of the wood with deteriorating copper and iron, and the presence of any contaminants that would influence the in-situ preservation of the shipwreck.

D. Archaeological Excavation and Artifact Recovery

Archaeologists will conduct a limited archaeological excavation inside the hold of *Clotilda*. The estimated area of excavation is from the forward bulkhead to 1 m. forward of it – i.e. seven one-meter units with an average depth after erosion of .75m, with sediment excavation done by hand-fanning into a small volume suction dredge that would empty screened sediments not captured in the small mesh bag at the outtake into an eroded void in the hold 2-3 meters forward of the excavation units. The excavation of sediment cannot exceed 25 cubic yards of material as allowed by NWP-19.

This excavation is intended to assess the nature and condition of ceiling (the bottom planking inside the hold) planking and the interface between the bulkhead and the ceiling. This is the space in which *Clotilda*'s captives were placed for the voyage to Alabama.

Archeologists will use the ARIS Defender 3000 hand-held sonar system to create a visual record in the limited to zero-visibility environment. The estimated depth of remaining sediment in the hold is approximately one meter in depth. Excavation is intended to conclude when the ceiling planking inside the hold is reached. In addition to the excavation inside the hull, archaeologists will map and then recover all disarticulated structural elements and artifacts (estimated to be c. 25 artifacts/structural remains such as planks) noted in previous investigation in the shallows along the starboard side of the shipwreck. These are known to include outer hull planks, a section of the iron bilge pump's intake tube, and a section of the centerboard/centerboard trunk. All artifacts will be taken to the project barge for documentation through photography, as well as scaled, measured drawings.

Terra Mare Conservation will conduct on on-barge condition assessment of objects temporarily excavated and brought to the surface from the wreck. The team will identify physical, biological, and corrosions risks in effect at the site, based on the materials analyzed. Examination of the degrees of corrosion and decay of wood will also be undertaken. This work will assist in determining the best preservation and conservation methods for the in-situ preservation of the shipwreck within the Mobile River environment.

In consultation with the AHC, artifacts brought to the surface for documentation and conservation assessment and analysis will be assessed for conservation and removal from the wreck. Factors will include retention and ongoing conservation of those artifacts if they are diagnostic or of exhibit quality and help physically tell the story of *Clotilda*'s final voyage and the people brought to Alabama in it against their will. Without knowing what specific artifacts or cultural materials may be encountered during this excavation and recovery, specific conservation details will be determined afterward for follow-up consultation and estimates by Terra Mare Conservation for full artifact conservation. Planning for long-term conservation requires advanced planning to identify the most suitable techniques for stabilization and long-term curation of the artifacts. Any artifacts recovered from the shipwreck during the process and not selected for retention and conservation will be repackaged in an environmentally neutral away and reburied within the shipwreck, likely in the more stable section of the ship's hold after excavation. As part of site stabilization, a minimal number of sandbags (c. 5 CY) might be placed on top of the timbers to retain them as part of in situ conservation of the wreck. If needed the sandbags will be made of either burlap or other natural/neutral fibers and be filled with local, culturally screened excavated material.

The AHC will provide the Corps with a weekly report including photos detailing the artifacts that are encountered, those that are removed from the wreck and those that are redeposited.

E. Wood Sampling

Samples (not to exceed ten) of the timbers from inside the hull, including from areas currently buried, for maritime conservation scientists to assess the level of chemical, biological, and physical deterioration. Previous work on site recovered 2-meter core samples from sediment inside the vessel to determine if human DNA could be found. Wood and sediment samples from the bottom of the hold and from the bilge, where evidence of human occupation may have collected on an extended voyage in close, overcrowded quarters.

F. Tree/Snag Removal

Trees or other woody masses which have floated and settled on the wreck will need to be removed for Diver and archeological site safety. These obstructions to the work site will be rigged and lifted via soft sling to the surface, examined by on site archeologists to ensure no reference to the wreck and placed in an area down flow and river from the work site to a spoil area (Appendix E).

G. Reporting and Site Conservation Plan.

The Corps shall ensure that all archaeological investigations undertaken in compliance with this MOA are conducted by qualified professional archaeologists that meet the Secretary of the Interior's Professional Qualification Standards and are recorded in a formal written report that meets the Secretary of the Interior's Standards and Guidelines for Archaeological and Historic Preservation (48FR 44716-740) and the Alabama Historical Commission Administrative Code, Chapter 460-x-9 Archaeological Investigations (2006).

1. The Consulting Parties shall be afforded thirty (30) calendar days to review and comment on all draft reports submitted in compliance with this MOA.

2. Within thirty (30) calendar days of the completion of the field investigations, a Management Summary will be provided to the Corps for review and comment. The Corps has thirty (30) calendar days from receipt in which to make comments and approve the Management Summary. Upon approval, the Corps will submit copies of the Management Summary to all Signatories. Concurring Parties will be provided AHC and Corps approved redacted versions.

3. Within one (1) calendar year from the date of the Corps' final approval of the Management Summaries, the AHC shall submit the completed draft final report(s) to the Corps. Upon approval, the Corps will submit redacted copies of the draft final report(s) to all Concurring Parties for review and comment. The final report(s) will incorporate editorial comments provided by the Consulting and Concurring Parties.

4. The AHC shall submit a digital copy of the final report(s) to the Corps. The Corps will submit one (1) printed copy and one (1) digital copy each to the ALSHPO. Concurring Parties will also receive a redacted copy of the final report(s).

5. RESOLVE, shall submit an updated Archaeological Site Survey Record for sites 1BA704 to both the Alabama State Archaeological Site File and the ALSHPO after the investigations are complete.

II. Treatment of Human Remains and Funerary Objects

No substantive evidence has been found that human remains, or funerary objects are present at site 1BA704.

A. If any human remains are encountered during the course of the investigation, the archaeological and/or construction contractor(s) shall cease all activities and notify the coroner or medical examiner, local law enforcement, ALSHPO, the Corps, and the AHC. The Corps shall also notify the Consulting Parties prior to resuming activities. After consultation, the AHC may grant a state permit to relocate the human remains, as outlined in state code (Code of Alabama 1975 13-A-7-23.1, as amended).

III. Post Review Discovery

Pursuant to 36 CFR 800.13(b), the Corps, in consultation with the ALSHPO, shall make a reasonable and good faith effort to avoid or minimize any adverse effects to newly identified NRHP eligible archaeological sites that may be discovered during the investigations. In the unlikely event that adverse effects to previously undiscovered NRHP eligible archaeological sites cannot be avoided or minimized, the Corps shall consult with AHC, the ALSHPO and Concurring Parties to resolve these adverse effects through execution of an amendment to this MOA.

A. In the event previously unidentified archaeological resources are discovered during the activities within the federal permit area, the construction contractor(s) shall cease all activities immediately within a 30-foot area around the resource. AHC or their contractors shall notify the Corps within 24 hours of the discovery and shall take appropriate steps to immediately secure and protect the site.

B. The AHC shall retain the services of a professional archaeologist(s) meeting the Secretary of the Interior's standards to undertake any necessary investigation to provide as much information as possible concerning the cultural resource, such as resource type, location, and size, as well as any information on its significance. The investigation will be done in consultation with the Corps, ALSHPO and other Concurring Parties in order to obtain technical advice and

guidance for the evaluation of the discovered cultural resource(s). Any investigation undertaken would follow all appropriate procedures for investigations and reporting requirements under applicable State and Federal requirements, including determinations of eligibility and the curation of recovered materials.

C. The investigation will evaluate the resource's eligibility for inclusion in the NRHP. The results of the investigation will be formally submitted to the Corps archaeologist, the ALSHPO and other appropriate review agencies for review and comment. The reviewing agencies shall be afforded two (2) business days (not including Federal/State holidays) to review and comment on the documents associated with unanticipated discoveries. All documents produced as a result of an unanticipated discovery will be distributed to the reviewing agencies and parties electronically via email.

D. If it is determined that the cultural resource does not represent a potentially significant resource, and the Corps archaeologist is in receipt of a written comment from the reviewing agencies, work may resume in the area of the unanticipated discovery.

E. In the event archaeological or cultural materials are discovered during the project undertaking, neither the construction team nor the applicant will disclose this information to the public or the media in any manner, including social media. Discoveries of archaeological materials will be kept private and confidential.

IV. Administrative Conditions

A. This MOA will be null and void if its terms are not carried out within five (5) years from the date of its execution. Prior to such time, the Corps may consult with the other signatories to reconsider the terms of the MOA and amend it in accordance with 36 CFR § 800.6(c).

B. Following the execution of this MOA until it is complete, expires or is terminated, AHC shall provide weekly fieldwork summaries to all Signatories to this MOA detailing work undertaken pursuant to its terms. The notification shall include any scheduling changes proposed, any problems encountered, and any disputes and objections received in the Corps' efforts to carry out the terms of this MOA.

C. Should any Signatories to this MOA object at any time to any actions proposed or the manner in which the terms of this MOA are implemented, the Corps shall consult with such party to resolve the objection(s). If the Corps determines that such objection cannot be resolved, the Corps shall forward all documentation relevant to the dispute, including the Corps proposed resolution to the ACHP. The ACHP shall provide the Corps with its advice on the resolution of the objection within thirty (30) calendar days of receiving adequate documentation. If the ACHP does not provide its advice regarding the dispute within the thirty (30)

calendar days, the Corps may make a final decision on the dispute and proceed accordingly. Prior to reaching such a final decision, the Corps shall prepare a written response that takes into account any timely comments regarding the dispute from the Signatories to the MOA and provide them and the ACHP with a copy of such written response.

D. If any Signatory to this MOA determines that its terms will not or cannot be carried out, that party shall immediately consult to seek an amendment to the MOA. Agreed to amendments will be effective on the date a copy signed by all of the signatories is filed with the ACHP. If the MOA is not amended, any Signatory may terminate the MOA. If the MOA is terminated, the Corps shall either execute a new agreement with the Signatories pursuant to 36 CFR § 800.6(c)(1) or request the comments of the ACHP pursuant to 36 CFR 800.7(a). The Corps shall notify the Signatories as to the course of action it will pursue.

E. The Signatories and Consulting Parties to this MOA acknowledge that historic properties are subject to the provisions of Section 304 of the NHPA (54 U.S.C. § 307103) and 36 C.F.R. § 800.11(c), relating to the disclosure of information about the location, character, or ownership of a historic property, and will ensure that any disclosure of information under this MOA is consistent with the terms of this MOA and with Section 304 of the NHPA, 36 C.F.R. § 800.11(c), and the Freedom of Information Act (5 U.S.C. § 552). Confidentiality regarding the specific nature and location of archaeological sites and any other cultural resources discussed in this MOA shall be maintained to the extent allowable by law. Dissemination of such information shall be limited to appropriate personnel within the Corps, the Signatories, Consulting Parties, Concurring Parties and those parties involved in planning, reviewing, and implementing this MOA.

F. The Corps' obligations under this MOA are subject to the availability of appropriated funds, and the stipulations of this MOA are subject to the provisions of the Anti-Deficiency Act. The Corps shall make reasonable and good faith efforts to secure the necessary funds to implement this MOA in its entirety. If compliance with the Anti-Deficiency Act alters or impairs the Corps' ability to implement the stipulations of this MOA, the Corps shall consult in accordance with the amendment and termination procedures found in this MOA.

G. All notices, demands, requests, consents, approvals, or communications from any or all Consulting Parties to this MOA to other Concurring Parties to this MOA shall be either personally delivered, sent by United States Mail, or electronic mail, and all parties shall be considered to be in receipt of the materials five (5) calendar days after deposit in the United States mail or on the day after being sent by electronic mail. If the Signatories agree in advance, in writing or by electronic mail, the Corps may use facsimiles, copies, electronic signatures or electronic versions of signed documents as if they bore original signatures. The Corps will use electronic versions of the management summaries, reports,

research designs, and other documents instead of hard copies for distribution and review.

H. This MOA shall take effect on the date that it has been fully executed by the Corps, the ALSHPO, and AHC.

I. This MOA may be executed contemporaneously in one or more counterparts, each of which shall be deemed an original, but all of which shall together constitute one and the same document.

Execution of this MOA by the Corps, the ALSHPO, and AHC, and implementation of its terms, is (or shall be) evidence that the Corps has taken into account the effects of the undertaking on historic properties in compliance with Section 106 of the National Historic Preservation Act.

Signatory:

U.S. Army Corps of Engineers, Mobile District

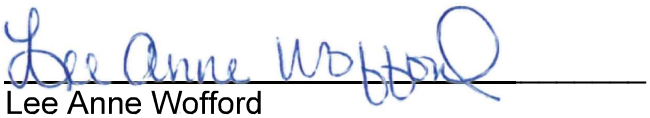


Trevor E. Popkin
Acting Chief, Regulatory Division

29 March 2022
(Date)

Signatory:

Alabama State Historic Preservation Officer



Lee Anne Wofford
Deputy State Historic Preservation Officer

March 28, 2022
(Date)

Signatory:

Alabama Historical Commission

Lisa D. Jones
Executive Director

3.25.2022
(Date)

Concurring Parties:

Descendants, Identified Community Members & Stakeholders

[signature]	3/17/2022 (Date)
Angela M. Jones	3-17-2022 (Date)
	(Date)
	(Date)
	(Date)
	(Date)
	(Date)
	(Date)
	(Date)
	(Date)
	(Date)
	(Date)
	(Date)
	(Date)



Concurring Parties:

Descendants, Identified Community Members & Stakeholders

_____	_____ (Date)
Kristine L. Dawson	3/17/2022 (Date)
_____	_____ (Date)
_____	_____ (Date)
_____	_____ (Date)
_____	_____ (Date)
_____	_____ (Date)
_____	_____ (Date)
_____	_____ (Date)
_____	_____ (Date)
_____	_____ (Date)
_____	_____ (Date)
_____	_____ (Date)
_____	_____ (Date)

Concurring Parties:

Descendants, Identified Community Members & Stakeholders


Yorktown Baptist Church 03/21/2022 (Date)

_____ _____ (Date)

_____ _____ (Date)

_____ _____ (Date)

_____ _____ (Date)

_____ _____ (Date)

_____ _____ (Date)

_____ _____ (Date)

_____ _____ (Date)

_____ _____ (Date)

_____ _____ (Date)

_____ _____ (Date)

_____ _____ (Date)

Concurring Parties:

Descendants, Identified Community Members & Stakeholders

Sec'y CDA
KEEBY FAMILY

3-15-22 (Date)

(Date)

(Date)

(Date)

(Date)

(Date)

(Date)

(Date)

(Date)

(Date)

(Date)

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(Date)

(Date)

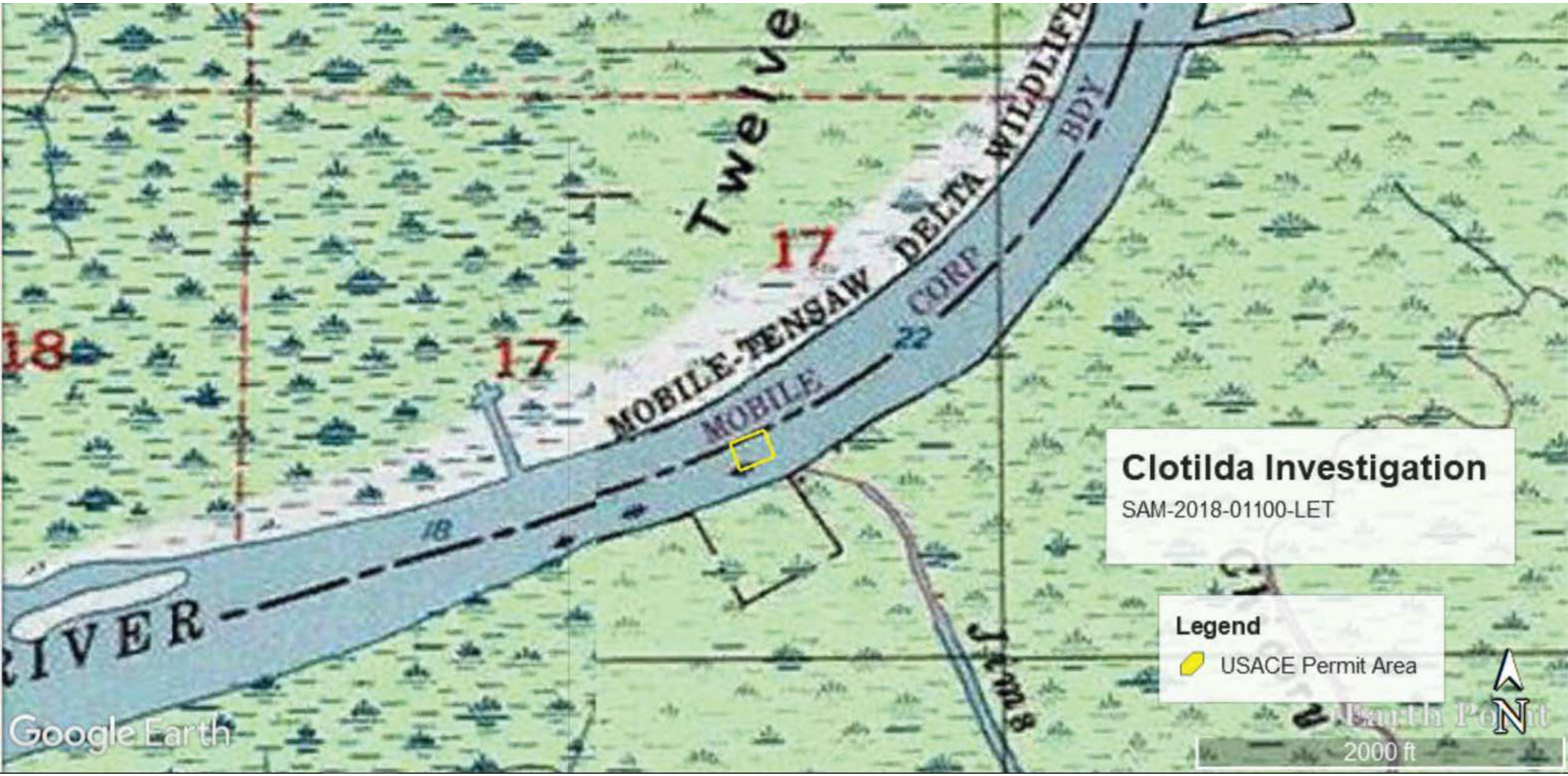
Scanned with CamScanner

Appendix A

Map of Permit Area / Area of Potential Effects


Mobile River
Clotilda Investigation
SAM-2018-01100-LET
Legend
USACE Permit Area
N
300 ft
Google Earth


Clotilda Investigation
SAM-2018-01100-LET
Legend
USACE Permit Area
N
2000 ft
Google Earth


Twelve
17
17
18
MOBILE-TENSAW DELTA WILDLIFE
CORP
BDY
22
MOBILE
18
IVER
Clotilda Investigation
SAM-2018-01100-LET
Legend
USACE Permit Area
N
2000 ft
Google Earth

Appendix B

SHPO Response Letters

ALABAMA HISTORICAL COMMISSION

468 South Perry Street
Montgomery, Alabama 36130-0900

Lisa D. Jones
Executive Director
State Historic Preservation Officer

Tel: 334-242-3184
Fax: 334-242-1083

August 27, 2021

Dylan Hendrix
Corps of Engineers
P.O. Box 2288
Mobile, AL 36628-0001

Re: AHC 21-1170
Clotilda - Environmental Sampling-SAM-2018-01100-LET
Baldwin County

Dear Mr. Hendrix:

Upon review of the above-referenced project, it is our opinion that the undertaking will have no adverse effect on historic properties.

We appreciate your commitment to helping us preserve Alabama's non-renewable resources. Should you have any questions, the point of contact for this project is Eric Sipes at 334.230.2667 or Eric.Sipes@ahc.alabama.gov. Please have the AHC tracking number referenced above available and include it with any correspondence.

Sincerely,

Lee Anne Wofford
Deputy State Historic Preservation Officer

LAW/es

ALABAMA HISTORICAL COMMISSION

468 South Perry Street
Montgomery, Alabama 36130-0900

Lisa D. Jones
Executive Director
State Historic Preservation Officer

Tel: 334-242-3184
Fax: 334-242-1083

January 4, 2022

Dylan Hendrix
Corps of Engineers
P.O. Box 2288
Mobile, AL 36628

Re: AHC 22-0217
Clotilda Hull Investigation
Baldwin County

Dear Mr. Hendrix:

Upon review of the materials submitted for the above referenced permit application, we find that we agree with your finding that the proposed investigations at the shipwreck Clotilda (1BA704) may represent a potential adverse effect upon this historic property. We further agree that the investigations will have no adverse effect upon the surrounding Twelve Mile Island Ship Graveyard Historical and Archaeological District. We look forward to continuing consultation on the Memorandum of Agreement to resolve the adverse effect to the Clotilda (1BA704).

We appreciate your commitment to helping us preserve Alabama's historic archaeological and architectural resources. Should you have any questions, please contact Eric Sipes at 334.230.2667 or Eric.Sipes@ahc.alabama.gov. Have the AHC tracking number referenced above available and include it with any future correspondence.

Sincerely,

Lee Anne Wofford
Deputy State Historic Preservation Officer

LAW/EDS/WJL/AMH/eds

January 18, 2022

Mr. Timothy Dodson, M.A., RPA
Archaeologist
U.S. Army Corps of Engineers
Regulatory Division (Nashville & Mobile Districts)
3701 Bell Road
Nashville, Tennessee 37214

Ref: *Shipwreck Clotilda Investigation*
Baldwin County, Alabama
SAM-2018-01100-LET
ACHP Project Number: 17873

Dear Mr. Dodson:

On January 7, 2022 the Advisory Council on Historic Preservation (ACHP) received your notification and supporting documentation regarding the potential adverse effects of the referenced undertaking on a property or properties listed or eligible for listing in the National Register of Historic Places. Based upon the information you provided, we have concluded that Appendix A, Criteria for Council Involvement in Reviewing Individual Section 106 Cases, of our regulations, "Protection of Historic Properties" (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act, does not apply to this undertaking. Accordingly, we do not believe our participation in the consultation to resolve adverse effects is needed.

However, if we receive a request for participation from the State Historic Preservation Officer, Tribal Historic Preservation Officer, affected Indian tribe, a consulting party, or other party, we may reconsider this decision. Should the undertaking's circumstances change, consulting parties cannot come to consensus, or you need further advisory assistance to conclude the consultation process, please contact us.

Pursuant to Section 800.6(b)(1)(iv), you will need to file the final Section 106 agreement document (Agreement), developed in consultation with the Alabama State Historic Preservation Office and any other consulting parties, and related documentation with the ACHP at the conclusion of the consultation process. The filing of the Agreement and supporting documentation with the ACHP is required in order to complete the requirements of Section 106 of the National Historic Preservation Act.

Thank you for providing us with your notification of adverse effect. If you have any questions or require our further assistance, please contact Ms. Emily Choi at (202) 517-0207 or by email at echoi@achp.gov and reference the ACHP Project Number above.

Sincerely,

LaShavio Johnson

LaShavio Johnson
Historic Preservation Technician
Office of Federal Agency Programs

Appendix C

List of Stakeholders, Descendants, Africatown Community

Name	Email	Affiliation
Stacye Hathorn	Stacye.Hathorn@ahc.alabama.gov	AHC
Lisa Jones	Lisa.Jones@ahc.alabama.gov	AHC
Clara Nobles	Clara.Nobles@ahc.alabama.gov	AHC
Eric Sipes	Eric.Sipes@ahc.alabama.gov	AHC (106)
Amanda McBride	Amanda.McBride@ahc.alabama.gov	AHC (106)
Dylan Hendrix	Dylan.C.Hendrix@usace.army.mil	USACE
Craig Littleken	Craig.J.Litteken@usace.army.mil	USACE
Tim Dodson	Timothy.S.Dodson@usace.army.mil	USACE
Sheri Zettle	Sheri.M.Zettle@usace.army.mil	USACE
Aaron Jozsef	ajozsef@resolvemarine.com	RESOLVE
Jonathan Burke	jburke@resolvemarine.com	RESOLVE
Jame Delgado	James.Delgado@searchinc.com	SEARCH
Meg Fowler	meg.fowler@historymuseumofmobile.com	Mobile History Museum
Christine Dawson	christine.dawson@cityofmobile.org	City of Mobile
Mary Elliott	elliottM@si.edu	Smithsonian
Joe Womack	jnwomack1@yahoo.com	Descendant/Africatown Member
Andersen Flen	aflen3@yahoo.com	Descendant/Africatown Member
Cleon & Angela Jones	angelacleon.jones@hotmail.com	Descendant/Africatown Member
Pastor Chris Williams	pastorymbc@bellsouth.net	Descendant/Africatown Member
Pastor Brady	pastorbrady001@aol.com	Descendant/Africatown Member
Darron Patterson	info@theclotildastory.com	Descendant/Africatown Member
Pastor Derek Tucker	derek.tucker38@gmail.com	Union Baptist Church of Africatown
Greg Stephens	gregbstepn@bellsouth.net	Africatown Heritage Preservation Foundation
Liz Smith-Incer	liz_smith-incer@nps.gov	National Park Service
Curtis Flakes	curtisf387@gmail.com	Descendant/Africatown Member
George Crozier	gcrozier@disl.org	Descendant/Africatown Member
Mary Mullins	mmullins@mpactpublicaffairs.com	Africatown Business and Community Panel
Jeremy Ellis	jeremydionellis@gmail.com	Descendant/Africatown Member
Joycelyn Davis	joycelyn.davis813@gmail.com	Descendant/Africatown Member
Bill Green	treasurer@theclotildastory.com	Descendant/Africatown Member
Clarence Wall	secretary@theclotildastory.com	Descendant/Africatown Member

From:	Dodson, Timothy (Tim) CIV USARMY CELRN (USA)
To:	Nobles, Clara
Cc:	Hendrix, Dylan C CIV USARMY CESAM (USA); Sipes, Eric; James Delgado; Litteken, Craig J CIV USARMY CESAM (USA); meg.fowler@historymuseumofmobile.com; christine.dawson@cityofmobile.org; elliottM@si.edu; Aaron Jozsef; Zettle, Sheri M CIV USARMY CESAM (USA); jnwomack1@yahoo.com; aflen3@yahoo.com; angelacleon.jones@hotmail.com; pastorymbc@bellsouth.net; pastorbrady001@aol.com; info@theclotildastory.com; writestuff@att.net; Jones, Lisa
Subject:	Clotilda Update and Africatown Contacts and MOA Consultation
Date:	Wednesday, December 22, 2021 10:02:00 AM

Good morning Clara,

I hope this email finds you well and that you will be able to spend the upcoming holidays with your family and loved ones.

As you are aware, the U.S. Army Corps of Engineers (USACE) is the lead federal agency for the upcoming work on the Clotilda.
As a part of the upcoming studies, the USACE is drafting a Memorandum of Agreement (MOA) that will fulfill our National Historic Preservation Act (NHPA) responsibilities and is required to consult with stakeholders on the proposed work.
In discussions with other AHC staff and the contractors that were awarded the RFP, they instructed me to reach out to you as you have established connections with the descendant community and Africatown. The USACE would like to get your input as how to best communicate our involvement and distribute the MOA for the descendant community to review and if choose so sign as a concurrent party.

Based on the last email you sent me this September the following contacts listed below were recommended:

Joe Womack jnwomack1@yahoo.com
Andersen Flen aflen3@yahoo.com
Cleon & Angela Jones angelacleon.jones@hotmail.com
Pastor Chris Williams pastorymbc@bellsouth.net
Pastor Brady pastorbrady001@aol.com
Darron Patterson info@theclotildastory.com; writestuff@att.net

Is this still correct? Do you recommend anyone else? What would be the best manner in insuring that the draft MOA gets distributed? I have included them in this email as well.

Do you (or anyone else) think having a in person meeting in Africatown would be the best way to communicate the USACE's involvement and seek opinions? Due to the anticipated fieldwork being conducted in March, if a meeting should be beneficial, then we would like to schedule it sometime between January 10-21, 2022.

Additionally, the USACE is including in this email contacts from the History Museum of Mobile and the Mobile Historic Development Commission as they have been involved in past with the archaeological work and the National Register of Historic Places Nominations for Africatown and the Clotilda. Mary Elliot from the National Museum of African American History and Culture is also being

included as a result of past involvement.

I hope everyone has a Happy Holiday and look forward to our continued communication.

As always, please feel free to reach out to me with any questions or concerns.

Thanks,

Tim

Timothy Dodson, M.A., RPA
Archaeologist
Regulatory Division (Nashville & Mobile Districts) U.S. Army Corps of Engineers
3701 Bell Road
Nashville, Tennessee 37214
(Office) 615-369-7512
(Cell) 615-336-2173
(Fax) 615-369-7501

From:	Dodson, Timothy (Tim) CIV USARMY CELRN (USA)
To:	meg.fowler@historymuseumofmobile.com; christine.dawson@cityofmobile.org; elliottM@si.edu; jnwomack1@yahoo.com; aflen3@yahoo.com; angelacleon.jones@hotmail.com; pastorymbc@bellsouth.net; pastorbrady001@aol.com; Clotilda Story; Derek Tucker; gregbstephn@bellsouth.net; liz_smith-incer@nps.gov; curtisf387@gmail.com; gcrozier@disl.org
Cc:	Hendrix, Dylan C CIV USARMY CESAM (USA); Litteken, Craig J CIV USARMY CESAM (USA); Zettle, Sheri M CIV USARMY CESAM (USA); Sipes, Eric; McBride, Amanda; Hathorn, Stacye; James Delgado; Aaron Jozsef; Nobles, Clara; Jones, Lisa; jburke@resolvemarine.com
Subject:	USACE Consultation Meeting for the Memorandum of Agreement for Clotilda Archaeological and Scientific Studies_Second Email
Date:	Tuesday, January 11, 2022 2:52:00 PM

Good morning and Happy New Year!

I hope this email finds everyone safe and well. If you are included in this email, you responded or were asked on behalf of someone to be included in the consultation meeting(s) that will occur regarding the upcoming archaeological and scientific studies on the shipwreck *Clotilda*.
The U.S. Army Corps of Engineers (USACE) is the lead federal agency for the upcoming work on the *Clotilda* and is in the process of drafting a Memorandum of Agreement (MOA) that will fulfill our National Historic Preservation Act (NHPA) responsibilities. The USACE sent out an initial email on December 23, 2021 requesting contact information of individuals and originations that might or would be interested in sharing information, providing comments and ideas that would facilitate the production of a MOA. This information was requested as the USACE would like to schedule a meeting to get feed back on the Draft MOA and answer any questions. The USACE anticipates that a Draft MOA will be sent out the week of January 24th. The USACE would like to set up a meeting with everyone the first week of February. How does February 3, 2022 sound?
Due to the latest wave of COVID-19, the USACE wanted to solicitate opinions from the group about how to best facilitate this meeting. The USACE can facilitate in-person, virtual or hybrid meetings. Please respond to the group on your preferred method/opinion.
Once we receive several responses, I will send a follow up email.
Please let me know if you have any questions or concerns regarding the upcoming process. I am available anytime via email and at the cell number listed below.
I look forward in working with you all on this important project.

Speak soon,

Tim

Timothy Dodson, M.A., RPA
Archaeologist
Regulatory Division (Nashville & Mobile Districts) U.S. Army Corps of Engineers
3701 Bell Road
Nashville, Tennessee 37214
(Office) 615-369-7512
(Cell) 615-336-2173
(Fax) 615-369-7501

Dodson, Timothy (Tim) CIV USARMY CELRN (USA)

From: Dodson, Timothy (Tim) CIV USARMY CELRN (USA)
Sent: Friday, January 28, 2022 2:34 PM
To: Hathorn, Stacye; Jones, Lisa; Nobles, Clara; Sipes, Eric; McBride, Amanda; Hendrix, Dylan C CIV USARMY CESAM (USA); Litteken, Craig J CIV USARMY CESAM (USA); Dodson, Timothy (Tim) CIV USARMY CELRN (USA); Zettle, Sheri M CIV USARMY CESAM (USA); Landry, Thomas G CIV USARMY CESAM (USA); Aaron Jozsef; jburke@resolvemarine.com; James Delgado; meg.fowler@historymuseumofmobile.com; christine.dawson@cityofmobile.org; elliottM@si.edu; jnwomack1@yahoo.com; aflen3@yahoo.com; angela jones; pastorymbc@bellsouth.net; pastorbrady001@aol.com; Clotilda Story; Derek Tucker; gregbstephn@bellsouth.net; liz_smith-incer@nps.gov; curtisf387@gmail.com; gcrozier@disl.org; mmullins@mpactpublicaffairs.com
Subject: Proposed Scientific and Archaeological Investigations on the wreck Clotilda (1BA704) Consultation Meeting
Attachments: Feb_4 USACE Meeting Agenda.pdf; Draft_USACE_Mobile_Dist_MOU_Clotilda_Draft_28Jan22.pdf

Importance: High

Good afternoon,

We have scheduled a virtual meeting on **Thursday February 3, 2022, between 2-4 p.m. CST** to discuss the proposed scientific and archaeological investigations on the wreck *Clotilda*. Please see attachments and feel free to provide any additional information or comments to me prior to the meeting. USACE File SAM-2018-01100-LET.

To join the meeting, click or copy/paste the following link into your browser:
https://usace1.webex.com/meet/dylan.c.hendrix
(if you do not have a Webex account, you may select "Join from your browser" when prompted)

1) Enter your name and email.
2) Enable audio/video when prompted (you may be prompted more than once).
3) Select the type of audio connection:
- DO NOT use the Computer Audio (microphone/speakers) setting, as this causes feedback issues.
- Select the "Call Me" option, and enter your telephone number;
- or, Select the "Dial In" option (a prompt will appear with the US Toll Free number, Access Code, and Attendee ID)
4) Click "Join Meeting" to be connected.
5) Unless actively speaking, please mute your audio to avoid feedback.

To join by telephone only, call 1-844-800-2712, enter access code 199 028 9592 and press "#", then press "#" again when prompted for an attendee ID.

Please let me know if you have any questions or concerns.

Looking forward in speaking with all of you next week.

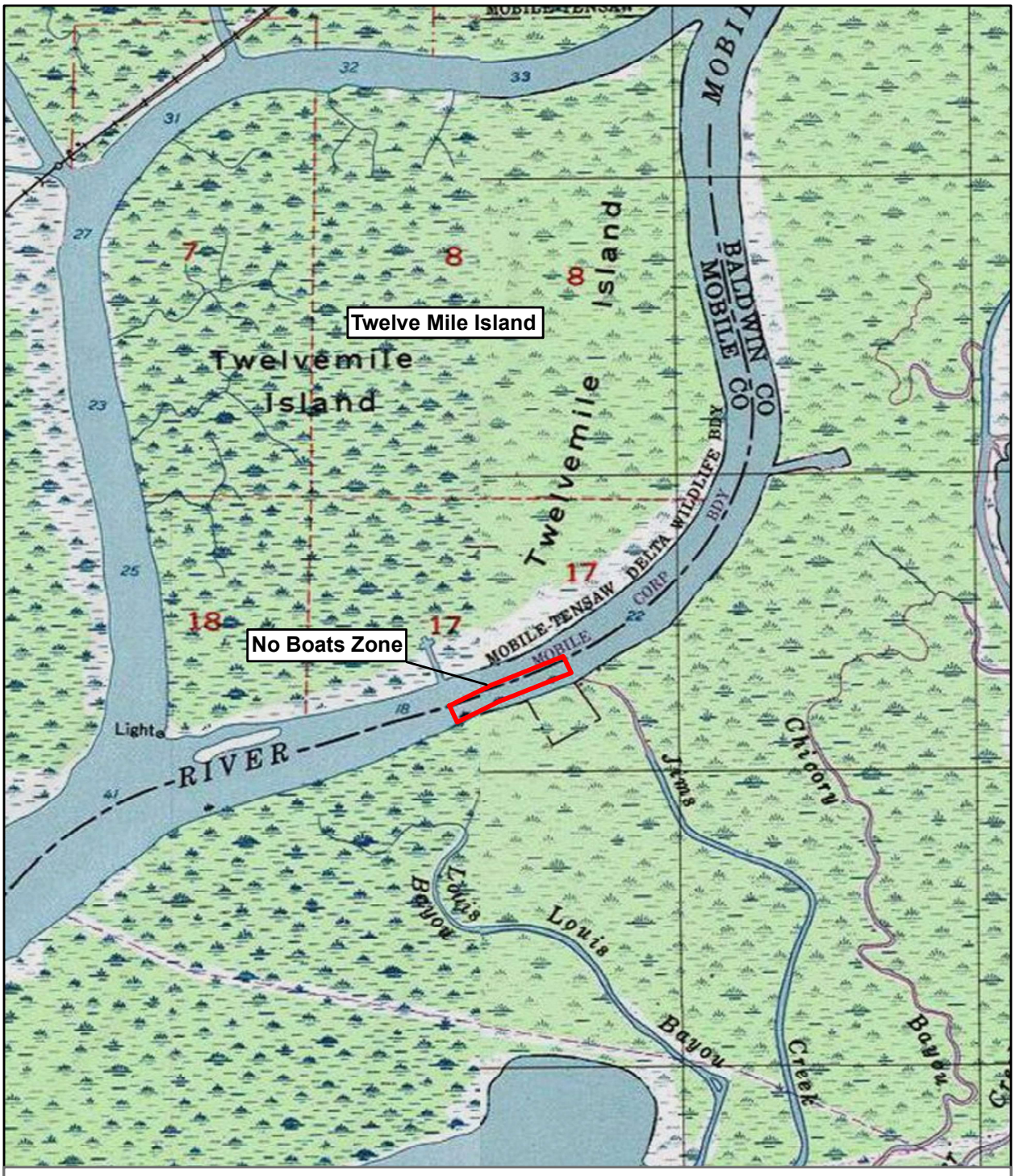
Tim

Timothy Dodson, M.A., RPA
Archaeologist
Regulatory Division (Nashville & Mobile Districts) U.S. Army Corps of Engineers
3701 Bell Road

Nashville, Tennessee 37214
(Office) 615-369-7512
(Cell) 615-336-2173
(Fax) 615-369-7501

Appendix D

No Boat Zone Map



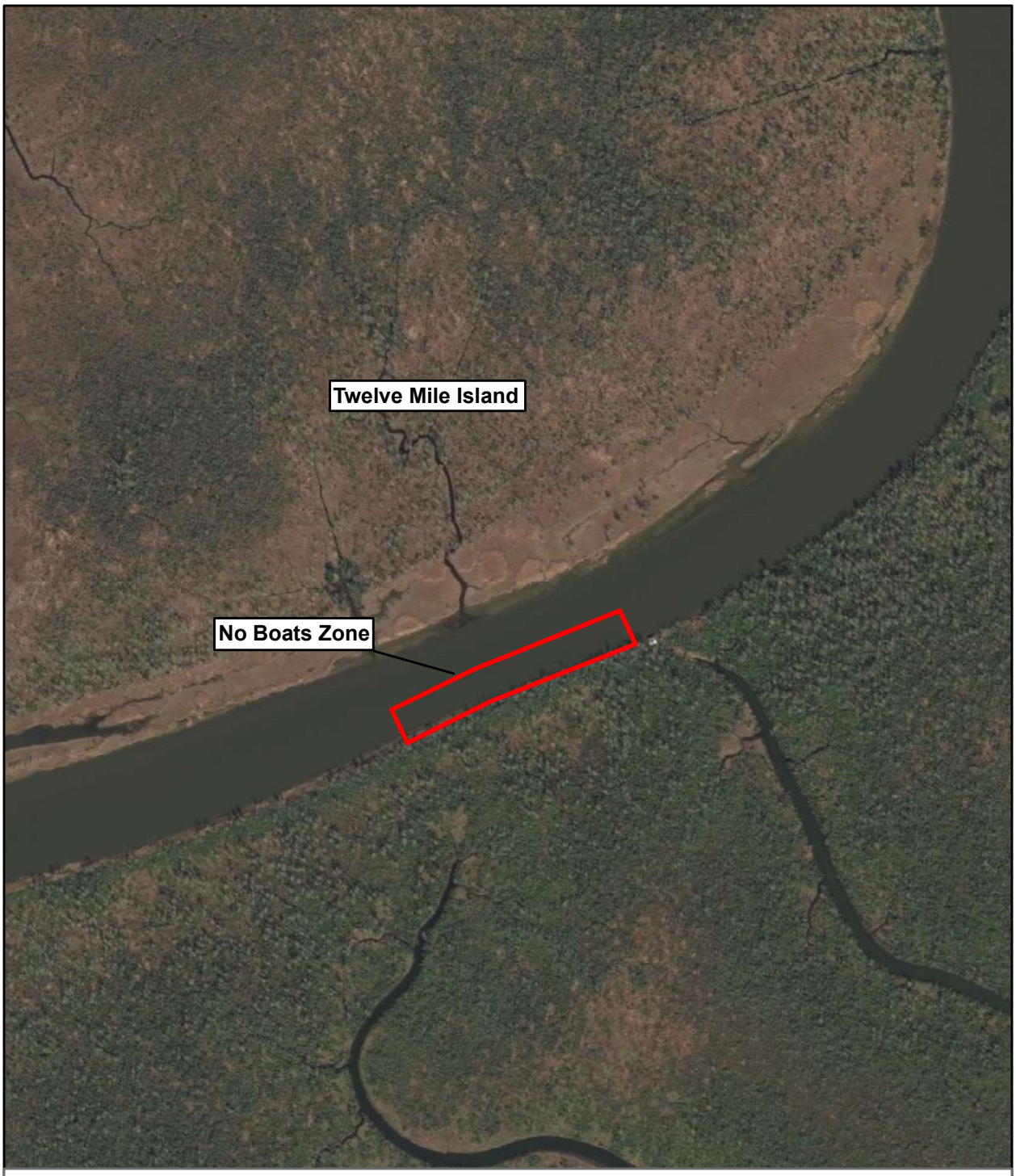
Alabama Historical Commission

Clotilda Site (1Ba704) - ALEA Established No Boats Zone

No Boat Zone

N

0 1,000 2,000 Feet



Alabama Historical Commission

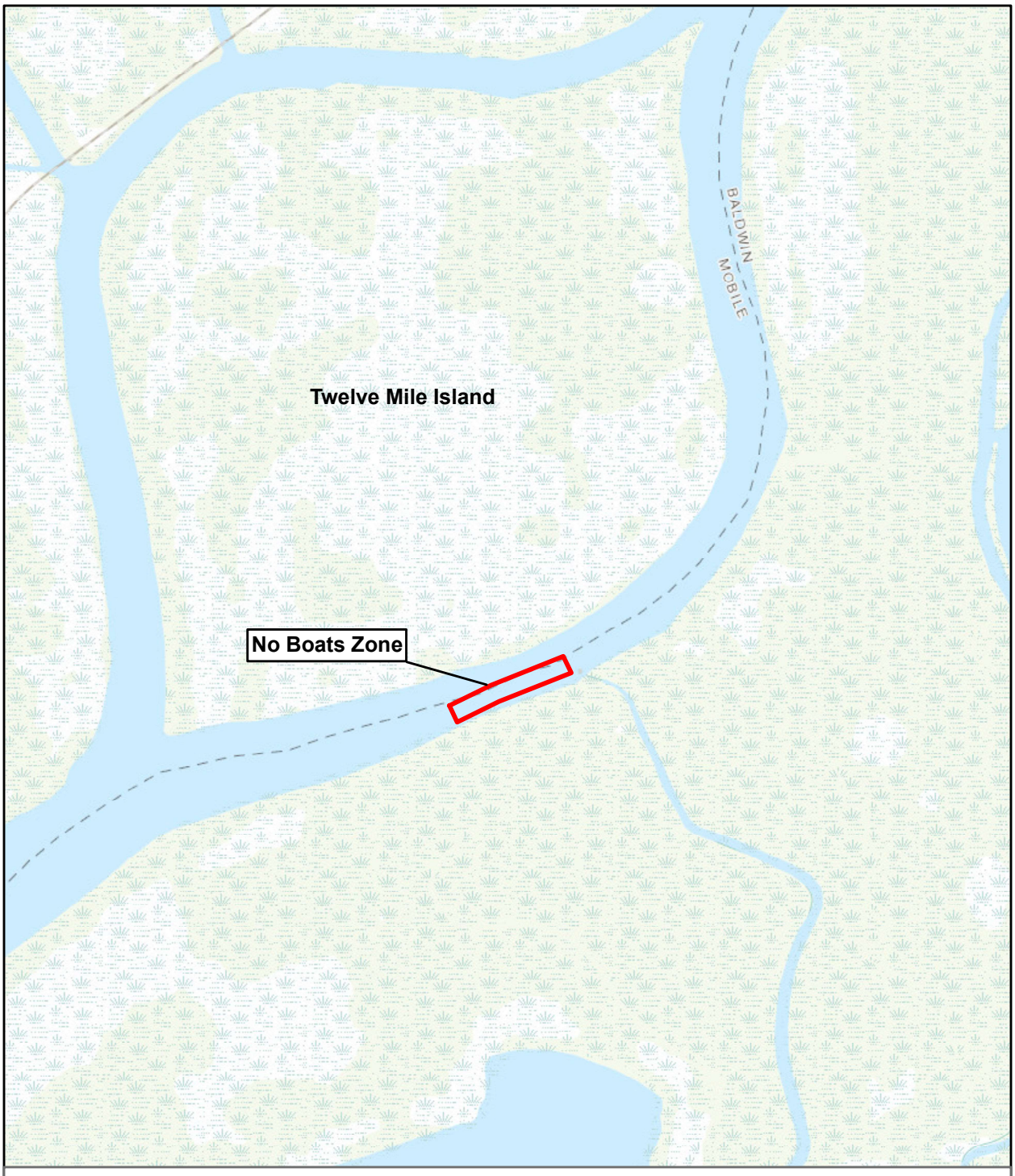
Clotilda Site (1Ba704) - ALEA Established No Boats Zone

No Boat Zone

N

0 500 1,000

Feet



Alabama Historical Commission

Clotilda Site (1Ba704) - ALEA Established No Boats Zone

No Boat Zone

N

0 1,000 2,000

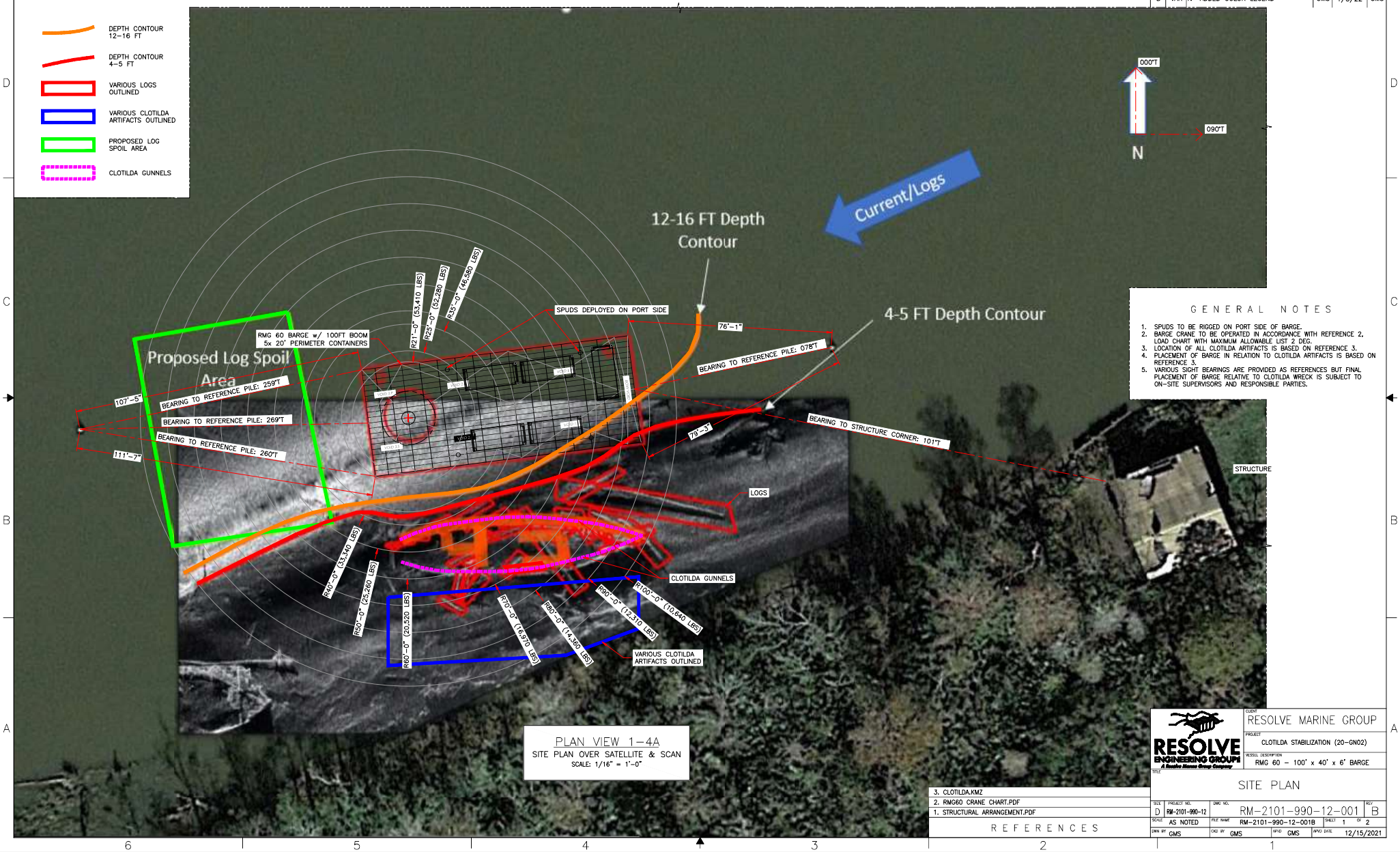
Feet

Appendix E

Tree and Snag Removal Diagram

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REVISIONS					
REV	ZONE	DESCRIPTION	DWN	DATE	APVD
A	VAR	1. ADDED CLOTILDA DEBRIS BOX.	GMS	12/16/21	GMS
B	VAR	1. ADDED COLOR LEGEND	GMS	1/3/22	GMS



GENERAL NOTES

1. SPUDS TO BE RIGGED ON PORT SIDE OF BARGE.
2. BARGE CRANE TO BE OPERATED IN ACCORDANCE WITH REFERENCE 2, LOAD CHART WITH MAXIMUM ALLOWABLE LIST 2 DEG.
3. LOCATION OF ALL CLOTILDA ARTIFACTS IS BASED ON REFERENCE 3.
4. PLACEMENT OF BARGE IN RELATION TO CLOTILDA ARTIFACTS IS BASED ON REFERENCE 3.
5. VARIOUS SIGHT BEARINGS ARE PROVIDED AS REFERENCES BUT FINAL PLACEMENT OF BARGE RELATIVE TO CLOTILDA WRECK IS SUBJECT TO ON-SITE SUPERVISORS AND RESPONSIBLE PARTIES.

PLAN VIEW 1-4A
SITE PLAN OVER SATELLITE & SCAN
SCALE: 1/16" = 1'-0"

REFERENCES

3. CLOTILDA.KMZ
2. RMG60 CRANE CHART.PDF
1. STRUCTURAL ARRANGEMENT.PDF

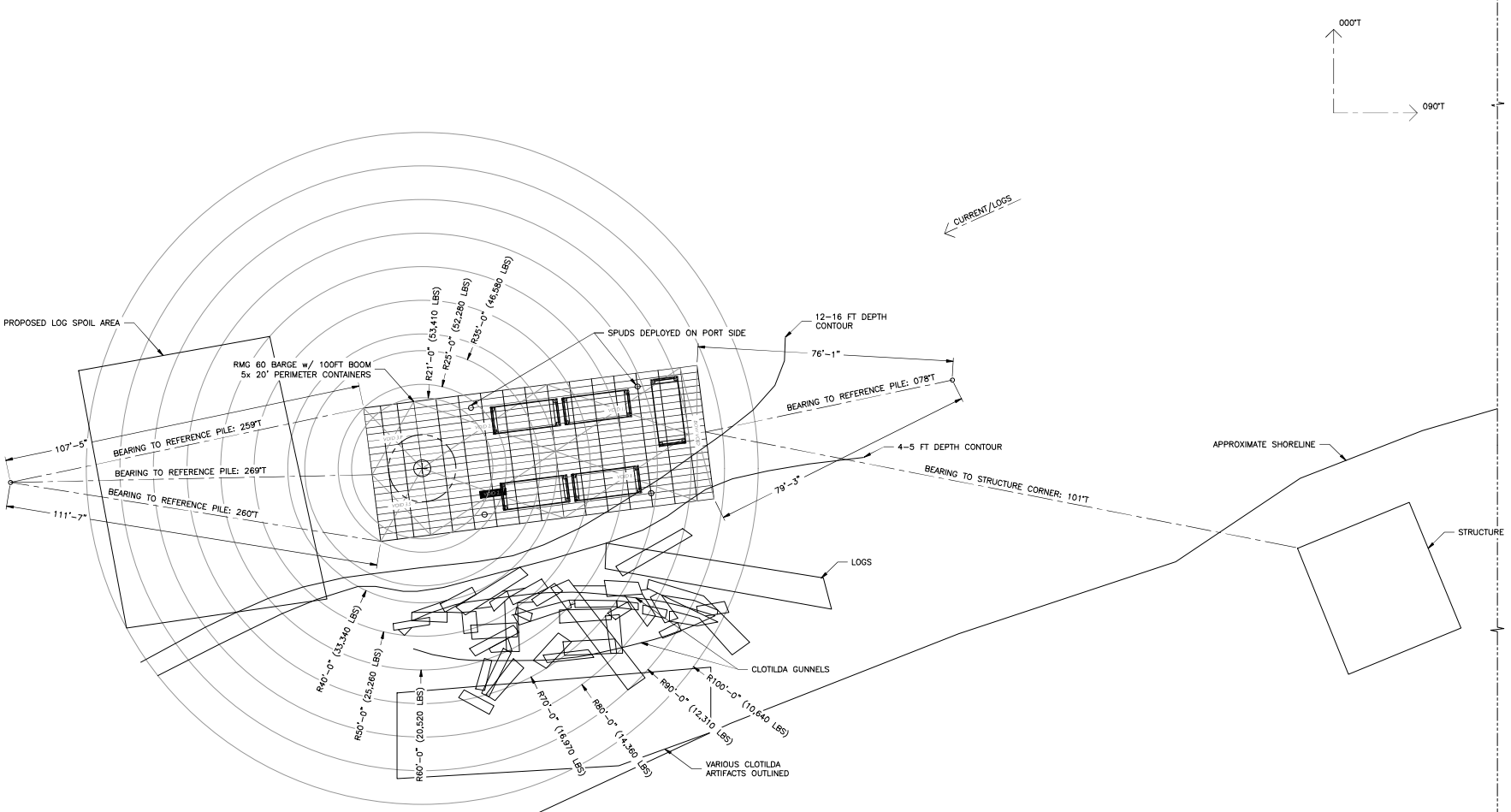
RESOLVE ENGINEERING GROUP
A Resolve Marine Group Company

CLIENT: RESOLVE MARINE GROUP
PROJECT: CLOTILDA STABILIZATION (20-GN02)
VESSEL DESCRIPTION: RMG 60 – 100' x 40' x 6' BARGE
TITLE: SITE PLAN

SIZE	PROJECT NO.	DWG NO.	REV
D	RM-2101-990-12	RM-2101-990-12-001	B

SCALE	FILE NAME	SHEET
AS NOTED	RM-2101-990-12-001B	1 OF 2

DWN BY	CKD BY	APVD	APVD DATE
GMS	GMS	GMS	12/15/2021



PLAN VIEW 2-4A

SITE PLAN

SCALE: 1/16" = 1'-0"

SIZE	PROJECT NO.	DWG NO.	REV
D	RM-2101-990-12	RM-2101-990-12-001	B
SCALE	AS NOTED	FILE NAME RM-2101-990-12-001B	SHEET 2 OF 2
DWN BY	GMS	CKD BY GMS APVD GMS	APVD DATE 12/15/2021

Nationwide Permit 5 – *Scientific Measurement Devices*
Effective Date: February 25, 2022 / Expiration Date: March 14, 2026
Authorities: Sections 10 and 404

Devices, whose purpose is to measure and record scientific data, such as staff gages, tide and current gages, meteorological stations, water recording and biological observation devices, water quality testing and improvement devices, and similar structures. Small weirs and flumes constructed primarily to record water quantity and velocity are also authorized provided the discharge of dredged or fill material is limited to 25 cubic yards. Upon completion of the use of the device to measure and record scientific data, the measuring device and any other structures or fills associated with that device (e.g., foundations, anchors, buoys, lines, etc.) must be removed to the maximum extent practicable and the site restored to pre-construction elevations.

REGIONAL CONDITIONS:

For applicable Water Quality Certification (WQC) determination or requirements and Coastal Zone Management Act (CZMA) consistency determinations or requirements see the Alabama Department of Environmental Management (ADEM) conditions affixed to the end of this document. Alternatively, copies of the final ADEM conditions are also available on the SAM District webpage at: https://www.sam.usace.army.mil/Missions/Regulatory/NWP/

GENERAL CONDITIONS:

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as applicable, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for an NWP. Every person who may wish to obtain permit authorization under one or more NWPs, or who is currently relying on an existing or prior permit authorization under one or more NWPs, has been and is on notice that all of the provisions of 33 CFR 330.1 through 330.6 apply to every NWP authorization. Note especially 33 CFR 330.5 relating to the modification, suspension, or revocation of any NWP authorization.

1. *Navigation.*
   (a) No activity may cause more than a minimal adverse effect on navigation.
   (b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.
   (c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. *Aquatic Life Movements.* No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species. If a bottomless culvert cannot be used, then the crossing should be designed and constructed to minimize adverse effects to aquatic life movements.

3. *Spawning Areas.* Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (*e.g.,* through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. *Migratory Bird Breeding Areas.* Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. *Shellfish Beds.* No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. *Suitable Material.* No activity may use unsuitable material (*e.g.,* trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see section 307 of the Clean Water Act).

7. *Water Supply Intakes.* No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. *Adverse Effects from Impoundments*. If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. *Management of Water Flows.* To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization, storm water management activities, and temporary and permanent road crossings, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g. stream restoration or relocation activities).

10. *Fills Within 100-Year Floodplains*. The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. *Equipment*. Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. *Soil Erosion and Sediment Controls*. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow, or during low tides.

13. *Removal of Structures and Fills*. Temporary structures must be removed, to the maximum extent practicable, after their use has been discontinued. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. *Proper Maintenance*. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. *Single and Complete Project*. The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. *Wild and Scenic Rivers*.
    (a) No NWP activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status.
    (b) If a proposed NWP activity will occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, the permittee must submit a pre-construction notification (see general condition 32). The district engineer will coordinate the PCN with the Federal agency with direct management responsibility for that river. Permittees shall not begin the NWP activity until notified by the district engineer that the Federal agency with direct management responsibility for that river has determined in writing that the proposed NWP activity will not adversely affect the Wild and Scenic River designation or study status.
    (c) Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service). Information on these rivers is also available at: http://www.rivers.gov/ .

17. *Tribal Rights*. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. *Endangered Species.*
    (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat unless ESA section 7 consultation addressing the consequences of the proposed activity on listed species or critical habitat has been completed. See 50 CFR 402.02 for the definition of "effects of the action" for the purposes of ESA section 7 consultation, as well as 50 CFR 402.17, which provides further explanation under ESA section 7 regarding "activities that are reasonably certain to occur" and "consequences caused by the proposed action."
    (b) Federal agencies should follow their own procedures for complying with the requirements of the ESA (see 33 CFR 330.4(f)(1)). If pre-construction notification is required for the proposed activity, the Federal permittee must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will verify that the appropriate documentation has been submitted. If the appropriate documentation has not been submitted, additional ESA section 7 consultation may be necessary for the activity and the respective federal agency would be responsible for fulfilling its obligation under section 7 of the ESA.
    (c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the activity, or if the activity is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed activity or that utilize the designated critical habitat that might be affected by the proposed activity. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non- Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. For activities where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the activity, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification that the proposed activity will have "no effect" on listed species or critical habitat, or until ESA section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.
    (d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species specific permit conditions to the NWPs.
    (e) (e) Authorization of an activity by an NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the FWS or the NMFS, the Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.
    (f) If the non-federal permittee has a valid ESA section 10(a)(1)(B) incidental take permit with an approved Habitat Conservation Plan for a project or a group of projects that includes the proposed NWP activity, the non-federal applicant should provide a copy of that ESA section 10(a)(1)(B) permit with the PCN required by paragraph (c) of this general condition. The district engineer will coordinate with the agency that issued the ESA section 10(a)(1)(B) permit to determine whether the proposed NWP activity and the associated incidental take were considered in the internal ESA section 7 consultation conducted for the ESA section 10(a)(1)(B) permit. If that coordination results in concurrence from the agency that the proposed NWP activity and the associated incidental take were considered in the internal ESA section 7 consultation for the ESA section 10(a)(1)(B) permit, the district engineer does not need to conduct a separate ESA section 7 consultation for the proposed NWP activity. The district engineer will notify the non-federal applicant within 45 days of receipt of a complete pre- construction notification whether the ESA section 10(a)(1)(B) permit covers the proposed NWP activity or whether additional ESA section 7 consultation is required.
    (g) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the FWS and NMFS or their worldwide Web pages at *http://www.fws.gov/* or *http://www.fws.gov/ipac* and *http://www.nmfs.noaa.gov/pr/species/esa/* respectively.

19. *Migratory Birds and Bald and Golden Eagles.* The permittee is responsible for ensuring that an action authorized by NWP complies with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The permittee is responsible for contacting the appropriate local office of the U.S. Fish and Wildlife Service to determine what measures, if any, are necessary or appropriate to reduce adverse effects to migratory birds or eagles, including whether "incidental take" permits are necessary and available under the Migratory Bird Treaty Act or Bald and Golden Eagle Protection Act for a particular activity.

20. *Historic Properties.*
    (a) No activity is authorized under any NWP which may have the potential to cause effects to properties listed, or eligible for listing, in the National Register of Historic Places until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.
    (b) Federal permittees should follow their own procedures for complying with the requirements of section 106 of the National Historic Preservation Act (see 33 CFR 330.4(g)(1)). If pre-construction notification is required for the proposed NWP activity, the Federal permittee must provide the district engineer with the appropriate documentation to

demonstrate compliance with those requirements. The district engineer will verify that the appropriate documentation has been submitted. If the appropriate documentation is not submitted, then additional consultation under section 106 may be necessary. The respective federal agency is responsible for fulfilling its obligation to comply with section 106.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the NWP activity might have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties might have the potential to be affected by the proposed NWP activity or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of, or potential for, the presence of historic properties can be sought from the State Historic Preservation Officer, Tribal Historic Preservation Officer, or designated tribal representative, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts commensurate with potential impacts, which may include background research, consultation, oral history interviews, sample field investigation, and/or field survey. Based on the information submitted in the PCN and these identification efforts, the district engineer shall determine whether the proposed NWP activity has the potential to cause effects on the historic properties. Section 106 consultation is not required when the district engineer determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR 800.3(a)). Section 106 consultation is required when the district engineer determines that the activity has the potential to cause effects on historic properties. The district engineer will conduct consultation with consulting parties identified under 36 CFR 800.2(c) when he or she makes any of the following effect determinations for the purposes of section 106 of the NHPA: no historic properties affected, no adverse effect, or adverse effect.

(d) Where the non-Federal applicant has identified historic properties on which the proposed NWP activity might have the potential to cause effects and has so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects to historic properties or that NHPA section 106 consultation has been completed. For non-federal permittees, the district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA section 106 consultation is required. If NHPA section 106 consultation is required, the district engineer will notify the non-Federal applicant that he or she cannot begin the activity until section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(e) Prospective permittees should be aware that section 110k of the NHPA (54 U.S.C. 306113) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

21. *Discovery of Previously Unknown Remains and Artifacts*. Permittees that discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by NWP, they must immediately notify the district engineer of what they have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal, and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. *Designated Critical Resource Waters*. Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.
    (a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, 52, 57 and 5258 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.
    (b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, 38, and 54, notification is required in accordance with general condition 32, for any activity proposed by permittees in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after she or he determines that the impacts to the critical resource waters will be no more than minimal.

23. *Mitigation*. The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that the individual and cumulative adverse environmental effects are no more than minimal:
    (a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (*i.e.,* on site).
    (b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the individual and cumulative adverse environmental effects are no more than minimal.
    (c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse environmental effects of the proposed activity are no more than minimal, and provides an activity-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in only minimal adverse environmental effects.
    (d) Compensatory mitigation at a minimum one-for-one ratio will be required for all losses of stream bed that exceed 1/103/100-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse environmental effects of the proposed activity are no more than minimal, and provides an activity-specific waiver of this requirement. This compensatory mitigation requirement may be satisfied through the restoration or enhancement of riparian areas next to streams in accordance with paragraph (e) of this general condition. For losses of stream bed of 1/103/100-acre or less that require pre- construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in only minimal adverse environmental effects. Compensatory mitigation for losses of streams should be provided, if practicable, through stream rehabilitation, enhancement, or preservation since streams are difficult-to- replace resources (see 33 CFR 332.3(e)(3)).

(e) Compensatory mitigation plans for NWP activities in or near streams or other open waters will normally include a requirement for the restoration or enhancement, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, the restoration or maintenance/protection of riparian areas may be the only compensatory mitigation required. If restoring riparian areas involves planting vegetation, only native species should be planted. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to restore or maintain/protect a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or maintaining/protecting a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of minimization or compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(f) Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in no more than minimal adverse environmental effects. For the NWPs, the preferred mechanism for providing compensatory mitigation is mitigation bank credits or in-lieu fee program credits (see 33 CFR 332.3(b)(2) and (3)). However, if an appropriate number and type of mitigation bank or in-lieu credits are not available at the time the PCN is submitted to the district engineer, the district engineer may approve the use of permittee- responsible mitigation.

(2) The amount of compensatory mitigation required by the district engineer must be sufficient to ensure that the authorized activity results in no more than minimal individual and cumulative adverse environmental effects (see 33 CFR 330.1(e)(3)). (See also 33 CFR 332.3(f)).

(3) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, aquatic resource restoration should be the first compensatory mitigation option considered for permittee-responsible mitigation.

(4) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) through (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)). If permittee-responsible mitigation is the proposed option, and the proposed compensatory mitigation site is located on land in which another federal agency holds an easement, the district engineer will coordinate with that federal agency to determine if proposed compensatory mitigation project is compatible with the terms of the easement.

(5) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan needs to address only the baseline conditions at the impact site and the number of credits to be provided (see 33 CFR 332.4(c)(1)(ii)).

(6) Compensatory mitigation requirements (*e.g.,* resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan (see 33 CFR 332.4(c)(1)(ii)).

(g) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of ½-acre, it cannot be used to authorize any NWP activity resulting in the loss of greater than ½-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that an NWP activity already meeting the established acreage limits also satisfies the no more than minimal impact requirement for the NWPs.

(h) Permittees may propose the use of mitigation banks, in-lieu fee programs, or permittee-responsible mitigation. When developing a compensatory mitigation proposal, the permittee must consider appropriate and practicable options consistent with the framework at 33 CFR 332.3(b). For activities resulting in the loss of marine or estuarine resources, permittee-responsible mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(i) Where certain functions and services of waters of the United States are permanently adversely affected by a regulated activity, such as discharges of dredged or fill material into waters of the United States that will convert a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse environmental effects of the activity to the no more than minimal level.

24. *Safety of Impoundment Structures.* To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state or federal, dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. *Water Quality.*

(a) Where the certifying authority (state, authorized tribe, or EPA, as appropriate) has not previously certified compliance of an NWP with CWA section 401, a CWA section 401 water quality certification for the proposed discharge must be obtained or waived (see 33 CFF 330.4(c)). If the permittee cannot comply with all of the conditions of a water quality certification previously issued by certifying authority for the issuance of the NWP, then the permittee must obtain a water quality certification or waiver for the proposed discharge in order for the activity to be authorized by an NWP.

(b) If the NWP activity requires pre-construction notification and the certifying authority has not previously certified compliance of an NWP with CWA section 401, the proposed discharge is not authorized by an NWP until water quality certification is obtained or waived. If the certifying authority issues a water quality certification for the proposed discharge, the permittee must submit a copy of the certification to the district engineer. The discharge is not authorized by an NWP until the district engineer has notified the permittee that the water quality certification requirement has been satisfied by the issuance of a water quality certification or a waiver.

(c) The district engineer or certifying authority may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. *Coastal Zone Management.* In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). If the permittee cannot comply with all of the conditions of a coastal zone management consistency concurrence previously issued by the state, then the permittee must obtain an individual coastal zone management consistency concurrence or presumption of concurrence in order for the activity to be authorized by an NWP. The district engineer or a state may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. *Regional and Case-By-Case Conditions.* The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its CWA section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. *Use of Multiple Nationwide Permits.* The use of more than one NWP for a single and complete project is authorized, subject to the following restrictions:

    (a) If only one of the NWPs used to authorize the single and complete project has a specified acreage limit, the acreage loss of waters of the United States cannot exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

    (b) If one or more of the NWPs used to authorize the single and complete project has specified acreage limits, the acreage loss of waters of the United States authorized by those NWPs cannot exceed their respective specified acreage limits. For example, if a commercial development is constructed under NWP 39, and the single and complete project includes the filling of an upland ditch authorized by NWP 46, the maximum acreage loss of waters of the United States for the commercial development under NWP 39 cannot exceed 1/2-acre, and the total acreage loss of waters of United States due to the NWP 39 and 46 activities cannot exceed 1 acre.

29. *Transfer of Nationwide Permit Verifications.* If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

    ''When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.''

    _____
    (Transferee)

    _____
    (Date)

30. *Compliance Certification*. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and implementation of any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:
    (a) A statement that the authorized activity was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;
    (b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and
    (c) The signature of the permittee certifying the completion of the activity and mitigation. The completed certification document must be submitted to the district engineer within 30 days of completion of the authorized activity or the implementation of any required compensatory mitigation, whichever occurs later.

31. *Activities Affecting Structures or Works Built by the United States*. If an NWP activity also requires permission from the Corps pursuant to 33 U.S.C. 408 because it will alter or temporarily or permanently occupy or use a U.S. Army Corps of Engineers (USACE) federally authorized Civil Works project (a ''USACE project''), the prospective permittee must submit a pre-construction notification. See paragraph (b)(10) of general condition 32. An activity that requires section 408 permission and/or review is not authorized by an NWP until the appropriate Corps office issues the section 408 permission or completes its review to alter, occupy, or use the USACE project, and the district engineer issues a written NWP verification.

32. *Pre-Construction Notification.*
    (a) *Timing.* Where required by the terms of the NWP, the permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:
        (1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or
        (2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or are in the vicinity of the activity, or to notify the Corps pursuant to general condition 20 that the activity might have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is ''no effect'' on listed species or ''no potential to cause effects'' on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or section 106 of the National Historic Preservation Act (see 33 CFR 330.4(g)) has been completed. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the pr set forth in 33 CFR 330.5(d)(2).
    (b) *Contents of Pre-Construction Notification:* The PCN must be in writing and include the following information:
        (1) Name, address and telephone numbers of the prospective permittee;
        (2) Location of the proposed activity;
        (3) Identify the specific NWP or NWP(s) the prospective permittee wants to use to authorize the proposed activity;

        (4)
            (i) A description of the proposed activity; the activity's purpose; direct and indirect adverse environmental effects the activity would cause, including the anticipated amount of loss of wetlands, other special aquatic sites, and other waters expected

to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; a description of any proposed mitigation measures intended to reduce the adverse environmental effects caused by the proposed activity; and any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity, including other separate and distant crossings for linear projects that require Department of the Army authorization but do not require pre-construction notification. The description of the proposed activity and any proposed mitigation measures should be sufficiently detailed to allow the district engineer to determine that the adverse environmental effects of the activity will be no more than minimal and to determine the need for compensatory mitigation or other mitigation measures.

(ii) For linear projects where one or more single and complete crossings require pre-construction notification, the PCN must include the quantity of anticipated losses of wetlands, other special aquatic sites, and other waters for each single and complete crossing of those wetlands, other special aquatic sites, and other waters (including those single and complete crossings authorized by an NWP but do not require PCNs). This information will be used by the district engineer to evaluate the cumulative adverse environmental effects of the proposed linear project and does not change those non-PCN NWP activities into NWP PCNs.

(iii) Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the activity and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans).

(5) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial and intermittent streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many wetlands, other special aquatic sites, and other waters. Furthermore, the 45-day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate.

(6) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands or 3/100-acre of stream bed and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse environmental effects are no more than minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

(7) For non-federal permittees, if any listed species (or species proposed for listing) or designated critical habitat (or critical habitat proposed for such designation) might be affected or is in the vicinity of the activity, or if the activity is located in designated critical habitat (or critical habitat proposed for such designation), the PCN must include the name(s) of those endangered or threatened species (or species proposed for listing) that might be affected by the proposed activity or utilize the designated critical habitat (or critical habitat proposed for such designation) that might be affected by the proposed activity. For NWP activities that require pre-construction notification, Federal permittees must provide documentation demonstrating compliance with the Endangered Species Act.

(8) For non-federal permittees, if the NWP activity might have the potential to cause effects to a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, the PCN must state which historic property might have the potential to be affected by the proposed activity or include a vicinity map indicating the location of the historic property. For NWP activities that require pre-construction notification, Federal permittees must provide documentation demonstrating compliance with section 106 of the National Historic Preservation Act.

(9) For an activity that will occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, the PCN must identify the Wild and Scenic River or the ''study river'' (see general condition 16); and

(10) For an NWP activity that requires permission from, or review by, the Corps pursuant to 33 U.S.C. 408 because it will alter or temporarily or permanently occupy or use a U.S. Army Corps of Engineers federally authorized civil works project, the pre-construction notification must include a statement confirming that the project proponent has submitted a written request for section 408 permission from, or review by, the Corps office having jurisdiction over that USACE project.

(c) *Form of Pre-Construction Notification:* The nationwide permit pre-construction notification form (Form ENG 6082) should be used for NWP PCNs. A letter containing the required information may also be used. Applicants may provide electronic files of PCNs and supporting materials if the district engineer has established tools and procedures for electronic submittals.

(d) *Agency Coordination:*

(1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the activity's adverse environmental effects so that they are no more than minimal.

(2) Agency coordination is required for:

(i) All NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States;

(ii) NWP 13 activities in excess of 500 linear feet, fills greater than one cubic yard per running foot, or involve discharges of dredged or fill material into special aquatic sites; and

(iii) NWP 54 activities in excess of 500 linear feet, or that extend into the waterbody more than 30 feet from the mean low water line in tidal waters or the ordinary high water mark in the Great Lakes.

(3) When agency coordination is required, the district engineer will immediately provide (e.g., via email, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (FWS, state natural resource or water quality agency, EPA, and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to notify the district engineer via telephone, facsimile transmission, or email that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse environmental effects will be more than minimal. If so, contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure that the net adverse environmental effects of the proposed activity are no more than minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(4) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

(5) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of pre-construction notifications to expedite agency coordination.

DISTRICT ENGINEER'S DECISION:

1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. If a project proponent requests authorization by a specific NWP, the district engineer should issue the NWP verification for that activity if it meets the terms and conditions of that NWP, unless he or she determines, after considering mitigation, that the proposed activity will result in more than minimal individual and cumulative adverse effects on the aquatic environment and other aspects of the public interest and exercises discretionary authority to require an individual permit for the proposed activity. For a linear project, this determination will include an evaluation of the single and complete crossings of waters of the United States that require PCNs to determine whether they individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings of waters of the United States authorized by an NWP. If an applicant requests a waiver of an applicable limit, as provided for in NWPs 13, 36, or 54, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in only minimal individual and cumulative adverse environmental effects.
2. When making minimal adverse environmental effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. He or she will also consider the cumulative adverse environmental effects caused by activities authorized by an NWP and whether those cumulative adverse environmental effects are no more than minimal. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional or condition assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse environmental effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.
3. If the proposed activity requires a PCN and will result in a loss of greater than 1/10-acre of wetlands or 3/100-acre of stream bed, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for NWP activities with smaller impacts, or for impacts to other types of waters. The district engineer will consider any proposed compensatory mitigation or other mitigation measures the applicant has included in the proposal in determining whether the net adverse environmental effects of the proposed activity are no more than minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse environmental effects are no more than minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure that the NWP activity results in no more than minimal adverse environmental effects. If the net adverse environmental effects of the NWP activity (after consideration of the mitigation proposal) are determined by the district engineer to be no more than minimal, the district engineer will provide a timely written response to the applicant. The response will state that the NWP activity can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.
4. If the district engineer determines that the adverse environmental effects of the proposed activity are more than minimal, then the district engineer will notify the applicant either:
   (a) That the activity does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit;
   (b) that the activity is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse environmental effects so that they are no more than minimal; or
   (c) that the activity is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse environmental effects, the activity will be authorized within the 45-day PCN period (unless additional time is required to comply with general conditions 18, 20, and/or 31), with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation plan or a requirement that the applicant submit a mitigation plan that would reduce the adverse environmental effects so that they are no more than minimal. When compensatory mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

FURTHER INFORMATION:

1. District engineers have authority to determine if an activity complies with the terms and conditions of an NWP.
2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.
3. NWPs do not grant any property rights or exclusive privileges.
4. NWPs do not authorize any injury to the property or rights of others.
5. NWPs do not authorize interference with any existing or proposed Federal project (see general condition 31).

DEFINITIONS:

Best management practices (BMPs): Policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural.

Compensatory mitigation: The restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Currently serviceable: Useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

Direct effects: Effects that are caused by the activity and occur at the same time and place.

Discharge: The term ''discharge'' means any discharge of dredged or fill material into waters of the United States.

Ecological reference: A model used to plan and design an aquatic habitat and riparian area restoration, enhancement, or establishment activity under NWP 27. An ecological reference may be based on the structure, functions, and dynamics of an aquatic habitat type or a riparian area type that currently exists in the region where the proposed NWP 27 activity is located. Alternatively, an ecological reference may be based on a conceptual model for the aquatic habitat type or riparian area type to be restored, enhanced, or established as a result of the proposed NWP 27 activity. An ecological reference takes into account the range of variation of the aquatic habitat type or riparian area type in the region.

Enhancement: The manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Establishment (creation): The manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area.

High Tide Line: The line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

Historic Property: Any prehistoric or historic district, site (including archaeological site), building, structure, or other object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR part 60).

Independent utility: A test to determine what constitutes a single and complete non-linear project in the Corps Regulatory Program. A project is considered to have independent utility if it would be constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

Indirect effects: Effects that are caused by the activity and are later in time or farther removed in distance but are still reasonably foreseeable.

Loss of waters of the United States: Waters of the United States that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. The loss of stream bed includes the acres of stream bed that are permanently adversely affected by filling or excavation because of the regulated activity. Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the United States is a threshold measurement of the impact to jurisdictional waters or wetlands for determining whether a project may qualify for an NWP; it is not a net threshold that is calculated after considering compensatory mitigation that may be used to offset losses of aquatic functions and services. Waters of the United States temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the United States. Impacts resulting from activities that do not require Department of the Army authorization, such as activities eligible for exemptions under section 404(f) of the Clean Water Act, are not considered when calculating the loss of waters of the United States.

Navigable waters: Waters subject to section 10 of the Rivers and Harbors Act of 1899. These waters are defined at 33 CFR part 329.

Non-tidal wetland: A non-tidal wetland is a wetland that is not subject to the ebb and flow of tidal waters. Non- tidal wetlands contiguous to tidal waters are located landward of the high tide line (i.e., spring high tide line).

Open water: For purposes of the NWPs, an open water is any area that in a year with normal patterns of precipitation has water flowing or standing above ground to the extent that an ordinary high water mark can be determined. Aquatic vegetation within the area of flowing or standing water is either non-emergent, sparse, or absent. Vegetated shallows are considered to be open waters. Examples of ''open waters'' include rivers, streams, lakes, and ponds.

Ordinary High Water Mark: The term ordinary high water mark means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Perennial stream: A perennial stream has surface water flowing continuously year-round during a typical year.

Practicable: Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Pre-construction notification: A request submitted by the project proponent to the Corps for confirmation that a particular activity is authorized by nationwide permit. The request may be a permit application, letter, or similar document that includes information about the proposed work and its anticipated environmental effects. Pre- construction notification may be required by the terms and conditions of a nationwide permit, or by regional conditions. A pre-construction notification may be voluntarily submitted in cases where pre-construction notification is not required and the project proponent wants confirmation that the activity is authorized by nationwide permit.

Preservation: The removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function but does not result in a gain in aquatic resource area.

Restoration: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: Re-establishment and rehabilitation.

Riffle and pool complex: Riffle and pool complexes are special aquatic sites under the 404(b)(1) Guidelines. Riffle and pool complexes sometimes characterize steep gradient sections of streams. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a course substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. A slower stream velocity, a streaming flow, a smooth surface, and a finer substrate characterize pools.

Riparian areas: Riparian areas are lands next to streams, lakes, and estuarine-marine shorelines. Riparian areas are transitional between terrestrial and aquatic ecosystems, through which surface and subsurface hydrology connects riverine, lacustrine, estuarine, and marine waters with their adjacent wetlands, non-wetland waters, or uplands. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality. (See general condition 23.)

Shellfish seeding: The placement of shellfish seed and/or suitable substrate to increase shellfish production. Shellfish seed consists of immature individual shellfish or individual shellfish attached to shells or shell fragments (i.e., spat on shell). Suitable substrate may consist of shellfish shells, shell fragments, or other appropriate materials placed into waters for shellfish habitat.

Single and complete linear project: A linear project is a project constructed for the purpose of getting people, goods, or services from a point of origin to a terminal point, which often involves multiple crossings of one or more waterbodies at separate and distant locations. The term ''single and complete project'' is defined as that portion of the total linear project proposed or accomplished by one owner/developer or partnership or other association of owners/developers that includes all crossings of a single water of the United States (i.e., a single waterbody) at a specific location. For linear projects crossing a single or multiple waterbodies several times at separate and distant locations, each crossing is considered a single and complete project for

purposes of NWP authorization. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately.

Single and complete non-linear project: For non-linear projects, the term ''single and complete project'' is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A single and complete non-linear project must have independent utility (see definition of ''independent utility''). Single and complete non-linear projects may not be ''piecemealed'' to avoid the limits in an NWP authorization.

Stormwater management: Stormwater management is the mechanism for controlling stormwater runoff for the purposes of reducing downstream erosion, water quality degradation, and flooding and mitigating the adverse effects of changes in land use on the aquatic environment.

Stormwater management facilities: Stormwater management facilities are those facilities, including but not limited to, stormwater retention and detention ponds and best management practices, which retain water for a period of time to control runoff and/or improve the quality (i.e., by reducing the concentration of nutrients, sediments, hazardous substances and other pollutants) of stormwater runoff.

Stream bed: The substrate of the stream channel between the ordinary high water marks. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the stream bed, but outside of the ordinary high water marks, are not considered part of the stream bed.

Stream channelization: The manipulation of a stream's course, condition, capacity, or location that causes more than minimal interruption of normal stream processes. A channelized jurisdictional stream remains a water of the United States.

Structure: An object that is arranged in a definite pattern of organization. Examples of structures include, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island, artificial reef, permanent mooring structure, power transmission line, permanently moored floating vessel, piling, aid to navigation, or any other manmade obstacle or obstruction.

Tidal wetland: A tidal wetland is a jurisdictional wetland that is inundated by tidal waters. Tidal waters rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by other waters, wind, or other effects. Tidal wetlands are located channelward of the high tide line.

Tribal lands: Any lands title to which is either: (1) Held in trust by the United States for the benefit of any Indian tribe or individual; or (2) held by any Indian tribe or individual subject to restrictions by the United States against alienation.

Tribal rights: Those rights legally accruing to a tribe or tribes by virtue of inherent sovereign authority, unextinguished aboriginal title, treaty, statute, judicial decisions, executive order or agreement, and that give rise to legally enforceable remedies.

Vegetated shallows: Vegetated shallows are special aquatic sites under the 404(b)(1) Guidelines. They are areas that are permanently inundated and under normal circumstances have rooted aquatic vegetation, such as seagrasses in marine and estuarine systems and a variety of vascular rooted plants in freshwater systems.

Waterbody: For purposes of the NWPs, a waterbody is a ''water of the United States.'' If a wetland is adjacent to a waterbody determined to be a water of the United States, that waterbody and any adjacent wetlands are considered together as a sing e aquatic unit (see 33 CFR 328.4(c)(2)).

Nationwide Permit 6 – *Survey Activities*
Effective Date: February 25, 2022 / Expiration Date: March 14, 2026
Authorities: Sections 10 and 404

Survey activities, such as core sampling, seismic exploratory operations, plugging of seismic shot holes and other exploratory-type bore holes, exploratory trenching, soil surveys, sampling, sample plots or transects for wetland delineations, and historic resources surveys. For the purposes of this NWP, the term "exploratory trenching" means mechanical land clearing of the upper soil profile to expose bedrock or substrate, for the purpose of mapping or sampling the exposed material. The area in which the exploratory trench is dug must be restored to its pre-construction elevation upon completion of the work and must not drain a water of the United States. In wetlands, the top 6 to 12 inches of the trench should normally be backfilled with topsoil from the trench. This NWP authorizes the construction of temporary pads, provided the discharge of dredged or fill material does not exceed 1/10-acre in waters of the U.S. Discharges of dredged or fill material and structures associated with the recovery of historic resources are not authorized by this NWP. Drilling and the discharge of excavated material from test wells for oil and gas exploration are not authorized by this NWP; the plugging of such wells is authorized. Fill placed for roads and other similar activities is not authorized by this NWP. The NWP does not authorize any permanent structures. The discharge of drilling mud and cuttings may require a permit under Section 402 of the Clean Water Act.

REGIONAL CONDITIONS:

For applicable Water Quality Certification (WQC) determination or requirements and Coastal Zone Management Act (CZMA) consistency determinations or requirements see the Alabama Department of Environmental Management (ADEM) conditions affixed to the end of this document. Alternatively, copies of the final ADEM conditions are also available on the SAM District webpage at: https://www.sam.usace.army.mil/Missions/Regulatory/NWP/

GENERAL CONDITIONS:

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as applicable, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for an NWP. Every person who may wish to obtain permit authorization under one or more NWPs, or who is currently relying on an existing or prior permit authorization under one or more NWPs, has been and is on notice that all of the provisions of 33 CFR 330.1 through 330.6 apply to every NWP authorization. Note especially 33 CFR 330.5 relating to the modification, suspension, or revocation of any NWP authorization.

1. *Navigation.*
   (a) No activity may cause more than a minimal adverse effect on navigation.
   (b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.
   (c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. *Aquatic Life Movements.* No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species. If a bottomless culvert cannot be used, then the crossing should be designed and constructed to minimize adverse effects to aquatic life movements.

3. *Spawning Areas.* Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (*e.g.,* through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. *Migratory Bird Breeding Areas.* Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. *Shellfish Beds.* No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. *Suitable Material.* No activity may use unsuitable material (*e.g.,* trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see section 307 of the Clean Water Act).

7. *Water Supply Intakes.* No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. *Adverse Effects from Impoundments*. If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. *Management of Water Flows.* To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization, storm water management activities, and temporary and permanent road crossings, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g. stream restoration or relocation activities).

10. *Fills Within 100-Year Floodplains*. The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. *Equipment.* Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. *Soil Erosion and Sediment Controls*. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow, or during low tides.

13. *Removal of Structures and Fills*. Temporary structures must be removed, to the maximum extent practicable, after their use has been discontinued. Temporary fills must be removed in

their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. *Proper Maintenance*. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. *Single and Complete Project*. The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. *Wild and Scenic Rivers*.
    (a) No NWP activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status.
    (b) If a proposed NWP activity will occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, the permittee must submit a pre-construction notification (see general condition 32). The district engineer will coordinate the PCN with the Federal agency with direct management responsibility for that river. Permittees shall not begin the NWP activity until notified by the district engineer that the Federal agency with direct management responsibility for that river has determined in writing that the proposed NWP activity will not adversely affect the Wild and Scenic River designation or study status.
    (c) Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service). Information on these rivers is also available at: http://www.rivers.gov/ .

17. *Tribal Rights*. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. *Endangered Species*.
    (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat unless ESA section 7 consultation addressing the consequences of the proposed activity on listed species or critical habitat has been completed. See 50 CFR 402.02 for the definition of "effects of the action" for the purposes of ESA section 7 consultation, as well as 50 CFR 402.17, which provides further explanation under ESA section 7 regarding "activities that are reasonably certain to occur" and "consequences caused by the proposed action."
    (b) Federal agencies should follow their own procedures for complying with the requirements of the ESA (see 33 CFR 330.4(f)(1)). If pre-construction notification is required for the proposed activity, the Federal permittee must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will verify that the appropriate documentation has been submitted. If the appropriate documentation has not been submitted, additional ESA section 7 consultation may be necessary for the activity and the respective federal agency would be responsible for fulfilling its obligation under section 7 of the ESA.
    (c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the activity, or if the activity is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed activity or that utilize the designated critical habitat that might be affected by the proposed activity. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non- Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. For activities where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the activity, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification that the proposed activity will have "no effect" on listed species or critical habitat, or until ESA section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.
    (d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species specific permit conditions to the NWPs.
    (e) (e) Authorization of an activity by an NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the FWS or the NMFS, the Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.
    (f) If the non-federal permittee has a valid ESA section 10(a)(1)(B) incidental take permit with an approved Habitat Conservation Plan for a project or a group of projects that includes the proposed NWP activity, the non-federal applicant should provide a copy of that ESA section 10(a)(1)(B) permit with the PCN required by paragraph (c) of this general condition. The district engineer will coordinate with the agency that issued the ESA section 10(a)(1)(B) permit to determine whether the proposed NWP activity and the associated incidental take were considered in the internal ESA section 7 consultation conducted for the ESA section 10(a)(1)(B) permit. If that coordination results in concurrence from the agency that the proposed NWP activity and the associated incidental take were considered in the internal ESA section 7 consultation for the ESA section 10(a)(1)(B) permit, the district engineer does not need to conduct a separate ESA section 7 consultation for the proposed NWP activity. The district engineer will notify the non-federal applicant within 45 days of receipt of a complete pre- construction notification whether the ESA section 10(a)(1)(B) permit covers the proposed NWP activity or whether additional ESA section 7 consultation is required.
    (g) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the FWS and NMFS or their worldwide Web pages at *http://www.fws.gov/* or *http://www.fws.gov/ipac* and *http://www.nmfs.noaa.gov/pr/species/esa/* respectively.

19. *Migratory Birds and Bald and Golden Eagles.* The permittee is responsible for ensuring that an action authorized by NWP complies with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The permittee is responsible for contacting the appropriate local office of the U.S. Fish and Wildlife Service to determine what measures, if any, are necessary or appropriate to reduce adverse effects to migratory birds or eagles, including whether "incidental take" permits are necessary and available under the Migratory Bird Treaty Act or Bald and Golden Eagle Protection Act for a particular activity.

20. *Historic Properties.*

(a) No activity is authorized under any NWP which may have the potential to cause effects to properties listed, or eligible for listing, in the National Register of Historic Places until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.
(b) Federal permittees should follow their own procedures for complying with the requirements of section 106 of the National Historic Preservation Act (see 33 CFR 330.4(g)(1)). If pre-construction notification is required for the proposed NWP activity, the Federal permittee must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will verify that the appropriate documentation has been submitted. If the appropriate documentation is not submitted, then additional consultation under section 106 may be necessary. The respective federal agency is responsible for fulfilling its obligation to comply with section 106.
(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the NWP activity might have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties might have the potential to be affected by the proposed NWP activity or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of, or potential for, the presence of historic properties can be sought from the State Historic Preservation Officer, Tribal Historic Preservation Officer, or designated tribal representative, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts commensurate with potential impacts, which may include background research, consultation, oral history interviews, sample field investigation, and/or field survey. Based on the information submitted in the PCN and these identification efforts, the district engineer shall determine whether the proposed NWP activity has the potential to cause effects on the historic properties. Section 106 consultation is not required when the district engineer determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR 800.3(a)). Section 106 consultation is required when the district engineer determines that the activity has the potential to cause effects on historic properties. The district engineer will conduct consultation with consulting parties identified under 36 CFR 800.2(c) when he or she makes any of the following effect determinations for the purposes of section 106 of the NHPA: no historic properties affected, no adverse effect, or adverse effect.
(d) Where the non-Federal applicant has identified historic properties on which the proposed NWP activity might have the potential to cause effects and has so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects to historic properties or that NHPA section 106 consultation has been completed. For non-federal permittees, the district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA section 106 consultation is required. If NHPA section 106 consultation is required, the district engineer will notify the non-Federal applicant that he or she cannot begin the activity until section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.
(e) Prospective permittees should be aware that section 110k of the NHPA (54 U.S.C. 306113) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

21. *Discovery of Previously Unknown Remains and Artifacts*. Permittees that discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by NWP, they must immediately notify the district engineer of what they have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal, and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. *Designated Critical Resource Waters*. Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.
    (a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, 52, 57 and 5258 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.
    (b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, 38, and 54, notification is required in accordance with general condition 32, for any activity proposed by permittees in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after she or he determines that the impacts to the critical resource waters will be no more than minimal.

23. *Mitigation*. The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that the individual and cumulative adverse environmental effects are no more than minimal:
    (a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (*i.e.,* on site).
    (b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the individual and cumulative adverse environmental effects are no more than minimal.
    (c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse environmental effects of the proposed activity are no more than minimal, and provides an activity-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in only minimal adverse environmental effects.
    (d) Compensatory mitigation at a minimum one-for-one ratio will be required for all losses of stream bed that exceed 1/103/100-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse environmental effects of the proposed activity are no more than minimal, and provides an activity-specific waiver of this requirement. This compensatory mitigation requirement may be satisfied through the

restoration or enhancement of riparian areas next to streams in accordance with paragraph (e) of this general condition. For losses of stream bed of 1/103/100-acre or less that require pre- construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in only minimal adverse environmental effects. Compensatory mitigation for losses of streams should be provided, if practicable, through stream rehabilitation, enhancement, or preservation since streams are difficult-to- replace resources (see 33 CFR 332.3(e)(3)).

(e) Compensatory mitigation plans for NWP activities in or near streams or other open waters will normally include a requirement for the restoration or enhancement, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, the restoration or maintenance/protection of riparian areas may be the only compensatory mitigation required. If restoring riparian areas involves planting vegetation, only native species should be planted. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to restore or maintain/protect a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or maintaining/protecting a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of minimization or compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(f) Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in no more than minimal adverse environmental effects. For the NWPs, the preferred mechanism for providing compensatory mitigation is mitigation bank credits or in-lieu fee program credits (see 33 CFR 332.3(b)(2) and (3)). However, if an appropriate number and type of mitigation bank or in-lieu credits are not available at the time the PCN is submitted to the district engineer, the district engineer may approve the use of permittee- responsible mitigation.

(2) The amount of compensatory mitigation required by the district engineer must be sufficient to ensure that the authorized activity results in no more than minimal individual and cumulative adverse environmental effects (see 33 CFR 330.1(e)(3)). (See also 33 CFR 332.3(f)).

(3) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, aquatic resource restoration should be the first compensatory mitigation option considered for permittee-responsible mitigation.

(4) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) through (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)). If permittee-responsible mitigation is the proposed option, and the proposed compensatory mitigation site is located on land in which another federal agency holds an easement, the district engineer will coordinate with that federal agency to determine if proposed compensatory mitigation project is compatible with the terms of the easement.

(5) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan needs to address only the baseline conditions at the impact site and the number of credits to be provided (see 33 CFR 332.4(c)(1)(ii)).

(6) Compensatory mitigation requirements (*e.g.,* resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan (see 33 CFR 332.4(c)(1)(ii)).

(g) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of ½-acre, it cannot be used to authorize any NWP activity resulting in the loss of greater than ½-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that an NWP activity already meeting the established acreage limits also satisfies the no more than minimal impact requirement for the NWPs.

(h) Permittees may propose the use of mitigation banks, in-lieu fee programs, or permittee-responsible mitigation. When developing a compensatory mitigation proposal, the permittee must consider appropriate and practicable options consistent with the framework at 33 CFR 332.3(b). For activities resulting in the loss of marine or estuarine resources, permittee-responsible mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(i) Where certain functions and services of waters of the United States are permanently adversely affected by a regulated activity, such as discharges of dredged or fill material into waters of the United States that will convert a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse environmental effects of the activity to the no more than minimal level.

24. *Safety of Impoundment Structures.* To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state or federal, dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. *Water Quality.*

(a) Where the certifying authority (state, authorized tribe, or EPA, as appropriate) has not previously certified compliance of an NWP with CWA section 401, a CWA section 401 water quality certification for the proposed discharge must be obtained or waived (see 33 CFF 330.4(c)). If the permittee cannot comply with all of the conditions of a water quality certification previously issued by certifying authority for the issuance of the NWP, then the permittee must obtain a water quality certification or waiver for the proposed discharge in order for the activity to be authorized by an NWP.

(b) If the NWP activity requires pre-construction notification and the certifying authority has not previously certified compliance of an NWP with CWA section 401, the proposed discharge is not authorized by an NWP until water quality certification is obtained or waived. If the certifying authority issues a water quality certification for the proposed discharge, the permittee must submit a copy of the certification to the district engineer. The discharge is not authorized by an NWP until the district engineer has notified the permittee that the water quality certification requirement has been satisfied by the issuance of a water quality certification or a waiver.

(c) The district engineer or certifying authority may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. *Coastal Zone Management.* In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone

management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). If the permittee cannot comply with all of the conditions of a coastal zone management consistency concurrence previously issued by the state, then the permittee must obtain an individual coastal zone management consistency concurrence or presumption of concurrence in order for the activity to be authorized by an NWP. The district engineer or a state may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. *Regional and Case-By-Case Conditions.* The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its CWA section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. *Use of Multiple Nationwide Permits.* The use of more than one NWP for a single and complete project is authorized, subject to the following restrictions:

    (a) If only one of the NWPs used to authorize the single and complete project has a specified acreage limit, the acreage loss of waters of the United States cannot exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.
    (b) If one or more of the NWPs used to authorize the single and complete project has specified acreage limits, the acreage loss of waters of the United States authorized by those NWPs cannot exceed their respective specified acreage limits. For example, if a commercial development is constructed under NWP 39, and the single and complete project includes the filling of an upland ditch authorized by NWP 46, the maximum acreage loss of waters of the United States for the commercial development under NWP 39 cannot exceed 1/2-acre, and the total acreage loss of waters of United States due to the NWP 39 and 46 activities cannot exceed 1 acre.

29. *Transfer of Nationwide Permit Verifications.* If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

    ''When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.''

    _____
    (Transferee)

    _____
    (Date)

30. *Compliance Certification*. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and implementation of any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:
    (a) A statement that the authorized activity was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;
    (b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and
    (c) The signature of the permittee certifying the completion of the activity and mitigation. The completed certification document must be submitted to the district engineer within 30 days of completion of the authorized activity or the implementation of any required compensatory mitigation, whichever occurs later.

31. *Activities Affecting Structures or Works Built by the United States*. If an NWP activity also requires permission from the Corps pursuant to 33 U.S.C. 408 because it will alter or temporarily or permanently occupy or use a U.S. Army Corps of Engineers (USACE) federally authorized Civil Works project (a ''USACE project''), the prospective permittee must submit a pre-construction notification. See paragraph (b)(10) of general condition 32. An activity that requires section 408 permission and/or review is not authorized by an NWP until the appropriate Corps office issues the section 408 permission or completes its review to alter, occupy, or use the USACE project, and the district engineer issues a written NWP verification.

32. *Pre-Construction Notification.*
    (a) *Timing.* Where required by the terms of the NWP, the permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:
        (1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or
        (2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or are in the vicinity of the activity, or to notify the Corps pursuant to general condition 20 that the activity might have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is ''no effect'' on listed species or ''no potential to cause effects'' on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or section 106 of the National Historic Preservation Act (see 33 CFR 330.4(g)) has been completed. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the pr set forth in 33 CFR 330.5(d)(2).
    (b) *Contents of Pre-Construction Notification:* The PCN must be in writing and include the following information:
        (1) Name, address and telephone numbers of the prospective permittee;
        (2) Location of the proposed activity;

(3) Identify the specific NWP or NWP(s) the prospective permittee wants to use to authorize the proposed activity;

(4)

(i) A description of the proposed activity; the activity's purpose; direct and indirect adverse environmental effects the activity would cause, including the anticipated amount of loss of wetlands, other special aquatic sites, and other waters expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; a description of any proposed mitigation measures intended to reduce the adverse environmental effects caused by the proposed activity; and any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity, including other separate and distant crossings for linear projects that require Department of the Army authorization but do not require pre-construction notification. The description of the proposed activity and any proposed mitigation measures should be sufficiently detailed to allow the district engineer to determine that the adverse environmental effects of the activity will be no more than minimal and to determine the need for compensatory mitigation or other mitigation measures.

(ii)For linear projects where one or more single and complete crossings require pre-construction notification, the PCN must include the quantity of anticipated losses of wetlands, other special aquatic sites, and other waters for each single and complete crossing of those wetlands, other special aquatic sites, and other waters (including those single and complete crossings authorized by an NWP but do not require PCNs). This information will be used by the district engineer to evaluate the cumulative adverse environmental effects of the proposed linear project and does not change those non-PCN NWP activities into NWP PCNs.

(iii) Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the activity and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans).

(5) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial and intermittent streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many wetlands, other special aquatic sites, and other waters. Furthermore, the 45-day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate.

(6) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands or 3/100-acre of stream bed and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse environmental effects are no more than minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

(7) For non-federal permittees, if any listed species (or species proposed for listing) or designated critical habitat (or critical habitat proposed for such designation) might be affected or is in the vicinity of the activity, or if the activity is located in designated critical habitat (or critical habitat proposed for such designation), the PCN must include the name(s) of those endangered or threatened species (or species proposed for listing) that might be affected by the proposed activity or utilize the designated critical habitat (or critical habitat proposed for such designation) that might be affected by the proposed activity. For NWP activities that require pre-construction notification, Federal permittees must provide documentation demonstrating compliance with the Endangered Species Act.

(8) For non-federal permittees, if the NWP activity might have the potential to cause effects to a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, the PCN must state which historic property might have the potential to be affected by the proposed activity or include a vicinity map indicating the location of the historic property. For NWP activities that require pre-construction notification, Federal permittees must provide documentation demonstrating compliance with section 106 of the National Historic Preservation Act.

(9) For an activity that will occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, the PCN must identify the Wild and Scenic River or the ''study river'' (see general condition 16); and

(10) For an NWP activity that requires permission from, or review by, the Corps pursuant to 33 U.S.C. 408 because it will alter or temporarily or permanently occupy or use a U.S. Army Corps of Engineers federally authorized civil works project, the pre-construction notification must include a statement confirming that the project proponent has submitted a written request for section 408 permission from, or review by, the Corps office having jurisdiction over that USACE project.

(c) *Form of Pre-Construction Notification:* The nationwide permit pre-construction notification form (Form ENG 6082) should be used for NWP PCNs. A letter containing the required information may also be used. Applicants may provide electronic files of PCNs and supporting materials if the district engineer has established tools and procedures for electronic submittals.

(d) *Agency Coordination:*

(1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the activity's adverse environmental effects so that they are no more than minimal.

(2) Agency coordination is required for:

(i) All NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States;

(ii) NWP 13 activities in excess of 500 linear feet, fills greater than one cubic yard per running foot, or involve discharges of dredged or fill material into special aquatic sites; and

(iii) NWP 54 activities in excess of 500 linear feet, or that extend into the waterbody more than 30 feet from the mean low water line in tidal waters or the ordinary high water mark in the Great Lakes.

(3) When agency coordination is required, the district engineer will immediately provide (e.g., via email, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (FWS, state natural resource or water quality agency, EPA, and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to notify the district engineer via telephone, facsimile transmission, or email that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse environmental effects will be more than minimal. If so, contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure that the net adverse environmental effects of the proposed activity are no more than minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(4) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.
(5) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of pre-construction notifications to expedite agency coordination.

DISTRICT ENGINEER'S DECISION:

1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. If a project proponent requests authorization by a specific NWP, the district engineer should issue the NWP verification for that activity if it meets the terms and conditions of that NWP, unless he or she determines, after considering mitigation, that the proposed activity will result in more than minimal individual and cumulative adverse effects on the aquatic environment and other aspects of the public interest and exercises discretionary authority to require an individual permit for the proposed activity. For a linear project, this determination will include an evaluation of the single and complete crossings of waters of the United States that require PCNs to determine whether they individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings of waters of the United States authorized by an NWP. If an applicant requests a waiver of an applicable limit, as provided for in NWPs 13, 36, or 54, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in only minimal individual and cumulative adverse environmental effects.
2. When making minimal adverse environmental effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. He or she will also consider the cumulative adverse environmental effects caused by activities authorized by an NWP and whether those cumulative adverse environmental effects are no more than minimal. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional or condition assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse environmental effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.
3. If the proposed activity requires a PCN and will result in a loss of greater than 1/10-acre of wetlands or 3/100-acre of stream bed, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for NWP activities with smaller impacts, or for impacts to other types of waters. The district engineer will consider any proposed compensatory mitigation or other mitigation measures the applicant has included in the proposal in determining whether the net adverse environmental effects of the proposed activity are no more than minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse environmental effects are no more than minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure that the NWP activity results in no more than minimal adverse environmental effects. If the net adverse environmental effects of the NWP activity (after consideration of the mitigation proposal) are determined by the district engineer to be no more than minimal, the district engineer will provide a timely written response to the applicant. The response will state that the NWP activity can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.
4. If the district engineer determines that the adverse environmental effects of the proposed activity are more than minimal, then the district engineer will notify the applicant either:
   (a) That the activity does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit;
   (b) that the activity is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse environmental effects so that they are no more than minimal; or
   (c) that the activity is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse environmental effects, the activity will be authorized within the 45-day PCN period (unless additional time is required to comply with general conditions 18, 20, and/or 31), with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation plan or a requirement that the applicant submit a mitigation plan that would reduce the adverse environmental effects so that they are no more than minimal. When compensatory mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

FURTHER INFORMATION:

1. District engineers have authority to determine if an activity complies with the terms and conditions of an NWP.
2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.
3. NWPs do not grant any property rights or exclusive privileges.
4. NWPs do not authorize any injury to the property or rights of others.
5. NWPs do not authorize interference with any existing or proposed Federal project (see general condition 31).

DEFINITIONS:

Best management practices (BMPs): Policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural.

Compensatory mitigation: The restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Currently serviceable: Useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

Direct effects: Effects that are caused by the activity and occur at the same time and place.

Discharge: The term ''discharge'' means any discharge of dredged or fill material into waters of the United States.

Ecological reference: A model used to plan and design an aquatic habitat and riparian area restoration, enhancement, or establishment activity under NWP 27. An ecological reference may be based on the structure, functions, and dynamics of an aquatic habitat type or a riparian area

type that currently exists in the region where the proposed NWP 27 activity is located. Alternatively, an ecological reference may be based on a conceptual model for the aquatic habitat type or riparian area type to be restored, enhanced, or established as a result of the proposed NWP 27 activity. An ecological reference takes into account the range of variation of the aquatic habitat type or riparian area type in the region.

Enhancement: The manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Establishment (creation): The manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area.

High Tide Line: The line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

Historic Property: Any prehistoric or historic district, site (including archaeological site), building, structure, or other object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR part 60).

Independent utility: A test to determine what constitutes a single and complete non-linear project in the Corps Regulatory Program. A project is considered to have independent utility if it would be constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

Indirect effects: Effects that are caused by the activity and are later in time or farther removed in distance but are still reasonably foreseeable.

Loss of waters of the United States: Waters of the United States that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. The loss of stream bed includes the acres of stream bed that are permanently adversely affected by filling or excavation because of the regulated activity. Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the United States is a threshold measurement of the impact to jurisdictional waters or wetlands for determining whether a project may qualify for an NWP; it is not a net threshold that is calculated after considering compensatory mitigation that may be used to offset losses of aquatic functions and services. Waters of the United States temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the United States. Impacts resulting from activities that do not require Department of the Army authorization, such as activities eligible for exemptions under section 404(f) of the Clean Water Act, are not considered when calculating the loss of waters of the United States.

Navigable waters: Waters subject to section 10 of the Rivers and Harbors Act of 1899. These waters are defined at 33 CFR part 329.

Non-tidal wetland: A non-tidal wetland is a wetland that is not subject to the ebb and flow of tidal waters. Non- tidal wetlands contiguous to tidal waters are located landward of the high tide line (i.e., spring high tide line).

Open water: For purposes of the NWPs, an open water is any area that in a year with normal patterns of precipitation has water flowing or standing above ground to the extent that an ordinary high water mark can be determined. Aquatic vegetation within the area of flowing or standing water is either non-emergent, sparse, or absent. Vegetated shallows are considered to be open waters. Examples of ''open waters'' include rivers, streams, lakes, and ponds.

Ordinary High Water Mark: The term ordinary high water mark means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Perennial stream: A perennial stream has surface water flowing continuously year-round during a typical year.

Practicable: Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Pre-construction notification: A request submitted by the project proponent to the Corps for confirmation that a particular activity is authorized by nationwide permit. The request may be a permit application, letter, or similar document that includes information about the proposed work and its anticipated environmental effects. Pre- construction notification may be required by the terms and conditions of a nationwide permit, or by regional conditions. A pre-construction notification may be voluntarily submitted in cases where pre-construction notification is not required and the project proponent wants confirmation that the activity is authorized by nationwide permit.

Preservation: The removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function but does not result in a gain in aquatic resource area.

Restoration: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: Re-establishment and rehabilitation.

Riffle and pool complex: Riffle and pool complexes are special aquatic sites under the 404(b)(1) Guidelines. Riffle and pool complexes sometimes characterize steep gradient sections of streams. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a course substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. A slower stream velocity, a streaming flow, a smooth surface, and a finer substrate characterize pools.

Riparian areas: Riparian areas are lands next to streams, lakes, and estuarine-marine shorelines. Riparian areas are transitional between terrestrial and aquatic ecosystems, through which surface and subsurface hydrology connects riverine, lacustrine, estuarine, and marine waters with their adjacent wetlands, non-wetland waters, or uplands. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality. (See general condition 23.)

Shellfish seeding: The placement of shellfish seed and/or suitable substrate to increase shellfish production. Shellfish seed consists of immature individual shellfish or individual shellfish attached to shells or shell fragments (i.e., spat on shell). Suitable substrate may consist of shellfish shells, shell fragments, or other appropriate materials placed into waters for shellfish habitat.

Single and complete linear project: A linear project is a project constructed for the purpose of getting people, goods, or services from a point of origin to a terminal point, which often involves multiple crossings of one or more waterbodies at separate and distant locations. The term

''single and complete project'' is defined as that portion of the total linear project proposed or accomplished by one owner/developer or partnership or other association of owners/developers that includes all crossings of a single water of the United States (i.e., a single waterbody) at a specific location. For linear projects crossing a single or multiple waterbodies several times at separate and distant locations, each crossing is considered a single and complete project for purposes of NWP authorization. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately.

Single and complete non-linear project: For non-linear projects, the term ''single and complete project'' is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A single and complete non-linear project must have independent utility (see definition of ''independent utility''). Single and complete non-linear projects may not be ''piecemealed'' to avoid the limits in an NWP authorization.

Stormwater management: Stormwater management is the mechanism for controlling stormwater runoff for the purposes of reducing downstream erosion, water quality degradation, and flooding and mitigating the adverse effects of changes in land use on the aquatic environment.

Stormwater management facilities: Stormwater management facilities are those facilities, including but not limited to, stormwater retention and detention ponds and best management practices, which retain water for a period of time to control runoff and/or improve the quality (i.e., by reducing the concentration of nutrients, sediments, hazardous substances and other pollutants) of stormwater runoff.

Stream bed: The substrate of the stream channel between the ordinary high water marks. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the stream bed, but outside of the ordinary high water marks, are not considered part of the stream bed.

Stream channelization: The manipulation of a stream's course, condition, capacity, or location that causes more than minimal interruption of normal stream processes. A channelized jurisdictional stream remains a water of the United States.

Structure: An object that is arranged in a definite pattern of organization. Examples of structures include, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island, artificial reef, permanent mooring structure, power transmission line, permanently moored floating vessel, piling, aid to navigation, or any other manmade obstacle or obstruction.

Tidal wetland: A tidal wetland is a jurisdictional wetland that is inundated by tidal waters. Tidal waters rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by other waters, wind, or other effects. Tidal wetlands are located channelward of the high tide line.

Tribal lands: Any lands title to which is either: (1) Held in trust by the United States for the benefit of any Indian tribe or individual; or (2) held by any Indian tribe or individual subject to restrictions by the United States against alienation.

Tribal rights: Those rights legally accruing to a tribe or tribes by virtue of inherent sovereign authority, unextinguished aboriginal title, treaty, statute, judicial decisions, executive order or agreement, and that give rise to legally enforceable remedies.

Vegetated shallows: Vegetated shallows are special aquatic sites under the 404(b)(1) Guidelines. They are areas that are permanently inundated and under normal circumstances have rooted aquatic vegetation, such as seagrasses in marine and estuarine systems and a variety of vascular rooted plants in freshwater systems.

Waterbody: For purposes of the NWPs, a waterbody is a ''water of the United States.'' If a wetland is adjacent to a waterbody determined to be a water of the United States, that waterbody and any adjacent wetlands are considered together as a sing e aquatic unit (see 33 CFR 328.4(c)(2)).

Nationwide Permit 18 – *Minor Discharges*
Effective Date: February 25, 2022 / Expiration Date: March 14, 2026
Authorities: Sections 10 and 404

Minor discharges of dredged or fill material into all waters of the United States, provided the activity meets all of the following criteria:

(a) The quantity of discharged dredged or fill material and the volume of area excavated do not exceed 25 cubic yards below the plane of the ordinary high water mark or the high tide line;

(b) The discharge of dredged or fill material will not cause the loss of more than 1/10-acre of waters of the United States; and

(c) The discharge of dredged or fill material is not placed for the purpose of a stream diversion.

***Notification*: The permittee must submit a pre-construction notification to the district engineer prior to commencing the activity if: (1) the discharge of dredged or fill material or the volume of area excavated exceeds 10 cubic yards below the plane of the ordinary high water mark or the high tide line, or (2) the discharge of dredged or fill material is in a special aquatic site, including wetlands. (See general condition 32.)**

REGIONAL CONDITIONS:

For applicable Water Quality Certification (WQC) determination or requirements and Coastal Zone Management Act (CZMA) consistency determinations or requirements see the Alabama Department of Environmental Management (ADEM) conditions affixed to the end of this document. Alternatively, copies of the final ADEM conditions are also available on the SAM District webpage at: https://www.sam.usace.army.mil/Missions/Regulatory/NWP/

GENERAL CONDITIONS:

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as applicable, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for an NWP. Every person who may wish to obtain permit authorization under one or more NWPs, or who is currently relying on an existing or prior permit authorization under one or more NWPs, has been and is on notice that all of the provisions of 33 CFR 330.1 through 330.6 apply to every NWP authorization. Note especially 33 CFR 330.5 relating to the modification, suspension, or revocation of any NWP authorization.

1. *Navigation.*
   (a) No activity may cause more than a minimal adverse effect on navigation.
   (b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.
   (c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. *Aquatic Life Movements.* No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species. If a bottomless culvert cannot be used, then the crossing should be designed and constructed to minimize adverse effects to aquatic life movements.

3. *Spawning Areas.* Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (*e.g.,* through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. *Migratory Bird Breeding Areas.* Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. *Shellfish Beds.* No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. *Suitable Material.* No activity may use unsuitable material (*e.g.,* trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see section 307 of the Clean Water Act).

7. *Water Supply Intakes.* No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. *Adverse Effects from Impoundments.* If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. *Management of Water Flows.* To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization, storm water management activities, and temporary and permanent road crossings, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g. stream restoration or relocation activities).

10. *Fills Within 100-Year Floodplains.* The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. *Equipment.* Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. *Soil Erosion and Sediment Controls.* Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow, or during low tides.

13. *Removal of Structures and Fills.* Temporary structures must be removed, to the maximum extent practicable, after their use has been discontinued. Temporary fills must be removed in

their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. *Proper Maintenance*. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. *Single and Complete Project*. The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. *Wild and Scenic Rivers*.
    (a) No NWP activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status.
    (b) If a proposed NWP activity will occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, the permittee must submit a pre-construction notification (see general condition 32). The district engineer will coordinate the PCN with the Federal agency with direct management responsibility for that river. Permittees shall not begin the NWP activity until notified by the district engineer that the Federal agency with direct management responsibility for that river has determined in writing that the proposed NWP activity will not adversely affect the Wild and Scenic River designation or study status.
    (c) Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service). Information on these rivers is also available at: http://www.rivers.gov/ .

17. *Tribal Rights*. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. *Endangered Species*.
    (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat unless ESA section 7 consultation addressing the consequences of the proposed activity on listed species or critical habitat has been completed. See 50 CFR 402.02 for the definition of "effects of the action" for the purposes of ESA section 7 consultation, as well as 50 CFR 402.17, which provides further explanation under ESA section 7 regarding "activities that are reasonably certain to occur" and "consequences caused by the proposed action."
    (b) Federal agencies should follow their own procedures for complying with the requirements of the ESA (see 33 CFR 330.4(f)(1)). If pre-construction notification is required for the proposed activity, the Federal permittee must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will verify that the appropriate documentation has been submitted. If the appropriate documentation has not been submitted, additional ESA section 7 consultation may be necessary for the activity and the respective federal agency would be responsible for fulfilling its obligation under section 7 of the ESA.
    (c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the activity, or if the activity is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed activity or that utilize the designated critical habitat that might be affected by the proposed activity. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non- Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. For activities where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the activity, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification that the proposed activity will have "no effect" on listed species or critical habitat, or until ESA section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.
    (d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species specific permit conditions to the NWPs.
    (e) (e) Authorization of an activity by an NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the FWS or the NMFS, the Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.
    (f) If the non-federal permittee has a valid ESA section 10(a)(1)(B) incidental take permit with an approved Habitat Conservation Plan for a project or a group of projects that includes the proposed NWP activity, the non-federal applicant should provide a copy of that ESA section 10(a)(1)(B) permit with the PCN required by paragraph (c) of this general condition. The district engineer will coordinate with the agency that issued the ESA section 10(a)(1)(B) permit to determine whether the proposed NWP activity and the associated incidental take were considered in the internal ESA section 7 consultation conducted for the ESA section 10(a)(1)(B) permit. If that coordination results in concurrence from the agency that the proposed NWP activity and the associated incidental take were considered in the internal ESA section 7 consultation for the ESA section 10(a)(1)(B) permit, the district engineer does not need to conduct a separate ESA section 7 consultation for the proposed NWP activity. The district engineer will notify the non-federal applicant within 45 days of receipt of a complete pre- construction notification whether the ESA section 10(a)(1)(B) permit covers the proposed NWP activity or whether additional ESA section 7 consultation is required.
    (g) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the FWS and NMFS or their worldwide Web pages at *http://www.fws.gov/* or *http://www.fws.gov/ipac* and *http://www.nmfs.noaa.gov/pr/species/esa/* respectively.

19. *Migratory Birds and Bald and Golden Eagles.* The permittee is responsible for ensuring that an action authorized by NWP complies with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The permittee is responsible for contacting the appropriate local office of the U.S. Fish and Wildlife Service to determine what measures, if any, are necessary or appropriate to reduce adverse effects to migratory birds or eagles, including whether "incidental take" permits are necessary and available under the Migratory Bird Treaty Act or Bald and Golden Eagle Protection Act for a particular activity.

20. *Historic Properties.*

(a) No activity is authorized under any NWP which may have the potential to cause effects to properties listed, or eligible for listing, in the National Register of Historic Places until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.
(b) Federal permittees should follow their own procedures for complying with the requirements of section 106 of the National Historic Preservation Act (see 33 CFR 330.4(g)(1)). If pre-construction notification is required for the proposed NWP activity, the Federal permittee must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will verify that the appropriate documentation has been submitted. If the appropriate documentation is not submitted, then additional consultation under section 106 may be necessary. The respective federal agency is responsible for fulfilling its obligation to comply with section 106.
(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the NWP activity might have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties might have the potential to be affected by the proposed NWP activity or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of, or potential for, the presence of historic properties can be sought from the State Historic Preservation Officer, Tribal Historic Preservation Officer, or designated tribal representative, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts commensurate with potential impacts, which may include background research, consultation, oral history interviews, sample field investigation, and/or field survey. Based on the information submitted in the PCN and these identification efforts, the district engineer shall determine whether the proposed NWP activity has the potential to cause effects on the historic properties. Section 106 consultation is not required when the district engineer determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR 800.3(a)). Section 106 consultation is required when the district engineer determines that the activity has the potential to cause effects on historic properties. The district engineer will conduct consultation with consulting parties identified under 36 CFR 800.2(c) when he or she makes any of the following effect determinations for the purposes of section 106 of the NHPA: no historic properties affected, no adverse effect, or adverse effect.
(d) Where the non-Federal applicant has identified historic properties on which the proposed NWP activity might have the potential to cause effects and has so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects to historic properties or that NHPA section 106 consultation has been completed. For non-federal permittees, the district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA section 106 consultation is required. If NHPA section 106 consultation is required, the district engineer will notify the non-Federal applicant that he or she cannot begin the activity until section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.
(e) Prospective permittees should be aware that section 110k of the NHPA (54 U.S.C. 306113) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

21. *Discovery of Previously Unknown Remains and Artifacts*. Permittees that discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by NWP, they must immediately notify the district engineer of what they have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal, and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. *Designated Critical Resource Waters*. Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.
    (a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, 52, 57 and 5258 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.
    (b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, 38, and 54, notification is required in accordance with general condition 32, for any activity proposed by permittees in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after she or he determines that the impacts to the critical resource waters will be no more than minimal.

23. *Mitigation*. The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that the individual and cumulative adverse environmental effects are no more than minimal:
    (a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (*i.e.,* on site).
    (b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the individual and cumulative adverse environmental effects are no more than minimal.
    (c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse environmental effects of the proposed activity are no more than minimal, and provides an activity-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in only minimal adverse environmental effects.
    (d) Compensatory mitigation at a minimum one-for-one ratio will be required for all losses of stream bed that exceed 1/103/100-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse environmental effects of the proposed activity are no more than minimal, and provides an activity-specific waiver of this requirement. This compensatory mitigation requirement may be satisfied through the

restoration or enhancement of riparian areas next to streams in accordance with paragraph (e) of this general condition. For losses of stream bed of 1/103/100-acre or less that require pre- construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in only minimal adverse environmental effects. Compensatory mitigation for losses of streams should be provided, if practicable, through stream rehabilitation, enhancement, or preservation since streams are difficult-to- replace resources (see 33 CFR 332.3(e)(3)).

(e) Compensatory mitigation plans for NWP activities in or near streams or other open waters will normally include a requirement for the restoration or enhancement, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, the restoration or maintenance/protection of riparian areas may be the only compensatory mitigation required. If restoring riparian areas involves planting vegetation, only native species should be planted. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to restore or maintain/protect a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or maintaining/protecting a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of minimization or compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(f) Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in no more than minimal adverse environmental effects. For the NWPs, the preferred mechanism for providing compensatory mitigation is mitigation bank credits or in-lieu fee program credits (see 33 CFR 332.3(b)(2) and (3)). However, if an appropriate number and type of mitigation bank or in-lieu credits are not available at the time the PCN is submitted to the district engineer, the district engineer may approve the use of permittee- responsible mitigation.

(2) The amount of compensatory mitigation required by the district engineer must be sufficient to ensure that the authorized activity results in no more than minimal individual and cumulative adverse environmental effects (see 33 CFR 330.1(e)(3)). (See also 33 CFR 332.3(f)).

(3) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, aquatic resource restoration should be the first compensatory mitigation option considered for permittee-responsible mitigation.

(4) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) through (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)). If permittee-responsible mitigation is the proposed option, and the proposed compensatory mitigation site is located on land in which another federal agency holds an easement, the district engineer will coordinate with that federal agency to determine if proposed compensatory mitigation project is compatible with the terms of the easement.

(5) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan needs to address only the baseline conditions at the impact site and the number of credits to be provided (see 33 CFR 332.4(c)(1)(ii)).

(6) Compensatory mitigation requirements (*e.g.,* resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan (see 33 CFR 332.4(c)(1)(ii)).

(g) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of ½-acre, it cannot be used to authorize any NWP activity resulting in the loss of greater than ½-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that an NWP activity already meeting the established acreage limits also satisfies the no more than minimal impact requirement for the NWPs.

(h) Permittees may propose the use of mitigation banks, in-lieu fee programs, or permittee-responsible mitigation. When developing a compensatory mitigation proposal, the permittee must consider appropriate and practicable options consistent with the framework at 33 CFR 332.3(b). For activities resulting in the loss of marine or estuarine resources, permittee-responsible mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(i) Where certain functions and services of waters of the United States are permanently adversely affected by a regulated activity, such as discharges of dredged or fill material into waters of the United States that will convert a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse environmental effects of the activity to the no more than minimal level.

24. *Safety of Impoundment Structures.* To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state or federal, dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. *Water Quality.*

(a) Where the certifying authority (state, authorized tribe, or EPA, as appropriate) has not previously certified compliance of an NWP with CWA section 401, a CWA section 401 water quality certification for the proposed discharge must be obtained or waived (see 33 CFF 330.4(c)). If the permittee cannot comply with all of the conditions of a water quality certification previously issued by certifying authority for the issuance of the NWP, then the permittee must obtain a water quality certification or waiver for the proposed discharge in order for the activity to be authorized by an NWP.

(b) If the NWP activity requires pre-construction notification and the certifying authority has not previously certified compliance of an NWP with CWA section 401, the proposed discharge is not authorized by an NWP until water quality certification is obtained or waived. If the certifying authority issues a water quality certification for the proposed discharge, the permittee must submit a copy of the certification to the district engineer. The discharge is not authorized by an NWP until the district engineer has notified the permittee that the water quality certification requirement has been satisfied by the issuance of a water quality certification or a waiver.

(c) The district engineer or certifying authority may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. *Coastal Zone Management.* In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone

management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). If the permittee cannot comply with all of the conditions of a coastal zone management consistency concurrence previously issued by the state, then the permittee must obtain an individual coastal zone management consistency concurrence or presumption of concurrence in order for the activity to be authorized by an NWP. The district engineer or a state may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. *Regional and Case-By-Case Conditions.* The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its CWA section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. *Use of Multiple Nationwide Permits.* The use of more than one NWP for a single and complete project is authorized, subject to the following restrictions:

    (a) If only one of the NWPs used to authorize the single and complete project has a specified acreage limit, the acreage loss of waters of the United States cannot exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.
    (b) If one or more of the NWPs used to authorize the single and complete project has specified acreage limits, the acreage loss of waters of the United States authorized by those NWPs cannot exceed their respective specified acreage limits. For example, if a commercial development is constructed under NWP 39, and the single and complete project includes the filling of an upland ditch authorized by NWP 46, the maximum acreage loss of waters of the United States for the commercial development under NWP 39 cannot exceed 1/2-acre, and the total acreage loss of waters of United States due to the NWP 39 and 46 activities cannot exceed 1 acre.

29. *Transfer of Nationwide Permit Verifications.* If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

    ''When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.''

    _____
    (Transferee)

    _____
    (Date)

30. *Compliance Certification*. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and implementation of any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:
    (a) A statement that the authorized activity was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;
    (b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and
    (c) The signature of the permittee certifying the completion of the activity and mitigation. The completed certification document must be submitted to the district engineer within 30 days of completion of the authorized activity or the implementation of any required compensatory mitigation, whichever occurs later.

31. *Activities Affecting Structures or Works Built by the United States*. If an NWP activity also requires permission from the Corps pursuant to 33 U.S.C. 408 because it will alter or temporarily or permanently occupy or use a U.S. Army Corps of Engineers (USACE) federally authorized Civil Works project (a ''USACE project''), the prospective permittee must submit a pre-construction notification. See paragraph (b)(10) of general condition 32. An activity that requires section 408 permission and/or review is not authorized by an NWP until the appropriate Corps office issues the section 408 permission or completes its review to alter, occupy, or use the USACE project, and the district engineer issues a written NWP verification.

32. *Pre-Construction Notification.*
    (a) *Timing.* Where required by the terms of the NWP, the permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:
        (1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or
        (2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or are in the vicinity of the activity, or to notify the Corps pursuant to general condition 20 that the activity might have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is ''no effect'' on listed species or ''no potential to cause effects'' on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or section 106 of the National Historic Preservation Act (see 33 CFR 330.4(g)) has been completed. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the pr set forth in 33 CFR 330.5(d)(2).
    (b) *Contents of Pre-Construction Notification:* The PCN must be in writing and include the following information:
        (1) Name, address and telephone numbers of the prospective permittee;
        (2) Location of the proposed activity;

(3) Identify the specific NWP or NWP(s) the prospective permittee wants to use to authorize the proposed activity;

(4)

(i) A description of the proposed activity; the activity's purpose; direct and indirect adverse environmental effects the activity would cause, including the anticipated amount of loss of wetlands, other special aquatic sites, and other waters expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; a description of any proposed mitigation measures intended to reduce the adverse environmental effects caused by the proposed activity; and any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity, including other separate and distant crossings for linear projects that require Department of the Army authorization but do not require pre-construction notification. The description of the proposed activity and any proposed mitigation measures should be sufficiently detailed to allow the district engineer to determine that the adverse environmental effects of the activity will be no more than minimal and to determine the need for compensatory mitigation or other mitigation measures.

(ii)For linear projects where one or more single and complete crossings require pre-construction notification, the PCN must include the quantity of anticipated losses of wetlands, other special aquatic sites, and other waters for each single and complete crossing of those wetlands, other special aquatic sites, and other waters (including those single and complete crossings authorized by an NWP but do not require PCNs). This information will be used by the district engineer to evaluate the cumulative adverse environmental effects of the proposed linear project and does not change those non-PCN NWP activities into NWP PCNs.

(iii) Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the activity and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans).

(5) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial and intermittent streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many wetlands, other special aquatic sites, and other waters. Furthermore, the 45-day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate.

(6) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands or 3/100-acre of stream bed and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse environmental effects are no more than minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

(7) For non-federal permittees, if any listed species (or species proposed for listing) or designated critical habitat (or critical habitat proposed for such designation) might be affected or is in the vicinity of the activity, or if the activity is located in designated critical habitat (or critical habitat proposed for such designation), the PCN must include the name(s) of those endangered or threatened species (or species proposed for listing) that might be affected by the proposed activity or utilize the designated critical habitat (or critical habitat proposed for such designation) that might be affected by the proposed activity. For NWP activities that require pre-construction notification, Federal permittees must provide documentation demonstrating compliance with the Endangered Species Act.

(8) For non-federal permittees, if the NWP activity might have the potential to cause effects to a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, the PCN must state which historic property might have the potential to be affected by the proposed activity or include a vicinity map indicating the location of the historic property. For NWP activities that require pre-construction notification, Federal permittees must provide documentation demonstrating compliance with section 106 of the National Historic Preservation Act.

(9) For an activity that will occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, the PCN must identify the Wild and Scenic River or the ''study river'' (see general condition 16); and

(10) For an NWP activity that requires permission from, or review by, the Corps pursuant to 33 U.S.C. 408 because it will alter or temporarily or permanently occupy or use a U.S. Army Corps of Engineers federally authorized civil works project, the pre-construction notification must include a statement confirming that the project proponent has submitted a written request for section 408 permission from, or review by, the Corps office having jurisdiction over that USACE project.

(c) *Form of Pre-Construction Notification:* The nationwide permit pre-construction notification form (Form ENG 6082) should be used for NWP PCNs. A letter containing the required information may also be used. Applicants may provide electronic files of PCNs and supporting materials if the district engineer has established tools and procedures for electronic submittals.

(d) *Agency Coordination:*

(1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the activity's adverse environmental effects so that they are no more than minimal.

(2) Agency coordination is required for:

(i) All NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States;

(ii) NWP 13 activities in excess of 500 linear feet, fills greater than one cubic yard per running foot, or involve discharges of dredged or fill material into special aquatic sites; and

(iii) NWP 54 activities in excess of 500 linear feet, or that extend into the waterbody more than 30 feet from the mean low water line in tidal waters or the ordinary high water mark in the Great Lakes.

(3) When agency coordination is required, the district engineer will immediately provide (e.g., via email, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (FWS, state natural resource or water quality agency, EPA, and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to notify the district engineer via telephone, facsimile transmission, or email that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse environmental effects will be more than minimal. If so, contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure that the net adverse environmental effects of the proposed activity are no more than minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(4) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.
(5) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of pre-construction notifications to expedite agency coordination.

DISTRICT ENGINEER'S DECISION:

1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. If a project proponent requests authorization by a specific NWP, the district engineer should issue the NWP verification for that activity if it meets the terms and conditions of that NWP, unless he or she determines, after considering mitigation, that the proposed activity will result in more than minimal individual and cumulative adverse effects on the aquatic environment and other aspects of the public interest and exercises discretionary authority to require an individual permit for the proposed activity. For a linear project, this determination will include an evaluation of the single and complete crossings of waters of the United States that require PCNs to determine whether they individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings of waters of the United States authorized by an NWP. If an applicant requests a waiver of an applicable limit, as provided for in NWPs 13, 36, or 54, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in only minimal individual and cumulative adverse environmental effects.
2. When making minimal adverse environmental effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. He or she will also consider the cumulative adverse environmental effects caused by activities authorized by an NWP and whether those cumulative adverse environmental effects are no more than minimal. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional or condition assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse environmental effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.
3. If the proposed activity requires a PCN and will result in a loss of greater than 1/10-acre of wetlands or 3/100-acre of stream bed, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for NWP activities with smaller impacts, or for impacts to other types of waters. The district engineer will consider any proposed compensatory mitigation or other mitigation measures the applicant has included in the proposal in determining whether the net adverse environmental effects of the proposed activity are no more than minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse environmental effects are no more than minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure that the NWP activity results in no more than minimal adverse environmental effects. If the net adverse environmental effects of the NWP activity (after consideration of the mitigation proposal) are determined by the district engineer to be no more than minimal, the district engineer will provide a timely written response to the applicant. The response will state that the NWP activity can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.
4. If the district engineer determines that the adverse environmental effects of the proposed activity are more than minimal, then the district engineer will notify the applicant either:
   (a) That the activity does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit;
   (b) that the activity is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse environmental effects so that they are no more than minimal; or
   (c) that the activity is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse environmental effects, the activity will be authorized within the 45-day PCN period (unless additional time is required to comply with general conditions 18, 20, and/or 31), with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation plan or a requirement that the applicant submit a mitigation plan that would reduce the adverse environmental effects so that they are no more than minimal. When compensatory mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

FURTHER INFORMATION:

1. District engineers have authority to determine if an activity complies with the terms and conditions of an NWP.
2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.
3. NWPs do not grant any property rights or exclusive privileges.
4. NWPs do not authorize any injury to the property or rights of others.
5. NWPs do not authorize interference with any existing or proposed Federal project (see general condition 31).

DEFINITIONS:

Best management practices (BMPs): Policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural.

Compensatory mitigation: The restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Currently serviceable: Useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

Direct effects: Effects that are caused by the activity and occur at the same time and place.

Discharge: The term ''discharge'' means any discharge of dredged or fill material into waters of the United States.

Ecological reference: A model used to plan and design an aquatic habitat and riparian area restoration, enhancement, or establishment activity under NWP 27. An ecological reference may be based on the structure, functions, and dynamics of an aquatic habitat type or a riparian area

type that currently exists in the region where the proposed NWP 27 activity is located. Alternatively, an ecological reference may be based on a conceptual model for the aquatic habitat type or riparian area type to be restored, enhanced, or established as a result of the proposed NWP 27 activity. An ecological reference takes into account the range of variation of the aquatic habitat type or riparian area type in the region.

Enhancement: The manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Establishment (creation): The manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area.

High Tide Line: The line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

Historic Property: Any prehistoric or historic district, site (including archaeological site), building, structure, or other object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR part 60).

Independent utility: A test to determine what constitutes a single and complete non-linear project in the Corps Regulatory Program. A project is considered to have independent utility if it would be constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

Indirect effects: Effects that are caused by the activity and are later in time or farther removed in distance but are still reasonably foreseeable.

Loss of waters of the United States: Waters of the United States that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. The loss of stream bed includes the acres of stream bed that are permanently adversely affected by filling or excavation because of the regulated activity. Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the United States is a threshold measurement of the impact to jurisdictional waters or wetlands for determining whether a project may qualify for an NWP; it is not a net threshold that is calculated after considering compensatory mitigation that may be used to offset losses of aquatic functions and services. Waters of the United States temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the United States. Impacts resulting from activities that do not require Department of the Army authorization, such as activities eligible for exemptions under section 404(f) of the Clean Water Act, are not considered when calculating the loss of waters of the United States.

Navigable waters: Waters subject to section 10 of the Rivers and Harbors Act of 1899. These waters are defined at 33 CFR part 329.

Non-tidal wetland: A non-tidal wetland is a wetland that is not subject to the ebb and flow of tidal waters. Non- tidal wetlands contiguous to tidal waters are located landward of the high tide line (i.e., spring high tide line).

Open water: For purposes of the NWPs, an open water is any area that in a year with normal patterns of precipitation has water flowing or standing above ground to the extent that an ordinary high water mark can be determined. Aquatic vegetation within the area of flowing or standing water is either non-emergent, sparse, or absent. Vegetated shallows are considered to be open waters. Examples of ''open waters'' include rivers, streams, lakes, and ponds.

Ordinary High Water Mark: The term ordinary high water mark means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Perennial stream: A perennial stream has surface water flowing continuously year-round during a typical year.

Practicable: Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Pre-construction notification: A request submitted by the project proponent to the Corps for confirmation that a particular activity is authorized by nationwide permit. The request may be a permit application, letter, or similar document that includes information about the proposed work and its anticipated environmental effects. Pre- construction notification may be required by the terms and conditions of a nationwide permit, or by regional conditions. A pre-construction notification may be voluntarily submitted in cases where pre-construction notification is not required and the project proponent wants confirmation that the activity is authorized by nationwide permit.

Preservation: The removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function but does not result in a gain in aquatic resource area.

Restoration: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: Re-establishment and rehabilitation.

Riffle and pool complex: Riffle and pool complexes are special aquatic sites under the 404(b)(1) Guidelines. Riffle and pool complexes sometimes characterize steep gradient sections of streams. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a course substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. A slower stream velocity, a streaming flow, a smooth surface, and a finer substrate characterize pools.

Riparian areas: Riparian areas are lands next to streams, lakes, and estuarine-marine shorelines. Riparian areas are transitional between terrestrial and aquatic ecosystems, through which surface and subsurface hydrology connects riverine, lacustrine, estuarine, and marine waters with their adjacent wetlands, non-wetland waters, or uplands. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality. (See general condition 23.)

Shellfish seeding: The placement of shellfish seed and/or suitable substrate to increase shellfish production. Shellfish seed consists of immature individual shellfish or individual shellfish attached to shells or shell fragments (i.e., spat on shell). Suitable substrate may consist of shellfish shells, shell fragments, or other appropriate materials placed into waters for shellfish habitat.

Single and complete linear project: A linear project is a project constructed for the purpose of getting people, goods, or services from a point of origin to a terminal point, which often involves multiple crossings of one or more waterbodies at separate and distant locations. The term

''single and complete project'' is defined as that portion of the total linear project proposed or accomplished by one owner/developer or partnership or other association of owners/developers that includes all crossings of a single water of the United States (i.e., a single waterbody) at a specific location. For linear projects crossing a single or multiple waterbodies several times at separate and distant locations, each crossing is considered a single and complete project for purposes of NWP authorization. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately.

Single and complete non-linear project: For non-linear projects, the term ''single and complete project'' is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A single and complete non-linear project must have independent utility (see definition of ''independent utility''). Single and complete non-linear projects may not be ''piecemealed'' to avoid the limits in an NWP authorization.

Stormwater management: Stormwater management is the mechanism for controlling stormwater runoff for the purposes of reducing downstream erosion, water quality degradation, and flooding and mitigating the adverse effects of changes in land use on the aquatic environment.

Stormwater management facilities: Stormwater management facilities are those facilities, including but not limited to, stormwater retention and detention ponds and best management practices, which retain water for a period of time to control runoff and/or improve the quality (i.e., by reducing the concentration of nutrients, sediments, hazardous substances and other pollutants) of stormwater runoff.

Stream bed: The substrate of the stream channel between the ordinary high water marks. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the stream bed, but outside of the ordinary high water marks, are not considered part of the stream bed.

Stream channelization: The manipulation of a stream's course, condition, capacity, or location that causes more than minimal interruption of normal stream processes. A channelized jurisdictional stream remains a water of the United States.

Structure: An object that is arranged in a definite pattern of organization. Examples of structures include, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island, artificial reef, permanent mooring structure, power transmission line, permanently moored floating vessel, piling, aid to navigation, or any other manmade obstacle or obstruction.

Tidal wetland: A tidal wetland is a jurisdictional wetland that is inundated by tidal waters. Tidal waters rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by other waters, wind, or other effects. Tidal wetlands are located channelward of the high tide line.

Tribal lands: Any lands title to which is either: (1) Held in trust by the United States for the benefit of any Indian tribe or individual; or (2) held by any Indian tribe or individual subject to restrictions by the United States against alienation.

Tribal rights: Those rights legally accruing to a tribe or tribes by virtue of inherent sovereign authority, unextinguished aboriginal title, treaty, statute, judicial decisions, executive order or agreement, and that give rise to legally enforceable remedies.

Vegetated shallows: Vegetated shallows are special aquatic sites under the 404(b)(1) Guidelines. They are areas that are permanently inundated and under normal circumstances have rooted aquatic vegetation, such as seagrasses in marine and estuarine systems and a variety of vascular rooted plants in freshwater systems.

Waterbody: For purposes of the NWPs, a waterbody is a ''water of the United States.'' If a wetland is adjacent to a waterbody determined to be a water of the United States, that waterbody and any adjacent wetlands are considered together as a sing e aquatic unit (see 33 CFR 328.4(c)(2)).

Nationwide Permit 19 – *Minor Dredging*
Effective Date: February 25, 2022 / Expiration Date: March 14, 2026
Authorities: Sections 10 and 404

Dredging of no more than 25 cubic yards below the plane of the ordinary high water mark or the mean high water mark from navigable waters of the United States (i.e., section 10 waters). This NWP does not authorize the dredging or degradation through siltation of coral reefs, sites that support submerged aquatic vegetation (including sites where submerged aquatic vegetation is documented to exist but may not be present in a given year), anadromous fish spawning areas, or wetlands, or the connection of canals or other artificial waterways to navigable waters of the United States (see 33 CFR 322.5(g)). All dredged material must be deposited and retained in an area that has no waters of the United States unless otherwise specifically approved by the district engineer under separate authorization.

REGIONAL CONDITIONS:

For applicable Water Quality Certification (WQC) determination or requirements and Coastal Zone Management Act (CZMA) consistency determinations or requirements see the Alabama Department of Environmental Management (ADEM) conditions affixed to the end of this document. Alternatively, copies of the final ADEM conditions are also available on the SAM District webpage at: https://www.sam.usace.army.mil/Missions/Regulatory/NWP/

GENERAL CONDITIONS:

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as applicable, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for an NWP. Every person who may wish to obtain permit authorization under one or more NWPs, or who is currently relying on an existing or prior permit authorization under one or more NWPs, has been and is on notice that all of the provisions of 33 CFR 330.1 through 330.6 apply to every NWP authorization. Note especially 33 CFR 330.5 relating to the modification, suspension, or revocation of any NWP authorization.

1. *Navigation.*
   (a) No activity may cause more than a minimal adverse effect on navigation.
   (b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.
   (c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. *Aquatic Life Movements.* No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species. If a bottomless culvert cannot be used, then the crossing should be designed and constructed to minimize adverse effects to aquatic life movements.

3. *Spawning Areas.* Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (*e.g.,* through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. *Migratory Bird Breeding Areas.* Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. *Shellfish Beds.* No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. *Suitable Material.* No activity may use unsuitable material (*e.g.,* trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see section 307 of the Clean Water Act).

7. *Water Supply Intakes.* No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. *Adverse Effects from Impoundments*. If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. *Management of Water Flows.* To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization, storm water management activities, and temporary and permanent road crossings, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g. stream restoration or relocation activities).

10. *Fills Within 100-Year Floodplains*. The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. *Equipment*. Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. *Soil Erosion and Sediment Controls*. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow, or during low tides.

13. *Removal of Structures and Fills*. Temporary structures must be removed, to the maximum extent practicable, after their use has been discontinued. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. *Proper Maintenance*. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. *Single and Complete Project*. The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. *Wild and Scenic Rivers*.
    (a) No NWP activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status.
    (b) If a proposed NWP activity will occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, the permittee must submit a pre-construction notification (see general condition 32). The district engineer will coordinate the PCN with the Federal agency with direct management responsibility for that river. Permittees shall not begin the NWP activity until notified by the district engineer that the Federal agency with direct management responsibility for that river has determined in writing that the proposed NWP activity will not adversely affect the Wild and Scenic River designation or study status.
    (c) Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service). Information on these rivers is also available at: http://www.rivers.gov/ .

17. *Tribal Rights*. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. *Endangered Species.*
    (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat unless ESA section 7 consultation addressing the consequences of the proposed activity on listed species or critical habitat has been completed. See 50 CFR 402.02 for the definition of "effects of the action" for the purposes of ESA section 7 consultation, as well as 50 CFR 402.17, which provides further explanation under ESA section 7 regarding "activities that are reasonably certain to occur" and "consequences caused by the proposed action."
    (b) Federal agencies should follow their own procedures for complying with the requirements of the ESA (see 33 CFR 330.4(f)(1)). If pre-construction notification is required for the proposed activity, the Federal permittee must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will verify that the appropriate documentation has been submitted. If the appropriate documentation has not been submitted, additional ESA section 7 consultation may be necessary for the activity and the respective federal agency would be responsible for fulfilling its obligation under section 7 of the ESA.
    (c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the activity, or if the activity is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed activity or that utilize the designated critical habitat that might be affected by the proposed activity. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non- Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. For activities where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the activity, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification that the proposed activity will have "no effect" on listed species or critical habitat, or until ESA section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.
    (d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species specific permit conditions to the NWPs.
    (e) (e) Authorization of an activity by an NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the FWS or the NMFS, the Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.
    (f) If the non-federal permittee has a valid ESA section 10(a)(1)(B) incidental take permit with an approved Habitat Conservation Plan for a project or a group of projects that includes the proposed NWP activity, the non-federal applicant should provide a copy of that ESA section 10(a)(1)(B) permit with the PCN required by paragraph (c) of this general condition. The district engineer will coordinate with the agency that issued the ESA section 10(a)(1)(B) permit to determine whether the proposed NWP activity and the associated incidental take were considered in the internal ESA section 7 consultation conducted for the ESA section 10(a)(1)(B) permit. If that coordination results in concurrence from the agency that the proposed NWP activity and the associated incidental take were considered in the internal ESA section 7 consultation for the ESA section 10(a)(1)(B) permit, the district engineer does not need to conduct a separate ESA section 7 consultation for the proposed NWP activity. The district engineer will notify the non-federal applicant within 45 days of receipt of a complete pre- construction notification whether the ESA section 10(a)(1)(B) permit covers the proposed NWP activity or whether additional ESA section 7 consultation is required.
    (g) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the FWS and NMFS or their worldwide Web pages at *http://www.fws.gov/* or *http://www.fws.gov/ipac* and *http://www.nmfs.noaa.gov/pr/species/esa/* respectively.

19. *Migratory Birds and Bald and Golden Eagles.* The permittee is responsible for ensuring that an action authorized by NWP complies with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The permittee is responsible for contacting the appropriate local office of the U.S. Fish and Wildlife Service to determine what measures, if any, are necessary or appropriate to reduce adverse effects to migratory birds or eagles, including whether "incidental take" permits are necessary and available under the Migratory Bird Treaty Act or Bald and Golden Eagle Protection Act for a particular activity.

20. *Historic Properties.*
    (a) No activity is authorized under any NWP which may have the potential to cause effects to properties listed, or eligible for listing, in the National Register of Historic Places until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.
    (b) Federal permittees should follow their own procedures for complying with the requirements of section 106 of the National Historic Preservation Act (see 33 CFR 330.4(g)(1)). If pre-construction notification is required for the proposed NWP activity, the Federal permittee must provide the district engineer with the appropriate documentation to

demonstrate compliance with those requirements. The district engineer will verify that the appropriate documentation has been submitted. If the appropriate documentation is not submitted, then additional consultation under section 106 may be necessary. The respective federal agency is responsible for fulfilling its obligation to comply with section 106.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the NWP activity might have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties might have the potential to be affected by the proposed NWP activity or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of, or potential for, the presence of historic properties can be sought from the State Historic Preservation Officer, Tribal Historic Preservation Officer, or designated tribal representative, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts commensurate with potential impacts, which may include background research, consultation, oral history interviews, sample field investigation, and/or field survey. Based on the information submitted in the PCN and these identification efforts, the district engineer shall determine whether the proposed NWP activity has the potential to cause effects on the historic properties. Section 106 consultation is not required when the district engineer determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR 800.3(a)). Section 106 consultation is required when the district engineer determines that the activity has the potential to cause effects on historic properties. The district engineer will conduct consultation with consulting parties identified under 36 CFR 800.2(c) when he or she makes any of the following effect determinations for the purposes of section 106 of the NHPA: no historic properties affected, no adverse effect, or adverse effect.

(d) Where the non-Federal applicant has identified historic properties on which the proposed NWP activity might have the potential to cause effects and has so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects to historic properties or that NHPA section 106 consultation has been completed. For non-federal permittees, the district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA section 106 consultation is required. If NHPA section 106 consultation is required, the district engineer will notify the non-Federal applicant that he or she cannot begin the activity until section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(e) Prospective permittees should be aware that section 110k of the NHPA (54 U.S.C. 306113) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

21. *Discovery of Previously Unknown Remains and Artifacts*. Permittees that discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by NWP, they must immediately notify the district engineer of what they have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal, and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. *Designated Critical Resource Waters*. Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.
    (a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, 52, 57 and 5258 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.
    (b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, 38, and 54, notification is required in accordance with general condition 32, for any activity proposed by permittees in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after she or he determines that the impacts to the critical resource waters will be no more than minimal.

23. *Mitigation*. The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that the individual and cumulative adverse environmental effects are no more than minimal:
    (a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (*i.e.,* on site).
    (b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the individual and cumulative adverse environmental effects are no more than minimal.
    (c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse environmental effects of the proposed activity are no more than minimal, and provides an activity-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in only minimal adverse environmental effects.
    (d) Compensatory mitigation at a minimum one-for-one ratio will be required for all losses of stream bed that exceed 1/103/100-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse environmental effects of the proposed activity are no more than minimal, and provides an activity-specific waiver of this requirement. This compensatory mitigation requirement may be satisfied through the restoration or enhancement of riparian areas next to streams in accordance with paragraph (e) of this general condition. For losses of stream bed of 1/103/100-acre or less that require pre- construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in only minimal adverse environmental effects. Compensatory mitigation for losses of streams should be provided, if practicable, through stream rehabilitation, enhancement, or preservation since streams are difficult-to- replace resources (see 33 CFR 332.3(e)(3)).

(e) Compensatory mitigation plans for NWP activities in or near streams or other open waters will normally include a requirement for the restoration or enhancement, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, the restoration or maintenance/protection of riparian areas may be the only compensatory mitigation required. If restoring riparian areas involves planting vegetation, only native species should be planted. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to restore or maintain/protect a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or maintaining/protecting a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of minimization or compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(f) Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in no more than minimal adverse environmental effects. For the NWPs, the preferred mechanism for providing compensatory mitigation is mitigation bank credits or in-lieu fee program credits (see 33 CFR 332.3(b)(2) and (3)). However, if an appropriate number and type of mitigation bank or in-lieu credits are not available at the time the PCN is submitted to the district engineer, the district engineer may approve the use of permittee- responsible mitigation.

(2) The amount of compensatory mitigation required by the district engineer must be sufficient to ensure that the authorized activity results in no more than minimal individual and cumulative adverse environmental effects (see 33 CFR 330.1(e)(3)). (See also 33 CFR 332.3(f)).

(3) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, aquatic resource restoration should be the first compensatory mitigation option considered for permittee-responsible mitigation.

(4) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) through (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)). If permittee-responsible mitigation is the proposed option, and the proposed compensatory mitigation site is located on land in which another federal agency holds an easement, the district engineer will coordinate with that federal agency to determine if proposed compensatory mitigation project is compatible with the terms of the easement.

(5) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan needs to address only the baseline conditions at the impact site and the number of credits to be provided (see 33 CFR 332.4(c)(1)(ii)).

(6) Compensatory mitigation requirements (*e.g.,* resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan (see 33 CFR 332.4(c)(1)(ii)).

(g) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any NWP activity resulting in the loss of greater than 1/2-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that an NWP activity already meeting the established acreage limits also satisfies the no more than minimal impact requirement for the NWPs.

(h) Permittees may propose the use of mitigation banks, in-lieu fee programs, or permittee-responsible mitigation. When developing a compensatory mitigation proposal, the permittee must consider appropriate and practicable options consistent with the framework at 33 CFR 332.3(b). For activities resulting in the loss of marine or estuarine resources, permittee-responsible mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(i) Where certain functions and services of waters of the United States are permanently adversely affected by a regulated activity, such as discharges of dredged or fill material into waters of the United States that will convert a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse environmental effects of the activity to the no more than minimal level.

24. *Safety of Impoundment Structures.* To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state or federal, dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. *Water Quality.*

(a) Where the certifying authority (state, authorized tribe, or EPA, as appropriate) has not previously certified compliance of an NWP with CWA section 401, a CWA section 401 water quality certification for the proposed discharge must be obtained or waived (see 33 CFF 330.4(c)). If the permittee cannot comply with all of the conditions of a water quality certification previously issued by certifying authority for the issuance of the NWP, then the permittee must obtain a water quality certification or waiver for the proposed discharge in order for the activity to be authorized by an NWP.

(b) If the NWP activity requires pre-construction notification and the certifying authority has not previously certified compliance of an NWP with CWA section 401, the proposed discharge is not authorized by an NWP until water quality certification is obtained or waived. If the certifying authority issues a water quality certification for the proposed discharge, the permittee must submit a copy of the certification to the district engineer. The discharge is not authorized by an NWP until the district engineer has notified the permittee that the water quality certification requirement has been satisfied by the issuance of a water quality certification or a waiver.

(c) The district engineer or certifying authority may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. *Coastal Zone Management.* In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). If the permittee cannot comply with all of the conditions of a coastal zone management consistency concurrence previously issued by the state, then the permittee must obtain an individual coastal zone management consistency concurrence or presumption of concurrence in order for the activity to be authorized by an NWP. The district engineer or a state may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. *Regional and Case-By-Case Conditions.* The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its CWA section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. *Use of Multiple Nationwide Permits.* The use of more than one NWP for a single and complete project is authorized, subject to the following restrictions:

    (a) If only one of the NWPs used to authorize the single and complete project has a specified acreage limit, the acreage loss of waters of the United States cannot exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

    (b) If one or more of the NWPs used to authorize the single and complete project has specified acreage limits, the acreage loss of waters of the United States authorized by those NWPs cannot exceed their respective specified acreage limits. For example, if a commercial development is constructed under NWP 39, and the single and complete project includes the filling of an upland ditch authorized by NWP 46, the maximum acreage loss of waters of the United States for the commercial development under NWP 39 cannot exceed 1/2-acre, and the total acreage loss of waters of United States due to the NWP 39 and 46 activities cannot exceed 1 acre.

29. *Transfer of Nationwide Permit Verifications.* If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

    ''When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.''

    _____

    (Transferee)

    _____

    (Date)

30. *Compliance Certification*. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and implementation of any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:
    (a) A statement that the authorized activity was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;
    (b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and
    (c) The signature of the permittee certifying the completion of the activity and mitigation. The completed certification document must be submitted to the district engineer within 30 days of completion of the authorized activity or the implementation of any required compensatory mitigation, whichever occurs later.

31. *Activities Affecting Structures or Works Built by the United States*. If an NWP activity also requires permission from the Corps pursuant to 33 U.S.C. 408 because it will alter or temporarily or permanently occupy or use a U.S. Army Corps of Engineers (USACE) federally authorized Civil Works project (a ''USACE project''), the prospective permittee must submit a pre-construction notification. See paragraph (b)(10) of general condition 32. An activity that requires section 408 permission and/or review is not authorized by an NWP until the appropriate Corps office issues the section 408 permission or completes its review to alter, occupy, or use the USACE project, and the district engineer issues a written NWP verification.

32. *Pre-Construction Notification.*
    (a) *Timing.* Where required by the terms of the NWP, the permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:
        (1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or
        (2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or are in the vicinity of the activity, or to notify the Corps pursuant to general condition 20 that the activity might have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is ''no effect'' on listed species or ''no potential to cause effects'' on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or section 106 of the National Historic Preservation Act (see 33 CFR 330.4(g)) has been completed. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the pr set forth in 33 CFR 330.5(d)(2).
    (b) *Contents of Pre-Construction Notification:* The PCN must be in writing and include the following information:
        (1) Name, address and telephone numbers of the prospective permittee;
        (2) Location of the proposed activity;
        (3) Identify the specific NWP or NWP(s) the prospective permittee wants to use to authorize the proposed activity;

        (4)
            (i) A description of the proposed activity; the activity's purpose; direct and indirect adverse environmental effects the activity would cause, including the anticipated amount of loss of wetlands, other special aquatic sites, and other waters expected

to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; a description of any proposed mitigation measures intended to reduce the adverse environmental effects caused by the proposed activity; and any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity, including other separate and distant crossings for linear projects that require Department of the Army authorization but do not require pre-construction notification. The description of the proposed activity and any proposed mitigation measures should be sufficiently detailed to allow the district engineer to determine that the adverse environmental effects of the activity will be no more than minimal and to determine the need for compensatory mitigation or other mitigation measures.

(ii) For linear projects where one or more single and complete crossings require pre-construction notification, the PCN must include the quantity of anticipated losses of wetlands, other special aquatic sites, and other waters for each single and complete crossing of those wetlands, other special aquatic sites, and other waters (including those single and complete crossings authorized by an NWP but do not require PCNs). This information will be used by the district engineer to evaluate the cumulative adverse environmental effects of the proposed linear project and does not change those non-PCN NWP activities into NWP PCNs.

(iii) Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the activity and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans).

(5) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial and intermittent streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many wetlands, other special aquatic sites, and other waters. Furthermore, the 45-day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate.

(6) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands or 3/100-acre of stream bed and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse environmental effects are no more than minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

(7) For non-federal permittees, if any listed species (or species proposed for listing) or designated critical habitat (or critical habitat proposed for such designation) might be affected or is in the vicinity of the activity, or if the activity is located in designated critical habitat (or critical habitat proposed for such designation), the PCN must include the name(s) of those endangered or threatened species (or species proposed for listing) that might be affected by the proposed activity or utilize the designated critical habitat (or critical habitat proposed for such designation) that might be affected by the proposed activity. For NWP activities that require pre-construction notification, Federal permittees must provide documentation demonstrating compliance with the Endangered Species Act.

(8) For non-federal permittees, if the NWP activity might have the potential to cause effects to a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, the PCN must state which historic property might have the potential to be affected by the proposed activity or include a vicinity map indicating the location of the historic property. For NWP activities that require pre-construction notification, Federal permittees must provide documentation demonstrating compliance with section 106 of the National Historic Preservation Act.

(9) For an activity that will occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, the PCN must identify the Wild and Scenic River or the ''study river'' (see general condition 16); and

(10) For an NWP activity that requires permission from, or review by, the Corps pursuant to 33 U.S.C. 408 because it will alter or temporarily or permanently occupy or use a U.S. Army Corps of Engineers federally authorized civil works project, the pre-construction notification must include a statement confirming that the project proponent has submitted a written request for section 408 permission from, or review by, the Corps office having jurisdiction over that USACE project.

(c) *Form of Pre-Construction Notification:* The nationwide permit pre-construction notification form (Form ENG 6082) should be used for NWP PCNs. A letter containing the required information may also be used. Applicants may provide electronic files of PCNs and supporting materials if the district engineer has established tools and procedures for electronic submittals.

(d) *Agency Coordination:*

(1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the activity's adverse environmental effects so that they are no more than minimal.

(2) Agency coordination is required for:

(i) All NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States;

(ii) NWP 13 activities in excess of 500 linear feet, fills greater than one cubic yard per running foot, or involve discharges of dredged or fill material into special aquatic sites; and

(iii) NWP 54 activities in excess of 500 linear feet, or that extend into the waterbody more than 30 feet from the mean low water line in tidal waters or the ordinary high water mark in the Great Lakes.

(3) When agency coordination is required, the district engineer will immediately provide (e.g., via email, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (FWS, state natural resource or water quality agency, EPA, and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to notify the district engineer via telephone, facsimile transmission, or email that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse environmental effects will be more than minimal. If so, contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure that the net adverse environmental effects of the proposed activity are no more than minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(4) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

(5) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of pre-construction notifications to expedite agency coordination.

DISTRICT ENGINEER'S DECISION:

1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. If a project proponent requests authorization by a specific NWP, the district engineer should issue the NWP verification for that activity if it meets the terms and conditions of that NWP, unless he or she determines, after considering mitigation, that the proposed activity will result in more than minimal individual and cumulative adverse effects on the aquatic environment and other aspects of the public interest and exercises discretionary authority to require an individual permit for the proposed activity. For a linear project, this determination will include an evaluation of the single and complete crossings of waters of the United States that require PCNs to determine whether they individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings of waters of the United States authorized by an NWP. If an applicant requests a waiver of an applicable limit, as provided for in NWPs 13, 36, or 54, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in only minimal individual and cumulative adverse environmental effects.
2. When making minimal adverse environmental effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. He or she will also consider the cumulative adverse environmental effects caused by activities authorized by an NWP and whether those cumulative adverse environmental effects are no more than minimal. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional or condition assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse environmental effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.
3. If the proposed activity requires a PCN and will result in a loss of greater than 1/10-acre of wetlands or 3/100-acre of stream bed, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for NWP activities with smaller impacts, or for impacts to other types of waters. The district engineer will consider any proposed compensatory mitigation or other mitigation measures the applicant has included in the proposal in determining whether the net adverse environmental effects of the proposed activity are no more than minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse environmental effects are no more than minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure that the NWP activity results in no more than minimal adverse environmental effects. If the net adverse environmental effects of the NWP activity (after consideration of the mitigation proposal) are determined by the district engineer to be no more than minimal, the district engineer will provide a timely written response to the applicant. The response will state that the NWP activity can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.
4. If the district engineer determines that the adverse environmental effects of the proposed activity are more than minimal, then the district engineer will notify the applicant either:
   (a) That the activity does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit;
   (b) that the activity is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse environmental effects so that they are no more than minimal; or
   (c) that the activity is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse environmental effects, the activity will be authorized within the 45-day PCN period (unless additional time is required to comply with general conditions 18, 20, and/or 31), with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation plan or a requirement that the applicant submit a mitigation plan that would reduce the adverse environmental effects so that they are no more than minimal. When compensatory mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

FURTHER INFORMATION:

1. District engineers have authority to determine if an activity complies with the terms and conditions of an NWP.
2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.
3. NWPs do not grant any property rights or exclusive privileges.
4. NWPs do not authorize any injury to the property or rights of others.
5. NWPs do not authorize interference with any existing or proposed Federal project (see general condition 31).

DEFINITIONS:

Best management practices (BMPs): Policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural.

Compensatory mitigation: The restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Currently serviceable: Useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

Direct effects: Effects that are caused by the activity and occur at the same time and place.

Discharge: The term ''discharge'' means any discharge of dredged or fill material into waters of the United States.

Ecological reference: A model used to plan and design an aquatic habitat and riparian area restoration, enhancement, or establishment activity under NWP 27. An ecological reference may be based on the structure, functions, and dynamics of an aquatic habitat type or a riparian area type that currently exists in the region where the proposed NWP 27 activity is located. Alternatively, an ecological reference may be based on a conceptual model for the aquatic habitat type or riparian area type to be restored, enhanced, or established as a result of the proposed NWP 27 activity. An ecological reference takes into account the range of variation of the aquatic habitat type or riparian area type in the region.

Enhancement: The manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Establishment (creation): The manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area.

High Tide Line: The line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

Historic Property: Any prehistoric or historic district, site (including archaeological site), building, structure, or other object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR part 60).

Independent utility: A test to determine what constitutes a single and complete non-linear project in the Corps Regulatory Program. A project is considered to have independent utility if it would be constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

Indirect effects: Effects that are caused by the activity and are later in time or farther removed in distance but are still reasonably foreseeable.

Loss of waters of the United States: Waters of the United States that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. The loss of stream bed includes the acres of stream bed that are permanently adversely affected by filling or excavation because of the regulated activity. Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the United States is a threshold measurement of the impact to jurisdictional waters or wetlands for determining whether a project may qualify for an NWP; it is not a net threshold that is calculated after considering compensatory mitigation that may be used to offset losses of aquatic functions and services. Waters of the United States temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the United States. Impacts resulting from activities that do not require Department of the Army authorization, such as activities eligible for exemptions under section 404(f) of the Clean Water Act, are not considered when calculating the loss of waters of the United States.

Navigable waters: Waters subject to section 10 of the Rivers and Harbors Act of 1899. These waters are defined at 33 CFR part 329.

Non-tidal wetland: A non-tidal wetland is a wetland that is not subject to the ebb and flow of tidal waters. Non- tidal wetlands contiguous to tidal waters are located landward of the high tide line (i.e., spring high tide line).

Open water: For purposes of the NWPs, an open water is any area that in a year with normal patterns of precipitation has water flowing or standing above ground to the extent that an ordinary high water mark can be determined. Aquatic vegetation within the area of flowing or standing water is either non-emergent, sparse, or absent. Vegetated shallows are considered to be open waters. Examples of ''open waters'' include rivers, streams, lakes, and ponds.

Ordinary High Water Mark: The term ordinary high water mark means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Perennial stream: A perennial stream has surface water flowing continuously year-round during a typical year.

Practicable: Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Pre-construction notification: A request submitted by the project proponent to the Corps for confirmation that a particular activity is authorized by nationwide permit. The request may be a permit application, letter, or similar document that includes information about the proposed work and its anticipated environmental effects. Pre- construction notification may be required by the terms and conditions of a nationwide permit, or by regional conditions. A pre-construction notification may be voluntarily submitted in cases where pre-construction notification is not required and the project proponent wants confirmation that the activity is authorized by nationwide permit.

Preservation: The removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function but does not result in a gain in aquatic resource area.

Restoration: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: Re-establishment and rehabilitation.

Riffle and pool complex: Riffle and pool complexes are special aquatic sites under the 404(b)(1) Guidelines. Riffle and pool complexes sometimes characterize steep gradient sections of streams. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a course substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. A slower stream velocity, a streaming flow, a smooth surface, and a finer substrate characterize pools.

Riparian areas: Riparian areas are lands next to streams, lakes, and estuarine-marine shorelines. Riparian areas are transitional between terrestrial and aquatic ecosystems, through which surface and subsurface hydrology connects riverine, lacustrine, estuarine, and marine waters with their adjacent wetlands, non-wetland waters, or uplands. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality. (See general condition 23.)

Shellfish seeding: The placement of shellfish seed and/or suitable substrate to increase shellfish production. Shellfish seed consists of immature individual shellfish or individual shellfish attached to shells or shell fragments (i.e., spat on shell). Suitable substrate may consist of shellfish shells, shell fragments, or other appropriate materials placed into waters for shellfish habitat.

Single and complete linear project: A linear project is a project constructed for the purpose of getting people, goods, or services from a point of origin to a terminal point, which often involves multiple crossings of one or more waterbodies at separate and distant locations. The term ''single and complete project'' is defined as that portion of the total linear project proposed or accomplished by one owner/developer or partnership or other association of owners/developers that includes all crossings of a single water of the United States (i.e., a single waterbody) at a specific location. For linear projects crossing a single or multiple waterbodies several times at separate and distant locations, each crossing is considered a single and complete project for

purposes of NWP authorization. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately.

Single and complete non-linear project: For non-linear projects, the term ''single and complete project'' is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A single and complete non-linear project must have independent utility (see definition of ''independent utility''). Single and complete non-linear projects may not be ''piecemealed'' to avoid the limits in an NWP authorization.

Stormwater management: Stormwater management is the mechanism for controlling stormwater runoff for the purposes of reducing downstream erosion, water quality degradation, and flooding and mitigating the adverse effects of changes in land use on the aquatic environment.

Stormwater management facilities: Stormwater management facilities are those facilities, including but not limited to, stormwater retention and detention ponds and best management practices, which retain water for a period of time to control runoff and/or improve the quality (i.e., by reducing the concentration of nutrients, sediments, hazardous substances and other pollutants) of stormwater runoff.

Stream bed: The substrate of the stream channel between the ordinary high water marks. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the stream bed, but outside of the ordinary high water marks, are not considered part of the stream bed.

Stream channelization: The manipulation of a stream's course, condition, capacity, or location that causes more than minimal interruption of normal stream processes. A channelized jurisdictional stream remains a water of the United States.

Structure: An object that is arranged in a definite pattern of organization. Examples of structures include, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island, artificial reef, permanent mooring structure, power transmission line, permanently moored floating vessel, piling, aid to navigation, or any other manmade obstacle or obstruction.

Tidal wetland: A tidal wetland is a jurisdictional wetland that is inundated by tidal waters. Tidal waters rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by other waters, wind, or other effects. Tidal wetlands are located channelward of the high tide line.

Tribal lands: Any lands title to which is either: (1) Held in trust by the United States for the benefit of any Indian tribe or individual; or (2) held by any Indian tribe or individual subject to restrictions by the United States against alienation.

Tribal rights: Those rights legally accruing to a tribe or tribes by virtue of inherent sovereign authority, unextinguished aboriginal title, treaty, statute, judicial decisions, executive order or agreement, and that give rise to legally enforceable remedies.

Vegetated shallows: Vegetated shallows are special aquatic sites under the 404(b)(1) Guidelines. They are areas that are permanently inundated and under normal circumstances have rooted aquatic vegetation, such as seagrasses in marine and estuarine systems and a variety of vascular rooted plants in freshwater systems.

Waterbody: For purposes of the NWPs, a waterbody is a ''water of the United States.'' If a wetland is adjacent to a waterbody determined to be a water of the United States, that waterbody and any adjacent wetlands are considered together as a sing e aquatic unit (see 33 CFR 328.4(c)(2)).

LANCE R. LEFLEUR
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December 14, 2020

Colonel Sebastien P. Joly
Commander, Mobile District
U.S. Army Corps of Engineers
P.O. Box 2288
Mobile, AL 36628-0001

RE: Clean Water Act (CWA) Section 401 Water Quality Certification (WQC), U.S. Army Corps of Engineers (COE) 2020 Proposed Issuance of Alabama Nationwide Permits (ALNWPs) For Activities Within the State of Alabama

Dear Colonel Joly:

This office has completed a review of the above-referenced notice and all associated materials submitted related to the proposed ALNWPs. Any comments made during the public notice period have also been forwarded to the Department for review.

1. Aids to Navigation
2. Structures in Artificial Canals
3. Maintenance
4. Fish and Wildlife Harvesting, Enhancement, and Attraction Devices and Activities
5. Scientific Measurement Devices
6. Survey Activities
7. Outfall Structures and Associated Intake Structures
8. Oil and Gas Structures on the Outer Continental Shelf
9. Structures in Fleeting and Anchorage Areas
10. Mooring Buoys
11. Temporary Recreational Structures
12. Oil or Natural Gas Pipeline Activities
13. Bank Stabilization
14. Linear Transportation Projects
15. U.S. Coast Guard Approved Bridges
16. Return Water From Upland Contained Disposal Areas
17. Hydropower Projects
18. Minor Discharges
19. Minor Dredging
20. Response Operations for Oil or Hazardous Substances
21. Surface Coal Mining Activities
22. Removal of Vessels
23. Approved Categorical Exclusions
24. Indian Tribe or State Administered Section 404 Programs
25. Structural Discharges
26. [Reserved]
27. Aquatic Habitat Restoration, Establishment, and Enhancement Activities
28. Modifications of Existing Marinas

29. Residential Developments
30. Moist Soil Management for Wildlife
31. Maintenance of Existing Flood Control Facilities
32. Completed Enforcement Actions
33. Temporary Construction, Access, and Dewatering
34. Cranberry Production Activities
35. Maintenance Dredging of Existing Basins
36. Boat Ramps
37. Emergency Watershed Protection and Rehabilitation
38. Cleanup of Hazardous and Toxic Waste
39. Commercial and Institutional Developments
40. Agricultural Activities
41. Reshaping Existing Drainage Ditches
42. Recreational Facilities
43. Stormwater Management Facilities
44. Mining Activities
45. Repair of Uplands Damaged by Discrete Events
46. Discharges in Ditches
47. [Reserved]
48. Commercial Shellfish Mariculture Activities
49. Coal Remining Activities
50. Underground Coal Mining Activities
51. Land-Based Renewable Energy Generation Facilities
52. Water-Based Renewable Energy Generation Pilot Projects
53. Removal of Low-Head Dams
54. Living Shorelines

A. Seaweed Mariculture Activities
B. Finfish Mariculture Activities
C. Electric Utility Line and Telecommunications Activities
D. Utility Line Activities for Water and Other Substances
E. Water Reclamation and Reuse Facilities

Because action pertinent to WQC is required by Section 401(a)(1) of the CWA, 33 U.S.C. Section 1251, et seq., we hereby issue certification that there is reasonable assurance that the discharge resulting from the proposed activities as submitted will not violate applicable water quality standards established under Section 303 of the CWA and Title 22, Section 22-22-9(g), Code of Alabama, 1975, provided the applicant acts in accordance with the following conditions as specified. We further certify that there are no applicable effluent limitations under Sections 301 and 302 nor applicable standards under Sections 306 and 307 of the CWA in regard to the activities specified. This certification shall expire at the same time as the expiration date for the above-referenced Alabama Nationwide Permits for activities within the State of Alabama.

To minimize adverse impacts to State waters, by copy of this letter we are requesting the Mobile District Corps of Engineers to incorporate the following as special conditions as appropriate to the type, location, scope, duration, and potential impact of each activity in Alabama authorized by the COE NWPs:

1. During project implementation, the applicant shall ensure compliance with applicable requirements of ADEM. Admin. Code Chapter 335-6-6 [National Pollutant Discharge Elimination System (NPDES)], Chapter 335-6-10 (Water Quality Criteria), and Chapter 335-6-11 (Water Use Classifications for Interstate and Intrastate Waters).

2. ADEM permit coverage may be required prior to commencing and/or continuing certain activities/operations relating to or resulting from the project. If an applicant has any questions regarding ADEM regulated activity or the need for NPDES permit coverage, the applicant can contact ADEM's Water Division at (334) 271-7823. If an applicant has any questions regarding ADEM regulated activity or the need for air permit coverage, the applicant can contact ADEM's Air Division at (334) 271-7869. If the applicant has any questions regarding ADEM regulated activity or the need for hazardous, toxic, and/or solid waste permit coverage, the applicant can contact ADEM's Land Division at (334) 271-7730.

3. Upon the loss or failure of any treatment facility, Best Management Practice (BMP), or other control, the applicant shall, where necessary to maintain compliance with this certification, suspend, cease, reduce or otherwise control work/activity and all discharges until effective treatment is restored. It shall not be a defense for the applicant in a compliance action that it would have been necessary to halt or reduce work or other activities in order to maintain compliance with the conditions of this certification.

4. The applicant shall retain records adequate to document activities authorized by this certification for a period of at least three years after completion of work/activity authorized by the certification. Upon written request, the applicant shall provide ADEM with a copy of any record/information required to be retained by this paragraph.

5. The applicant shall conduct or have conducted, at a minimum, weekly comprehensive site inspections until completion of the proposed activity to ensure that effective BMPs are properly designed, implemented, and regularly maintained (i.e. repair, replace, add to, improve, implement more effective practice, etc.) to prevent/minimize to the maximum extent practicable discharges of pollutants in order to provide for the protection of water quality.

6. The applicant shall implement a project-specific or a detailed general BMP Plan prepared by an ADEM recognized qualified credentialed professional (QCP) applicable to and commensurate with activities of the type proposed. Effective BMPs shall be implemented and continually maintained for the prevention and control of turbidity, sediment, and other sources of pollutants, including measures to ensure permanent revegetation or cover of all disturbed areas, during and after project implementation.

7. The applicant shall implement a Spill Prevention Control and Countermeasures (SPCC) Plan for all temporary and permanent onsite fuel or chemical storage tanks or facilities consistent with the requirements of ADEM Admin. Code R. 335-6-6-.12(r), Section 311 of the Federal Water Pollution Control Act, and 40 CFR Part 112. The applicant shall maintain onsite or have readily available sufficient oil & grease absorbing material and flotation booms to contain and clean-up fuel or chemical spills and leaks. The applicant shall immediately notify ADEM after becoming aware of a significant visible oil sheen in the vicinity of the proposed activity. In the event of a spill with the potential to impact groundwater or other waters of the State, the applicant should immediately call the National Response Center at 1-800-424-8802 and the Alabama Emergency Management Agency at 1-800-843-0699. The caller should be prepared to report the name, address and telephone number of person reporting spill, the exact location of the spill, the company name and location, the material spilled, the estimated quantity, the source of spill, the cause of the spill, the nearest downstream water with the potential to receive the spill, and the actions taken for containment and cleanup.

8. Additional, effective BMPs shall be fully implemented and maintained on a daily basis as needed to prevent to the maximum extent possible potential discharges of pollutants from activities authorized by this certification, directly to or to a tributary or other stream segment, that have the potential to impact a State water currently considered impaired [waterbody is identified on the Alabama 303(d) list, a total maximum daily load (TMDL) has been finalized for the waterbody, and/or the waterbody is otherwise considered a Tier 1 water pursuant to ADEM Admin. Code Ch. 335-6-10]. The applicant shall inspect all BMPs as often as is necessary (daily if needed) for effectiveness, need for maintenance, and the need to implement additional, effective BMPs. Additional effective BMPs shall immediately be implemented as needed to ensure full compliance with ADEM requirements and the protection of water quality in the impaired waterbody.

9. All construction and worker debris (e.g. trash, garbage, etc.) must be immediately removed and disposed in an approved manner. If acceptable offsite options are unavailable, effective onsite provisions for collection and control of onsite worker toilet wastes or gray waste waters (i.e. port-o-let, shower washdown, etc.) must be implemented and maintained. Soil contaminated by paint or chemical spills, oil spills, etc. must be immediately cleaned up or be removed and disposed in an approved manner. Also, the applicant shall manage and dispose of any trash, debris, and solid waste according to applicable state and federal requirements.

10. All materials used as fill, or materials used for construction of structures in a waterbody, must be non-toxic, non-leaching, non-acid forming, and free of solid waste or other debris. This requirement does not preclude the use of construction materials authorized by the COE that are typically utilized in marine or other aquatic applications.

11. The applicant shall implement appropriate measures to minimize the potential for a decrease of instream dissolved oxygen concentrations as a result of project implementation. In addition, the applicant shall ensure that the activities authorized by this certification do not significantly contribute to or cause a violation of applicable water quality standards for instream dissolved oxygen.

12. The applicant shall implement appropriate, effective BMPs, including installation of floating turbidity screens as necessary, to minimize downstream turbidity to the maximum extent practicable. The applicant shall visually monitor or measure background turbidity. The applicant must suspend operations should turbidity resulting from project implementation exceed background turbidity by more than 50 NTUs. Operations may resume when the turbidity decreases to within acceptable levels.

13. The applicant shall evaluate, characterize, and as necessary, conduct regular analysis of any material proposed to be dredged/removed/disturbed in order to ensure that potential pollutants are not present in concentrations that could cause or contribute to a violation of applicable water quality standards. Information regarding the evaluation, characterization, or detailed results of any analyses shall be made available to ADEM upon request.

14. If upland disposal areas are utilized, the applicant shall be responsible for the condition of the disposal area, including the structural integrity of any embankments, until the disposal area is permanently reclaimed or adequately stabilized, to ensure that sediment and/or turbidity in the return water and/or stormwater runoff will not cause substantial visible contrast with the receiving waters, or result in an increase of 50 NTUs above background turbidity levels in the receiving waters.

15. For proposed activities associated with new or updated docks, marinas, multiple boat slips, floating docks, large or multiple piers, etc. or that increase the number of berthing areas, the applicant shall

ensure that these facilities are equipped with appurtenances (i.e. trash receptacles, receptacles for fish offal and carcasses, SPCC for fueling facilities, and a sewage pump out system where appropriate) as needed to protect water quality.

16. The applicant is encouraged to consider additional pollution prevention practices, low impact development (LID), and other alternatives to assist in complying with applicable regulatory requirements and possible reduction/elimination of pollutant discharges. LID is an approach to land development or re-development that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product. There are many practices that have been used to implement these sustainable ideas such as bio-retention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements. By implementing LID principles and practices, water can be managed in a way that reduces the impact of built areas and promotes the natural movement of water within an ecosystem or watershed.

17. The applicant is encouraged to consider and implement a site design plan/strategy for post-construction hydrology to mimic pre-construction hydrology to the extent feasible, and for post-construction stormwater runoff peak flows and total stormwater volume to minimize potential downstream channel and stream bank erosion.

18. In recognition that projects are site specific in nature and conditions can change during project implementation, ADEM reserves the right to require the submission of additional information or require additional management measures to be implemented, as necessary on a case-by-case basis, in order to ensure the protection of water quality. Liability and responsibility for compliance with this certification are not delegable by contract or otherwise. The applicant shall ensure that any agent, contractor, subcontractor, or other person employed by, under contract, or paid a salary by the applicant complies with this certification. Any violations resulting from the actions of such person may be considered violations of this certification.

19. Issuance of a certification by ADEM neither precludes nor negates an operator/owner's responsibility or liability to apply for, obtain, or comply with other ADEM, federal, state, or local government permits, certifications, licenses, or other approvals. This certification does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to persons or property or invasion of other private rights, trespass, or any infringement of Federal, State, or local laws or regulations, and in no way purports to vest in the applicant title to lands now owned by the State of Alabama, nor shall it be construed as acquiescence by the State of Alabama of lands owned by the State of Alabama that may be in the applicant's possession.

Please feel free to contact me at 334/394-4304 in the event you have any questions.

Sincerely,

Anthony Scott Hughes, Chief
Field Operations Division

File: WQ401

c: Nashville District COE & EPA Region IV

LANCE R. LEFLEUR
DIRECTOR

KAY IVEY
GOVERNOR

Alabama Department of Environmental Management
adem.alabama.gov
1400 Coliseum Blvd. 36110-2400 ▪ Post Office Box 301463
Montgomery, Alabama 36130-1463
(334) 271-7700 ▪ FAX (334) 271-7950

December 15, 2020

Colonel Sebastien P. Joly
District Commander
U. S. Army Corps of Engineers, Mobile District
109 St. Joseph Street
Mobile, Alabama 36619

RE: U. S. Army Corps of Engineers Nationwide Permits (NWPs) Program
State of Alabama Coastal Consistency Concurrence
2020 NWP Reissuance
ACAMP-2016-301.1 | COE-2020-0002

Dear Colonel Joly:

The NWPs listed below have been determined by the ADEM, based on their scope or nature, not to have a significant impact on coastal resources when implemented in accordance with the specific conditions described herein and are therefore categorically certified to be consistent with the ACAMP pursuant to ADEM Administrative Code 335-8-1-.03(4).

1. **Aids to Navigation**
No additional coastal consistency conditions.

2. **Structures in Artificial Canals**
The permittee must obtain all appropriate authorizations required by the Alabama Department of Conservation and Natural Resources – State Lands Division (ADCNR-SLD) prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

3. **Maintenance**
   A. Activities authorized under Nationwide Permit 3 must not be located within or in close proximity to existing wetlands, submersed grassbeds, or natural oyster reefs and shall not result in adverse impacts to those resources.
   B. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

4. **Fish and Wildlife Harvesting, Enhancement, and Attraction Devices and Activities**
The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

5. **Scientific Measurement Devices**
   A. Activities authorized under Nationwide Permit 5 must not be located within or in close proximity to existing wetlands, submersed grassbeds, or natural oyster reefs and shall not result in adverse impacts to those resources.
   B. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

6. **Survey Activities**
No additional coastal consistency conditions.

7. Outfall Structures and Associated Intake Structures

A. Activities authorized under Nationwide Permit 7 must not be located within or in close proximity to existing wetlands, submersed grassbeds, or natural oyster reefs and shall not result in adverse impacts to those resources.
B. There must be no placement of new riprap in previously unarmored areas.
C. There must be no construction of new outfall and/or intake structures on properties fronting the Gulf of Mexico, Pelican Bay, Weeks Bay, Dauphin Island Audubon Sanctuary, or the Point aux Pines wetland system owned by the Board of Trustees of the University of Alabama.
D. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

8. Oil and Gas Structures on the Outer Continental Shelf

No additional coastal consistency conditions.

9. Structures in Fleeting and Anchorage Areas

The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

11. Temporary Recreational Structures

The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

12. Utility Line Activities

A. The permittee must submit a copy of the Pre-Construction Notification (PCN) required by the Corps to the ADEM Mobile-Coastal office.
B. Activities authorized under Nationwide Permit 12 must not be located within or in close proximity to existing submersed grassbeds or natural oyster reefs and shall not result in adverse impacts to those resources.
C. The permittee must demonstrate avoidance and minimization of wetland impacts to the maximum extent practicable. Wetland impacts may be considered only after utilization of all available uplands.
D. The permittee must undertake restoration of any wetland areas or State waterbottoms temporarily impacted as a result of activities authorized under Nationwide Permit 12. Disturbed areas must be returned to preproject elevations and wetland areas must be revegetated.
E. The permittee must provide compensatory mitigation for any authorized permanent wetland impacts and must submit supporting documentation (e.g. certificate of credit purchase) to the ADEM Mobile-Coastal office for verification.
F. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

14. Linear Transportation Crossings

A. The permittee must submit a copy of the PCN required by the Corps to the ADEM Mobile-Coastal office.
B. Nationwide Permit 14 may not be used to authorize wetland dredge or fill activities on residential or commercial lots, except on legally platted lots or parcels in existence on or before 14 August 1979. This condition does not apply to uses of regional benefit such as roads, highways, railways, trails, airport runways, and taxiways.
C. The permittee must demonstrate avoidance and minimization of wetland impacts to the maximum extent practicable. Wetland impacts may be considered only after utilization of all available uplands.
D. The permittee must provide compensatory mitigation for any authorized permanent wetland impacts and must submit supporting documentation (e.g. certificate of credit purchase) to the ADEM Mobile-Coastal office for verification.
E. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

15. U.S. Coast Guard Approved Bridges

The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

16. Return Water from Upland Contained Disposal Areas

A. The permittee must ensure the salinity of return waters from dredge disposal sites is similar to the salinity of the receiving waters.
B. The discharge from the upland contained disposal area(s) must not cause a violation of State water quality standards or applicable conditions of the State Clean Water Act Section 401 Water Quality Certification.

17. Hydropower Projects

No additional coastal consistency conditions.

18. Minor Discharges

A. The permittee must submit a copy of the PCN required by the Corps to the ADEM Mobile-Coastal office. The PCN must include a copy of the legal plat.
B. There must be no dredging or filling of wetlands, except on legally platted lots or parcels in existence on or before 14 August 1979.
C. Nationwide Permit 18 must not be used to authorize fill to accommodate construction of swimming pools, boat ramps, tennis courts, lawns, play areas or other ancillary projects or activities not directly related to the construction of residential dwellings and/or associated access drives and parking.
D. Activities authorized under Nationwide Permit 18 must not be located in close proximity to existing submersed grassbeds or natural oyster reefs and shall not result in adverse impacts to those resources.
E. The permittee must demonstrate avoidance and minimization of wetland impacts to the maximum extent practicable. Wetland impacts may be considered only after utilization of all available uplands.
F. The permittee must provide compensatory mitigation for any authorized permanent wetland impacts and must submit supporting documentation (e.g. certificate of credit purchase) to the ADEM Mobile-Coastal office for verification.
G. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

19. Minor Dredging

A. Activities authorized under Nationwide Permit 19 must not be located in close proximity to existing wetlands, submersed grassbeds, or natural oyster reefs and shall not result in adverse impacts to those resources.
B. Dredging is prohibited in the Gulf of Mexico or Pelican Bay in an area from the ADEM Construction Control Line to a point 1,500 feet seaward of Mean High Tide.
C. Dredging is prohibited in the Gulf of Mexico in an area from the City of Gulf Shores Construction Control Line to a point 1,500 feet seaward of Mean High Tide.
D. Dredged material must be placed in an upland disposal area and properly contained to prevent re-entering the waterway or wetlands unless specifically authorized by other approved permits or exemptions.
E. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

20. Response Operations for Oil and Hazardous Substances

The permittee must undertake restoration of any wetland areas or State waterbottoms temporarily impacted as a result of activities authorized under Nationwide Permit 20. Disturbed areas must be returned to preproject elevations and wetland areas must be revegetated.

22. Removal of Vessels

A. The permittee must undertake restoration of any wetland areas or State waterbottoms temporarily impacted as a result of activities authorized under Nationwide Permit 22. Disturbed areas must be returned to preproject elevations and wetland areas must be revegetated.

B. Vessel removal related to a catastrophic natural disaster (e.g. hurricane, discrete flooding event, etc.) is not authorized during the time an applicable Temporary State/Regional General Permit for Emergency Vessel Removal related to the natural disaster recovery is in effect.

23. Approved Categorical Exclusions

No additional coastal consistency conditions.

25. Structural Discharges

A. Activities authorized under Nationwide Permit 25 must not be located in close proximity to existing submersed grassbeds or natural oyster reefs and shall not result in adverse impacts to those resources.

B. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

27. Aquatic Habitat Restoration, Establishment, and Enhancement Activities

A. The permittee must submit a copy of the PCN required by the Corps to the ADEM Mobile-Coastal office.

B. There must be no construction of open water areas in existing wetlands unless the impacted wetland acreage is replaced elsewhere within the restoration, establishment, and/or enhancement project area.

C. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

28. Modifications of Existing Marinas

A. The permittee must submit notification to the ADEM Mobile-Coastal office prior to reconfiguration of existing docking facilities at marinas having 10 or more wet slips.

B. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

31. Maintenance of Existing Flood Control Facilities

No additional coastal consistency conditions.

32. Completed Enforcement Actions

No additional coastal consistency conditions.

33. Temporary Construction, Access and Dewatering

No additional coastal consistency conditions.

35. Maintenance Dredging of Existing Basins

A. Dredged material must be placed in an upland disposal area and properly contained to prevent re-entering the waterway or wetlands unless specifically authorized by other approved permits or exemptions.

B. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

36. Boat Ramps

A. Activities authorized under Nationwide Permit 36 must not be located within or in close proximity to existing wetlands, submersed grassbeds, or natural oyster reefs and shall not result in adverse impacts to those resources.

B. Nationwide Permit 36 must not allow construction of boat ramps on properties fronting the Gulf of Mexico, Pelican Bay, Weeks Bay, Dauphin Island Audubon Sanctuary, or the Point aux Pines wetland system owned by the Board of Trustees of the University of Alabama.

C. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

37. Emergency Watershed Protection and Rehabilitation

No additional coastal consistency conditions.

38. Cleanup of Hazardous and Toxic Waste

No additional coastal consistency conditions.

45. Repair of Uplands Damaged by Discrete Events

A. Activities authorized under Nationwide Permit 45 must not be located within or in close proximity to existing wetlands, submersed grassbeds, or natural oyster reefs and shall not result in adverse impacts to those resources.

B. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

46. Discharges in Ditches and Canals

No additional coastal consistency conditions.

48. Commercial Shellfish Aquaculture Activities

A. Activities and structures authorized under Nationwide Permit 48 must not be located within or in close proximity to existing wetlands, submersed grassbeds, or natural oyster reefs and shall not result in adverse impacts to those resources. The permittee may be required to submit a submersed grassbed survey to the ADEM Mobile-Coastal office prior to commencement of work.

B. There must be no placement or addition of fill onto State-Owned Submerged Lands.

C. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

53. Removal of Low-Head Dams

A. The permittee must submit a copy of the PCN required by the Corps to the ADEM Mobile-Coastal office.

B. The permittee must undertake the restoration of any wetland areas or State waterbottoms temporarily impacted as a result of activities authorized under Nationwide Permit 53. Disturbed areas must be restored to preproject elevations and wetland areas must be revegetated.

C. The permittee must obtain all appropriate authorizations required by the ADCNR-SLD prior to commencement of activities that would impact or be located over State-Owned Submerged Lands.

54. Living Shorelines

A. The permittee must submit a copy of the PCN required by the Corps to the ADEM Mobile-Coastal office.

B. Activities and structures authorized under Nationwide Permit 54 must not be located within or in close proximity to existing submersed grassbeds or natural oyster reefs and shall not result in adverse impacts to those resources. The permittee may be required to submit a submersed grassbed survey to the ADEM Mobile-Coastal office prior to commencement of work.

NWP C Electric Utility Line and Telecommunications Activities

A. The permittee must submit a copy of the PCN required by the Corps to the ADEM Mobile-Coastal office.
B. Activities and structures authorized under NWP C must not be located within or in close proximity to existing submersed grassbeds or natural oyster reefs and shall not result in adverse impacts to those resources.

NWP D Utility Line Activities for Water or Other Substances

A. The permittee must submit a copy of the PCN required by the Corps to the ADEM Mobile-Coastal office.
B. Activities and structures authorized under NWP D must not be located within or in close proximity to existing submersed grassbeds or natural oyster reefs and shall not result in adverse impacts to those resources.

Recognizing that projects are site specific in nature and scope and that conditions may change during project implementation, the ADEM reserves the right to the require a permittee to submit additional information or require additional management measures to be implemented, as necessary on a case-by-case basis, in order to ensure that activities authorized under one or more NWPs are being conducted in a manner that protects water quality and coastal resources.

These coastal consistency concurrences only addresses activities which are also regulated under the enforceable policies of the ACAMP as codified in ADEM Admin. Code R. 335-8. These concurrences do not convey any property rights in either real or personal property, or any exclusive privileges, nor do they authorize any injury to persons or property or invasion of other private rights, trespass, or any infringement of Federal, State, or local laws or regulations and in no way purports to vest in any person title to lands now owned by the State of Alabama nor may it be construed as acquiescence by the State of Alabama of lands owned by the State that may be in anyone's possession. These concurrences do not obviate the responsibility of any applicant to acquire all other needed permits nor do these concurrences, in any way, imply that proposed activities comply with the requirements of any other jurisdictional entity nor do they imply that the projects can or should be approved by any other jurisdictional entity.

The following NWPs have been found to be inconsistent with the ACAMP and are not authorized for use within the coastal area of Alabama without individual review of the applicant's certification of coastal consistency.

10. Mooring Bouys
13. Bank Stabilization
21. Surface Coal Mining Activities
24. Indian Tribe or State Administered Section 404 Programs
26. Reserved
29. Residential Developments
30. Moist Soil Management for Wildlife
34. Cranberry Production Activities
39. Commercial and Institutional Developments
40. Agricultural Activities
41. Reshaping Existing Drainage Ditches
42. Recreational Facilities
43. Stormwater Management Facilities
44. Mining Activities
47. Reserved
49. Coal Remining Activities
50. Underground Coal Mining Activities
51. Land-Based Renewable Energy Generation Facilities

52. Water-Based Renewable Energy Generation Pilot Projects
NWP A – Seaweed Mariculture Activities
NWP B – Finfish Mariculture Activities
NWP E – Water Reclamation and Reuse Facilities

Call, write, or email the Mobile-Coastal office anytime with questions. Always include the ADEM tracking code above when corresponding on this matter. The ADEM contact for this and other coastal zone management issues is J. Scott Brown. He may be reached by telephone at 251. 304.1176 or via e-mail (jsb@adem.alabama.gov).

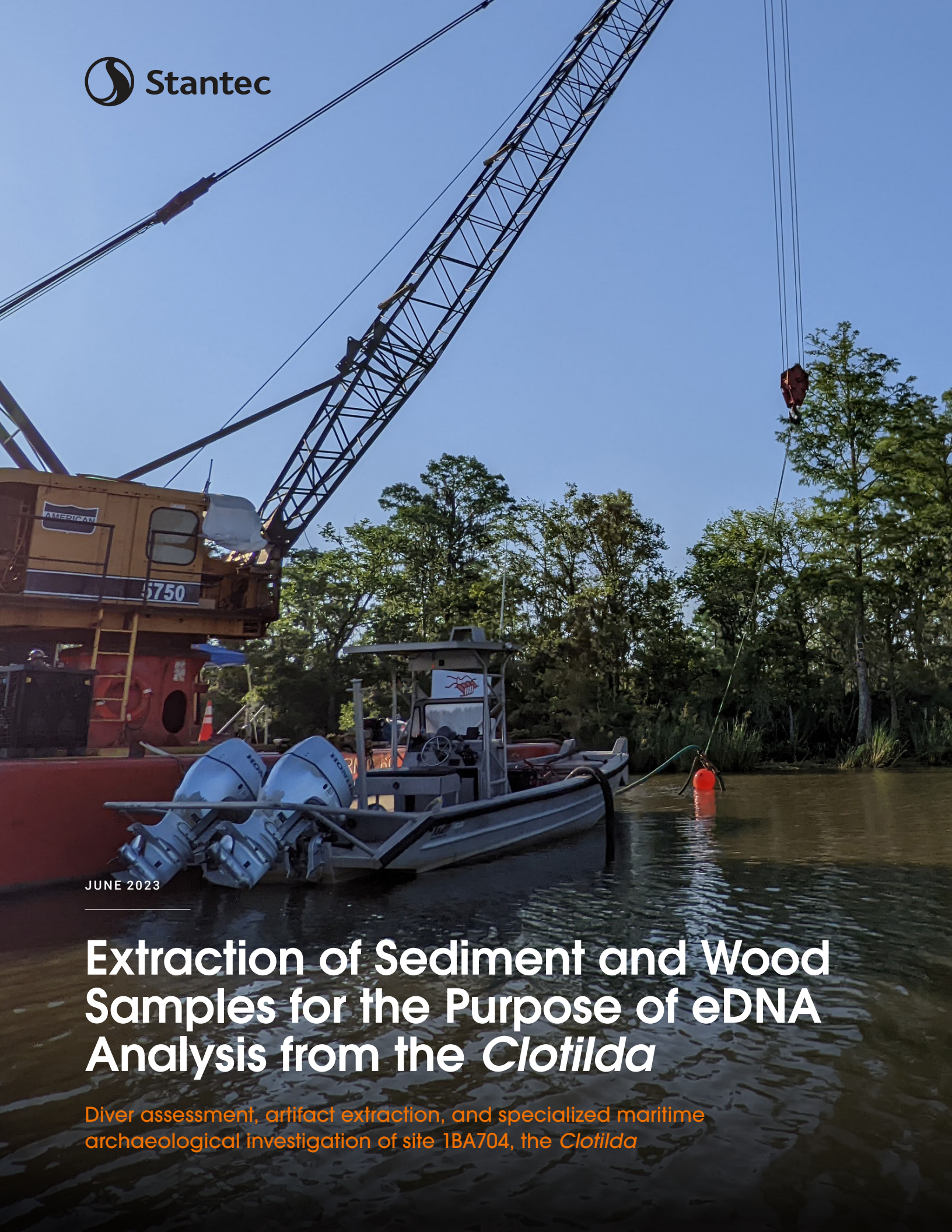
Sincerely,

A. Scott Hughes, Chief
Field Operations Division

cc: DCNR.Coastal@dcnr.alabama.gov

ANNEX B:

STANTEC
Sampling Methodology and Final Report



JUNE 2023

Extraction of Sediment and Wood Samples for the Purpose of eDNA Analysis from the *Clotilda*

Diver assessment, artifact extraction, and specialized maritime archaeological investigation of site 1BA704, the *Clotilda*

The conclusions in the Report titled Extraction of Sediment and Wood Samples for the Purpose of eDNA Analysis from The *Clotilda* are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk. Stantec has assumed all information received from Aaron Jozsef, Resolve Marine Services (the "Client") and third parties in the preparation of the Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein. This Report is intended solely for use by the Client in accordance with Stantec's contract with the Client. While the Report may be provided to applicable authorities having jurisdiction and others for whom the Client is responsible, Stantec does not warrant the services to any third party. The report may not be relied upon by any other party without the express written consent of Stantec, which may be withheld at Stantec's discretion.

Authored by: Emma Heffernan
Signature

Emma Heffernan, Biologist
Printed Name

Reviewed by:
Signature

Michael Moloney, Senior Research Analyst
Printed Name

Reviewed by:
Signature

Carl Ferraro, Senior Environmental Scientist
Printed Name

Approved by: Dominic Kempson
Signature

Don Kempson, Vice President, Environmental Services
Printed Name

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1 Project Introduction

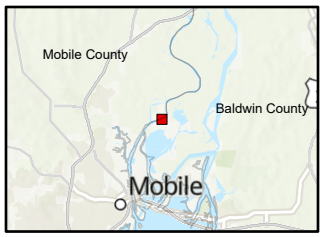
Resolve Marine Group (RESOLVE) and SEARCH, Inc., under contract with, and at the direction of, the Alabama Historical Commission (AHC) conducted an archaeological and structural assessment, environmental sampling, data collection, and diver operations at the wreck of the *Clotilda* (Site 1BA704, Project Area). The 0.62-acre Project Area (illustrated in **Figure 1**) is approximately 7 miles northeast of the city of Mobile, Alabama, and is located within the open water of the Mobile River. Immediately southeast of the Project Area is the shoreline, comprising predominantly undeveloped land with an adjacent fish camp located just outside the northern Project Area boundary.

Stantec Consulting Services Inc. (Stantec) was retained by RESOLVE and AHC to advise and coordinate the sampling of sediment and wood from the wreck of the *Clotilda*, for the purpose of eDNA analysis. Stantec provided the coring equipment and together with Dr. Frankie West, Associate Professor, West Carolina University, advised RESOLVE divers on the appropriate protocols for extracting the samples while in the field.

This report on the extraction of sediment and wood samples for environmental DNA (eDNA) and ancient DNA (aDNA) analysis from the *Clotilda* includes:

- Background information on past and current DNA research for project context;
- Originally proposed sampling protocols and revised sampling protocols due to adaptive management while in the field;
- Results of the field efforts; and
- An evaluation of sample collection with emphasis on lessons learned.





Legend

Project Boundary

0 250 500 Feet

(At original document size of 8.5x11)
1:6,000

N

Stantec

Notes

1. Coordinate System: NAD 1983 State Plane Alabama West FIPS 0102 (US Feet)
2. Data Sources: Stantec, Esri
3. Background: Esri World Imagery (Clarity) 2021

Project Location
Baldwin County, Alabama

Prepared by AS on 2021-08-13
TR by EH on 2022-08-11
IR by CF on 2021-08-11

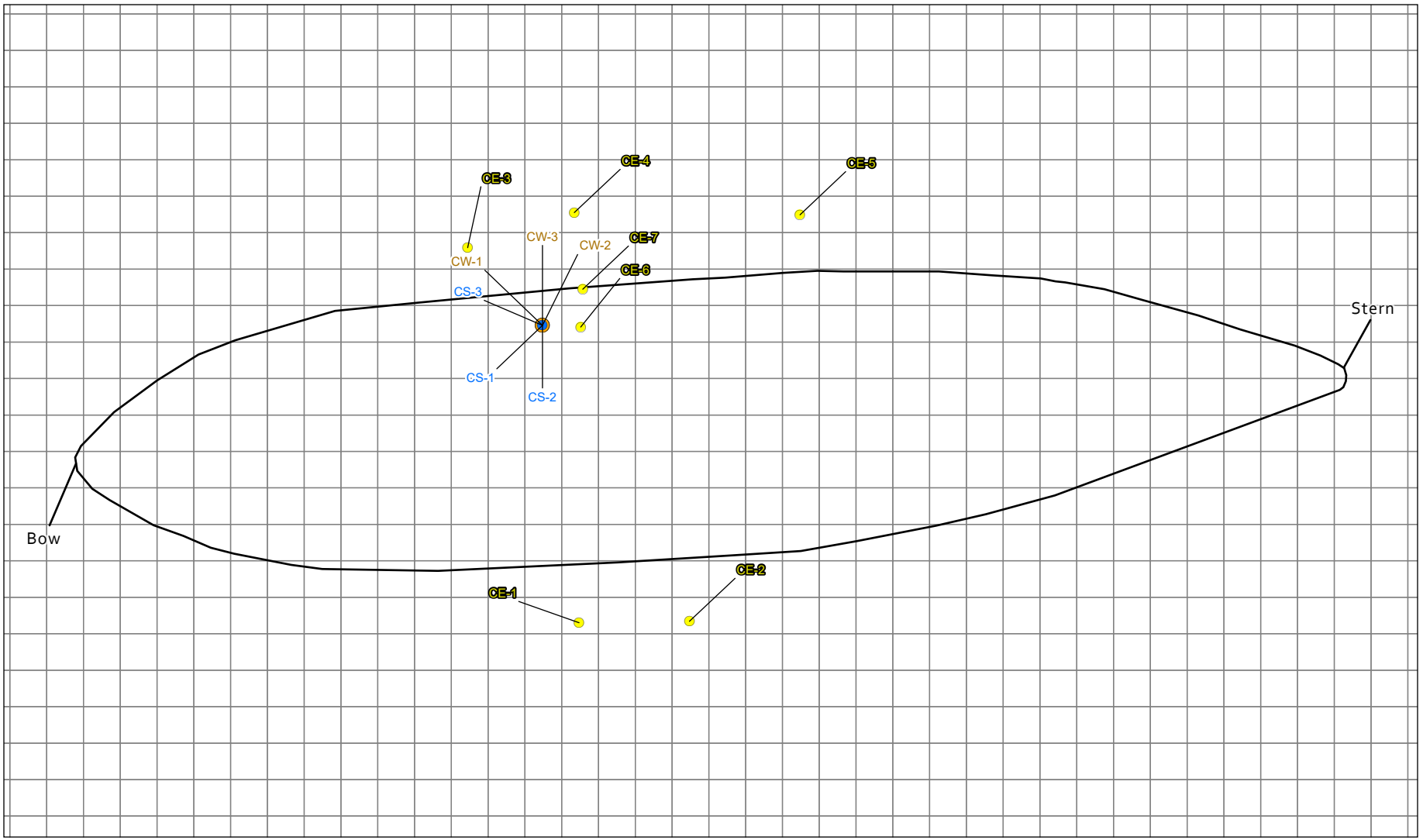
Client/Project
225600148
Resolve Marine
Clotilda Investigation

Figure No.
1

Title
Project Vicinity Map

C:\Users\astapleton\OneDrive - Stantec\Desktop\Clotilda\Clotilda_Working\Clotilda_Working.aprx Revised: 2023-06-20 By: astapleton

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.





Legend

- Clotilda Outline
- Reference Grid

Sample Point

- Environmental Control Sediment Core
- Sediment Core
- Wood Core

N

Notes

1. Coordinate System: NAD 1983 StatePlane Alabama West FIPS 0102 Feet

2. Data Sources: Stantec, Resolve Marine Group, NADS, USGS

Stantec

Project Location
Mobile & Baldwin Co. Line, AL

Prepared by MML on 2022-07-26
TR by JH on 2022-07-26
IR by MM on 2022-07-27

Client/Project
225600148
Resolve Marine Group
Clotilda Project
Sample Methodology Report

Figure No.
2

Title
Sample Locations

V:\2256\Active\225600148\03_data\gis_cad\gis\mxds\Clotilda_225600148_Sonar.aprx Revised: 2022-08-12 By: melamont

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

2 Background Information

Over the past decade, the collection and analysis of aquatic eDNA, or genetic material that is naturally released into the water and sediment, has revolutionized biological surveys for the detection of both recent and past organisms (Taberlet et al. 2012). Additionally, genomic techniques used to analyze marine sediment samples have enabled the ability to recover intact eDNA from long-dead organisms (termed ancient DNA [aDNA]), allowing researchers to characterize past environments (Armbrecht et al. 2019). For example, marine sediment samples collected from the Arabian Sea and analyzed for aDNA allowed for the description of eukaryotic plankton taxa approximately 43,000 years ago (More et al. 2018), and data from some cave sediments have been used to describe diverse biological communities dating back to the Pleistocene (Willerslev et al. 2003). Therefore, the collection of aDNA provides an opportunity to explore historical events, sometimes thousands of years later.

Recent research into aDNA applications has also gained interest within lacustrine, coastal, and marine archaeological sites. The potential for aDNA collection preserved within an underwater archaeological site was first realized more than three decades ago, as aDNA collected from faunal skeletal remains was used to identify the presence of pigs on-board shipwrecks (Hagelberg and Clegg 1991). Additionally, new genomic advancements have made it possible to collect traces of DNA that become preserved within sediment (Armbrecht et al. 2019), allowing new sampling methodology that does not rely on recovering intact skeletal remains. The ability to collect and analyze complex mixtures of aDNA that have been preserved within sediment provides new research avenues relating to plant, animal, and human evolution, disease, migration events, and animal/plant domestication (Briggs 2020).

DNA can quickly breakdown within the environment, and the degradation rate of DNA within sediment depends on several environmental characteristics (e.g., depth, temperature, pH, dissolved oxygen, ultraviolet exposure, and/or salinity) (Corinaldesi et al. 2008). Therefore, the rate of degradation and the ability for successful preservation will vary across marine and lacustrine environments. Significant portions of DNA degradation generally occur due to microbial activity; thus, cold and anoxic environments likely provide the best conditions for aDNA preservation.

Being able to verify that the DNA signal found within a sample is from an ancient origin rather than pertaining to a recent organism within the surrounding environment is crucial for proper interpretation of aDNA data. For example, the interpretations of some archaeological aDNA studies have come under scrutiny (Weiß et al. 2015), and recent suggestions have been outlined for implementing several sample collection controls and analysis steps to help differentiate recent from ancient DNA (Armbrecht et al. 2019).

Over the course of degradation, aDNA will begin to fragment into smaller pieces, leaving damage patterns present on older strands of DNA. Therefore, both fragmentation and damage patterns have been useful to authenticate aDNA and sometimes are capable of predicting its age (Kistler et al. 2017). Over time, DNA becomes highly fragmented as the cytosine residues deaminate into uracil residues on the terminal ends (March 1977). Thus, by assessing the extent of cytosine deamination within DNA fragments, it may be possible to differentiate recent DNA signatures (e.g., from the surrounding



environmental conditions) from that of aDNA signal (e.g., associated with an archaeological event) (Briggs et al. 2007).

Furthermore, detection (or lack of detection) of DNA for an organism associated with a point in time can be useful in assessing time periods within aDNA sediment. For example, lake sediment cores collected from Scandinavian lakes displayed the presence of whitefish DNA (*Coregonus lavaretus*) immediately after a deglaciation event, which supported the authors hypothesized colonization event (Olajos et al. 2018). Genomic advancements now allow for simultaneous sequencing of all the aDNA in a sample, providing large datasets capable of authenticating the DNA origin (Briggs et al. 2007).

Isotopic analysis has also been useful for aging layers within sediment cores and this analysis can be applied within aDNA studies to further address the potential age of DNA within a sediment layer. For example, cesium-137 is a by-product of nuclear weapons testing, first appeared in the environment in 1952, and peaked during 1963-64 (Ritchie et al. 1978). Therefore, isotopic analysis for cesium-137 should result in undetectable levels within sediment samples prior to the advent of nuclear weapons (before the presence of cesium-137), while the surrounding environmental sediment that is from post-1952 should display much higher levels of the isotope.

Due to low concentrations of aDNA typically found in lake sediment, and the fragmented nature of aDNA, potential contamination from both the surrounding environment and within the laboratory space are important considerations in aDNA collection and analysis (Briggs 2020). Therefore, multiple levels of controls are suggested for proper evaluation and interpretation of the DNA data (Armbrecht et al. 2019). It is crucial to have environmental samples representative of the DNA pool that are adjacent to the archaeological site of interest. These environmental samples are collected, extracted, and analyzed alongside any archaeological material. These environmental “control” samples are used to demonstrate that any target DNA recovered from the archaeological site is not linked to potential contamination from the surrounding environment, providing strong credibility in aDNA preservation and proper sample collection. Performing shotgun sequencing of the environmental control samples and those collected from the archaeological site is useful to assess the degree of potential leakage or contamination into archaeological sediments (Armbrecht et al. 2019). Additionally, for aDNA archaeological studies that have a specific focus on human DNA, sequencing of staff handling the samples (both in the field and laboratory) and of the surrounding environmental control samples should be completed. This allows for a direct comparison of the human mitochondrial DNA sequences that may have resulted in contamination from the collection/laboratory staff or from the surrounding environment.

In addition to concerns related to environmental contamination during sample collection, the amount of DNA leakage throughout sediments and/or mixing of sediment layers may impact proper interpretations of aDNA sediment samples. Particular to human archaeological sites, the introduction of new human DNA within some waterbodies is likely to have occurred long after the archaeological event in question; therefore, the presence of human DNA within samples collected from archaeological material is not directly an indication of successful collection of aDNA. In this case, methods outlined above to evaluate DNA fragmentation and damage patterns can be useful in evaluating the age of the DNA.

In some instances, it may be unknown to what extent sediment is recycled within an archaeological site. Therefore, analysis for DNA of a species that was not present in the environment until after an



archaeological event occurred (e.g., post-sinking of a ship) can be used as a proxy to evaluate if sediment recycling and mixing of DNA has taken place. Furthermore, the environmental control samples outlined above should be used as positive controls to assess if the presence of target DNA from these invasive species is in fact within the surrounding environment.

The steps outlined above provide a framework to aid in evaluating: (1) if samples within an archaeological site were isolated from the surrounding environment; (2) if aDNA was successfully preserved and collected within the archaeological material; and (3) to what degree environmental or laboratory contamination may have occurred. Based on the aDNA literature and best practices outlined above, a sampling plan was developed to collect sediment and wood core samples that may have preserved aDNA associated with the *Clotilda* shipwreck as detailed in the following sections.

The site of the *Clotilda*, near the mouth of the Mobile River in Alabama, presents a potentially challenging habitat for the preservation of aDNA, as it is located at a shallow depth (6 meters) with large fluctuations in temperature (including temperatures greater than 30 degrees Celsius (˚C) from June through September). However, sediment entrapment caused by the sinking of the ship may have resulted in an anoxic environment, which would likely have reduced microbial activity, thereby promoting aDNA preservation.

If DNA is successfully collected within *Clotilda* samples, shotgun sequencing of the total DNA pool could be useful to evaluate the presence of DNA from organisms originating in west Africa that may have been present on-board during the journey across the ocean. The most useful targets would likely be organisms associated with food items, such as plants, seeds, or fish. While the detection of west African species would not guarantee that any detected human DNA is of ancient origin, it would provide support that aDNA was well preserved within the sediment below the ship. For an example, both the invasive Asian clam (*Corbicula fluminea*) and the invasive plant *Hydrilla verticillata* were not discovered in Alabama until the late 1900s, greater than 100 years post-sinking of the *Clotilda*, which sank in the Mobile River in 1860 (United States Geological Survey Nonindigenous Aquatic Species database). Both invasive plant species have become established within the Mobile River basin and should be present within the environment surrounding the shipwreck. Thus, the detection of these species within any samples collected directly from the *Clotilda* indicates the sediment, and the associated DNA, was recycled at some point. In this scenario, the DNA collected may not be representative to that from just the *Clotilda*.



3 Developed Field Protocol

3.1 Decontamination and Storage

Due to the nature of DNA degradation over time, any present aDNA within a sample is expected to be extremely low quantity and thus presents a high-risk of potential DNA contamination from the collection, laboratory processing, and/or the nearby environments (Briggs 2020). In an attempt to eliminate potential sample contamination, a standard decontamination protocol was developed that will include:

- All equipment used in collection will undergo pre-sample cleaning with DNA AWAY™ Surface Decontaminant, which will eliminate all traces of DNA. This will include cleaning of sediment cores, core caps, hole-saws, plastic tubs for hole-saws and wood samples, falcon tubes for sediment controls, and coolers for sample storage will be cleaned prior to sample collection;
- Nitrile gloves will be worn when handling equipment and during sample collection, with gloves changed for each sample;
- Wood and sediment samples will be immediately placed into respective storage containers submerged under water prior to samples returning to the ship to avoid potential contamination during sample handling; and,
- Wood and sediment samples will not be opened from original storage containers until returned to West Carolina University.

In addition to potential sample collection contamination, the ambient water and sediment in the vicinity of sampling sites could present a source of DNA introduction. As detailed above, it crucial to be able to differentiate the signal of potential aDNA from the background DNA signal from the surrounding environment. Thus, the sampling protocol involved collecting several control sediment samples stationed around the perimeter of the shipwreck (further detailed below in Section 3.3).

3.2 Site-specific Sample Material

DNA may leach and migrate vertically through sediment (Haile et al. 2007), and in some cases aDNA has persisted attached to materials such as ancient ceramic vessels (Foley et al. 2012). Both factors suggest aDNA within an underwater archaeological shipwreck may disperse into the below sediment and into wood floorboards and be preserved for later extraction. Submerged wood aDNA has been previously successful in identifying both the tree species and location of origin (Wagner et al. 2018), further supporting the prospect of obtaining a mixture of aDNA molecules that may have dispersed into wood material within an archaeological shipwreck. Therefore, the first step of the sampling strategy involved the collection of floorboard material from the bilge of the *Clotilda*. The bilge was likely an area of high human contact and, therefore, an area with potential DNA dispersion into the associated wood.

Considering aDNA from lake sediment samples has been useful in describing historical plant communities across centuries (Smith et al. 2015, Sjögren et al. 2017), it was assumed that sediment



samples that quickly settled within the shipwreck likely provided an anoxic environment that promoted aDNA preservation associated with genetic material on the ship. Therefore, several sediment samples were planned to be collected within the bilge and hold areas of the ship.

Based on the literature and site-specific factors, a sampling protocol was developed to collect: (1) wood samples from the *Clotilda*; (2) sediment samples from the *Clotilda*; and (3) sediment samples from the surrounding environment.

3.3 Sampling Protocol

Prior to the start of excavation of the ship, a sampling schematic was developed for the RESOLVE divers to understand the workflow for sample collection. However, the amount of space RESOLVE divers would have within the bilge or how much wood material would actually be exposed prior to conducting the fieldwork was unknown. Therefore, an opportunistic sampling approach was used and a revised protocol was created while in the field. The following sections outline the initially proposed sampling protocol and also detail the revised sampling protocol.

3.3.1 INITIALLY PROPOSED SAMPLING PROTOCOL

The initial sampling protocol involved divers first collecting wood cores from the floorboards directly above the bilge and subsequently collecting a sediment sample within that now exposed hole in the wood (as illustrated in Figure 3). Wood and sediment samples would be collected at approximately 1.5-meter intervals with control sediment samples from the river collected 10 to 15 meters surrounding the shipwreck, as illustrated in Figure 3.

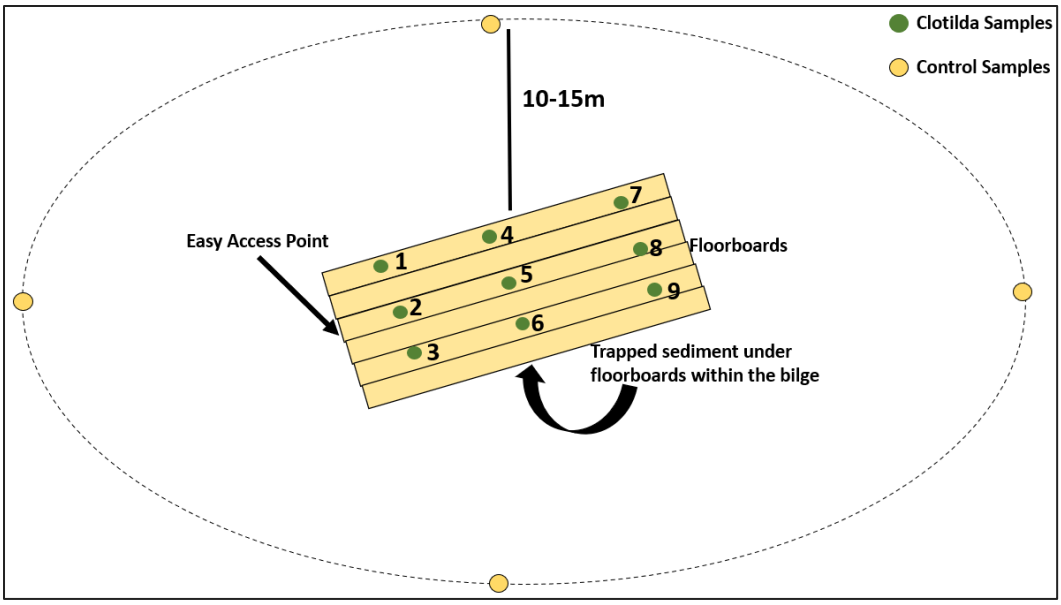


Figure 3. Initially Proposed Sampling Schematic

3.3.2 REVISED SAMPLING PROTOCOL

Once divers were on-site and excavation had begun, a revised sampling protocol was developed to include:

- Identify floorboards and bilge that will be used for sample collection;
- Determine the area (length and width) of the floorboards within the focal sampling location; and
- Determine how many samples can be collected at approximately 1.5 meters intervals (to avoid sediment disturbance during sampling collection)

The revised sampling protocol included four main steps as outlined in the following sections: wood core sample collection, sediment core collection within those wood core locations, sediment core collection in excavated portions of the shipwreck's hold, and environmental control sediment core samples.

3.3.2.1 Step 1: Wood Sample Collection

Wood samples were to be collected within the bilge area of the shipwreck according to the below protocol (as illustrated in Figure 4):

- Using a hole saw (3- to 6-inch diameter), a gloved RESOLVE diver will drill a hole completely through the floorboard at the identified sampling locations; While still under the water and without removing the wood sample from the hole saw, RESOLVE divers will place the entire hole saw head into a decontaminated plastic storage box.
- Storage boxes will then be placed and secured in a floating metal basket to be lifted by a crane onto the deck of the barge.
- Stantec scientists and Dr. West will label samples and place them into a cooler on ice for transport.

The number of samples to be collected was dependent on the number of intact floorboards and the size of the area during bilge excavation. Therefore, an opportunistic sampling approach was used to collect as many wood samples as time and space would allow.

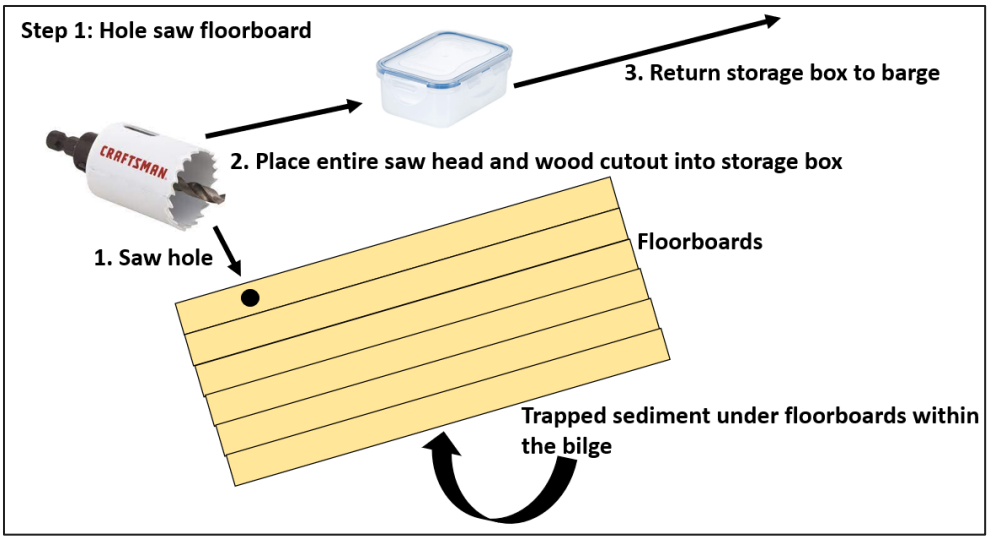


Figure 4. Wood Sample Schematic

3.3.2.2 Step 2: Sediment Sample Collection within Wreck

In other studies, detailed aDNA reviews and protocols have been outlined for the collection of sediment using piston cores from deep sea and offshore marine sites (Armbrecht et al. 2019); however, there is less available information for the collection of sediment cores trapped within an underwater archaeological site, especially within a flowing riverine setting. Due to the unique aspects of sampling material from an underwater archaeological site, it was not possible to implement a sampling strategy without first disturbing the site. To obtain sediment material entrapped within the bilge and hull of the ship, this first step required initial excavation to gain access to the bilge. Therefore, a sampling strategy that involved the use of gravity surface samplers, like those used in Sjögren et al. (2017), could not be implemented. Instead, the following strategy was developed.

As Step 2, sediment samples will then be collected within the bilge area of the shipwreck according to the below protocol (as illustrated in Figure 5):

- Using a 20-inch-long by 2-inch-diameter sediment core liner (Wildco® Hand Core Sediment Sampler), RESOLVE divers will collect a sediment sample within the previously collected wood sample locations with newly drilled holes.
- The sediment tube will be placed vertically through the newly drilled holes and pushed down into the sediment as far as possible.
- Divers will be requested to ensure that the cap at the end of the sediment corer remains in place while extracting the samples and to twist as needed to ensure a full core sample.
- Sediment tubes will be removed from drilled holes and immediately capped.

- Sediment tubes will then be secured within a floating basket, which was lifted by a crane onto the deck of the barge.
- Stantec scientists and Dr. West will label samples and place them into a cooler on ice for transport.

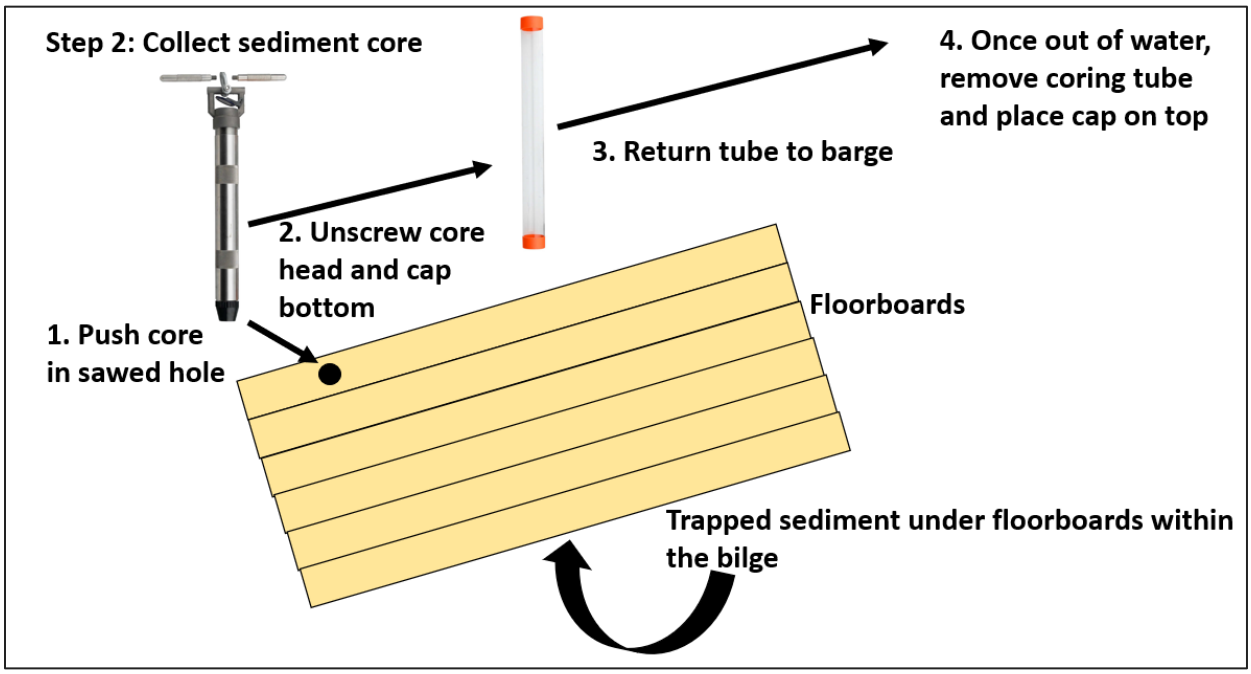


Figure 5. Sediment Core Schematic

Additional sediment samples will be collected from the excavated area within the center of the shipwreck's hold. Once holes are drilled into the floorboard, sediment tubes will be inserted to collect samples using the same protocol outlined above.

3.3.2.3 Step 3: Environmental Control Samples

In addition to collecting sediment samples from the wood core sample locations and the excavated hold locations, environmental sediment samples will be collected from as many locations as possible outside the shipwreck. The purpose of collecting environmental samples will be to provide a comparison set of data for environmental controls. Samples will be collected approximately 10 to 15 meters from the shipwreck using the same sediment tubes and protocol previously outlined in Step 2 (Section 3.3.2.2).

3.3.2.4 Step 4: Sample Transport

All wood core and sediment samples will be preserved while in the field in coolers filled with ice. Samples will then be temporarily transferred at the end of each field day to a -80˚C freezer. The day following field sampling efforts, Dr. West will transport all samples to the laboratory facilities at West Carolina University for analysis.

4 Field Results

All sampling equipment was decontaminated prior to use, following standard DNA decontamination protocols as described in Section 3.1, under the direction of Dr. West. The equipment was then placed in a mesh bag, tied to an equipment basket, that would be lowered to the diver by crane. Due to the lack of visibility for the divers, a number coding system was established that would allow the divers to differentiate sampling equipment by touch. In the case of the wood samples and bilge cores, it was necessary for each sample to correlate to the same location, such that the wood sample came from the hole through which the sediment sample was extracted. Equipment for the wood and sediment samples for each location were then placed in the same mesh bag and number coded with rings of electrical tape (one ring for Location 1, two rings for Location 2, etc.) so that they could be identified by touch. Once samples were collected and brought onboard the barge, Stantec scientists and Dr. West confirmed the location of each sample with RESOLVE divers then converted the generic label of “Location 1” etc. to a more specific label according to sample type. Core samples of wood were labeled as CW-# and core samples of sediment collected at these same locations were labeled as CS-#. The core samples of sediment for environmental controls were labeled as CE-#. During the collection process, the visibility was restricted to approximately 1 inch from the diver’s face plate. As such, all sample collection were conducted largely by feel and sampling locations are approximate locations as communicated by RESOLVE divers.

4.1 Wood Sample Collection

Three wood samples were successfully extracted from the bilge (as illustrated in Figure 2). The samples were taken opportunistically, based on the area excavated by the divers but roughly moved from bow to stern, such that the first sample was collected from the foremost area of the excavation trench and the third/last sample was collected from the aftmost area. Wood samples were extracted by means of a circular hole saw mounted on a pneumatic drill. The hole saws were between 3 and 3-5/8 inches in diameter and six inches deep. The centre of the saw was fitted with an arbor bit, and the cutting edges of the saw were carbide tipped.

All equipment associated with the wood core sampling were decontaminated on the surface, labelled according to the nomenclature noted above, and placed in the appropriate mesh bag. A labelled, airtight container was placed in each mesh bag to contain the core once it was removed. The containers were decontaminated at the same time as the hole saws and placed in the mesh bag with the lid off, to allow for them to remain negatively buoyant when submerged. Once decontamination was complete, all personnel on the barge were alerted to stay clear of the area to prevent contamination prior to the basket being lowered into the water.

To extract the wood cores, the hole saw was positioned by RESOLVE divers perpendicular to the planking, as best as the diver could assess by feel. The holes were drilled slowly and with as little downward pressure as possible to minimize disturbance to the wood and the underlying sediment. When the coring was completed, the entire drill bit and hole saw assembly, with the wood core inside, was removed from the drill and placed in the labelled container corresponding to the core location and sealed.



The diver placed the containers back in the mesh bags and the basket was raised to the surface via crane. As the entire process was performed underwater, the containers were filled with water and were not at risk of surface contamination once they were raised.

Once on the barge, the container was removed from the mesh bag and placed in a cooler with ice. No attempt was made to freeze the core immediately, as the resultant expansion of the wood would have disturbed the sample. Alternatively, scientists kept the samples cold over ice in the cooler to slow any organic decay of the sample. A new arbor and hole saw was used for each wood sample collected. Once all three samples were deposited in the cooler, the cooler was sealed for transport.

4.2 Sediment Sample Collection

The sediment sampling process included sampling from the wood sample locations, the excavation area within the hold, and the exterior of the shipwreck. The samples collected from the wood core sampling locations were considered to have the highest potential for undisturbed sediments contemporary with the wrecking of the ship.

4.2.1 SAMPLES COLLECTED WITHIN THE WRECK

Three sediment samples were extracted from the wood core sampling locations. Samples were extracted using 2-inch-diameter sediment core tubes pushed through the holes made by the wood sample extraction. Once the wood samples were removed, a square of neoprene, weighted on top, was placed over the hole to prevent disturbance to the sediment while the diver secured the wood sample and drill in the basket. The RESOLVE diver then returned with the sediment core tube and removed the neoprene before sampling the sediment. All sediment core tubes and caps were decontaminated prior to sample collection following the same protocols as previously described in Section 3.1.

The sediment samples were taken by inserting the core tube vertically into the opening made by the hole saw and pushing the tube into the sediment below. As the wood planking was approximately 4 inches thick, a stopper was fashioned on the barge and was positioned roughly 3 inches from the top of each sediment core tube prior to collection to prevent the tube from being pushed through the planking and being lost within the sediment. When the stopper hit the planking or the sediment core tube met significant resistance, a cap was secured to the open end of the tube to close it and create a seal. The resultant suction within the tubes kept the sediment cores in place while the tubes were extracted. RESOLVE divers were instructed to keep the tubes as vertical as possible to avoid losing or mixing the sediment samples. Sediment core tubes were then secured to a floating basket using zip-ties so that they remained vertical while being raised to the surface. Once sediment samples were received on the deck of the barge, samples were labeled and put in a cooler on ice.

4.2.2 ENVIRONMENTAL CONTROL SAMPLES

Five sediment samples were collected from the exterior of the wreck and two were collected within the excavation area in the hold to provide environmental controls for the DNA analysis (as illustrated in Figure



2). Samples were collected following the same extraction protocol as previously described in Section 4.2.1.

The samples taken outside the exterior of the wreck included three samples collected from the side of the ship facing the middle of the river and two samples were collected from the side of the ship facing the shore (Figure 2). The shore side samples were collected from the river bottom approximately 1 meter, toward the shore, from the exposed wall of the vessel, and roughly 3 meters apart. The river side samples were collected approximately 1 meter, toward mid-river, from the exposed wall of the vessel. The samples were collected along the vessel such that the middle sample was approximately amidship and the subsequent samples either side were roughly 3 meters from the center sample, as illustrated in Figure 2.

The two sediment samples collected within the excavated area in the hold were opportunistic samples, both collected on the shoreward side of the wreck, to the east of the three wood core and associated sediment sample locations.

4.3 Decontamination, Storage, and Transport

Decontamination was conducted on all materials and equipment used in the sampling process by Dr. West and Emma Heffernan (Stantec). During the decontamination process, both Dr. West and Mrs. Heffernan wore flashspun HDPE fiber Tyvek sleeve covers, face masks, and nitrile gloves to reduce the potential for contamination while handling sampling equipment. Once the decontamination process was complete and the equipment was stored in the equipment basket for RESOLVE divers, all personnel on the barge were requested to remain clear of the basket to avoid anyone accidentally breathing-on or touching the materials. All personnel that were required to come near the basket before it was lowered into the water were documented, so that they may be contacted in the future for DNA samples during the sequencing process if needed.

Once on the surface, the wood core samples remained sealed in containers and were put on ice in a standard cooler. the sediment core tubes were placed vertically in a 20-gallon drink cooler. The cooler was filled with ice and taped closed. With the given weather in Alabama at the time of sample collection, it was not possible to freeze the cores completely and so great care was taken while transporting the cooler.

The sediment core sample cooler was transported temporarily to a -80˚C freezer until completion of fieldwork. The day following field sampling effort completion, Dr. West transported all samples to the laboratory facilities West Carolina University for analysis. Upon recollection of the sediment core samples from the -80˚C freezer the following day, it was identified that the material in the sediment core tubes and in the tubes themselves had expanded at different rates and the capped portions of the tubes had neatly cut at the cap edge. This was likely due to a difference in water content throughout the cores. All material remained completely frozen and there was no evidence of any sample spillage. Dr. West donned Tyvek sleeve coverings, a mask, and nitrile gloves to recover the caps to individual plastic containers, which were decontaminated before use. New caps were decontaminated and used to secure the sediments within the sediment core tubes. All sample tubes and caps were placed in coolers and covered in ice for transport to the storage freezer at the West Carolina University laboratory.



5 Evaluation of Sample Collection

The collection of aDNA associated with sediment samples trapped within an archaeological site involves additional challenges compared to the developed protocols used for implementing standard sediment collection methodology from the marine environment (Armbrecht et al. 2019). Therefore, we developed an opportunistic sampling approach that could be adjusted in real-time within the field based on the dynamics of the environment and area of exposed material. This allowed the divers to collect wood and sediment samples within the constraints of the archaeological site.

The following bullets outline when, where, and/or how a modification occurred during or after sampling activities that could be avoided or mitigated for future similar research:

- Initial sampling protocols were adaptively revised in the field due to site-specific constraints. As this was a known potential threat, additional materials of varying types (extra tubes, different types of tubes, different size wood saws, duct tape and packaging tape, sharpies, extra labels, etc.) were included in the sampling gear set. Additionally, the adaptive protocol allowed for alternative sampling measures within the field.
- The number of collected samples was reduced due to timing constraints within the archeological site. This complication could not be avoided as other research was occurring simultaneously in a limited allowable timeframe due to the sensitivity of the project site.
- Despite the specifications of sediment core tubes used for sediment sampling, the material expanded during the temporary -80˚C freezer storage. The deep freeze storage is important for preservation of the samples to allow for transport without degrading. Alternative materials that are more equipped for a deep freeze may be better suited in the future.
    - Using dry ice in a cooler instead, however, could possibly have prevented or at least reduced the potential for sample expansion. Dry ice was unavailable at all local stores at the time of sample collection but may be a more viable solution to temporary storage in the future.



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ANNEX C:

FINAL REPORT
Terra Mare Conservation

Terra Mare Conservation

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FIELD CONSERVATION, CULTURAL RESOURCE MANAGEMENT, AND SITE PRESERVATION RECOMMENDATIONS FOR PHASE III ARCHAEOLOGICAL INVESTIGATION OF THE SCHOONER *CLOTILDA*

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November 11, 2022

EXECUTIVE SUMMARY

Between May 6 and 13, 2022, conservators Paul Mardikian and Claudia Chemello from Terra Mare Conservation, LLC (TMC) provided professional services in conservation, cultural resources management, and site preservation in support of archaeological investigation by SEARCH, Inc. (SEARCH), and Resolve Marine Group (Resolve Marine) during a field deployment to investigate the wreck of *Clotilda* located in a section of the Mobile River in Baldwin County, Alabama. The site deployment was conducted to evaluate the deterioration of the wreck's materials and consider in situ preservation strategies for *Clotilda's* long-term preservation.

During the deployment, TMC collaborated with team members on board the barge and with remote team member Vincent Blouin, naval architect, and marine engineer. Timbers and artifacts temporarily recovered by Resolve Marine divers were inspected to determine their condition. A radiography inspection of a limited number of iron and composite artifacts was carried out to assess the level of corrosion and the corrosion risks in effect at the site and confirm visual observations. At the conclusion of the site work, TMC assisted Resolve Marine in transporting four artifacts to the Mobile Museum of History for storage while awaiting conservation. A separate proposal for the conservation of the four artifacts was submitted at the request of the Alabama Historical Commission.

Following the deployment, the density and moisture content of a small number of wood samples was measured, along with mechanical testing to assess degradation and residual mechanical properties. Environmental, geotechnical, geochemical and ecological data collected from the site was reviewed, and preliminary in situ preservation options were evaluated and visualized.

The investigation found that, in general, the timbers that were tested appear to have retained a dense core, with a moisture content that was lower than anticipated. These observations were confirmed by mechanical testing of wood samples to assess the modulus of elasticity and tensile strength. However, the recovered timbers were heavily damaged by marine borers, colonized by barnacles and most likely fungi and bacteria, and were notably affected by erosion and moderate to severe mechanical damage. The presence of wood checks and deep splits on both small and large timbers, some going through the entire thickness of the board, could significantly affect the structural stability of the wreck if widespread. The structural integrity of the wreck overall, and particularly the parts still buried in sediment, could not be directly assessed.

No borer activity was noted on the three wood core samples removed from the bilge indicating that sediment coverage in this area may be sufficient to reduce oxygen levels and prevent borer colonization as well as reduce biodeterioration by fungi and bacteria.

Corrosion of the metallic artifacts, particularly the iron fasteners, is pervasive and varies from moderate to severe to total loss. Localized burial conditions on the wreck may be

conducive to complete loss of the structural integrity of the fasteners. The structural integrity and stability of the fasteners on the wreck could not be directly assessed.

The location of *Clotilda* in a shallow, medium to high energy brackish water environment, coupled with the biological and physical processes of deterioration observed, poses an immediate threat to the wreck's long-term survival. The level of damage observed indicates that many of the processes have been in effect for quite some time and likely fluctuate with prevailing climatic and environmental conditions.

The wreck is extremely vulnerable to physical damage from vessel strikes, impacts with floating objects, as well as damage from vandalism or severe weather events. There is a possibility of partial or complete loss of the surviving hull resulting from such events. Stabilization of the wreck, physical protection through reburial, and security are urgently needed.

In situ preservation, incorporating reburial in an anoxic (near zero oxygen) environment and physical protection of the wreck, is an appropriate strategy for *Clotilda* and is the most ethical and scientifically responsible approach at this time. Preservation in situ adheres to current best practices in archaeological site preservation and stewardship for the protection of underwater cultural heritage. Implementing in situ preservation methods is a complex process requiring coordinated planning across a multidisciplinary team of specialists in maritime archaeological conservation, maritime archaeology, civil engineering, environmental science, as well as collaboration with project partners.

This report presents an overview of preliminary options for in situ protection and preservation; however, further investigation is required to determine the most appropriate method for the wreck site. Reburial may be challenging if subsurface soils close to the wreck are loose. This should be investigated as soon as possible through a comprehensive geotechnical engineering study. The next steps should include developing an in situ preservation long-range plan integrating a comprehensive risk assessment of the archaeological site.

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Jeffrey Smith, Margaret Dopson, Buck Reed, and Chris Christofer from Applied Technical Services, Inc. provided exceptional radiography expertise and support.

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1 PROJECT DESCRIPTION

Terra Mare Conservation, LLC (TMC) was contracted by SEARCH to provide professional services in field conservation, cultural resource management and site preservation for a field deployment to investigate Site IBA704, the wreck of *Clotilda,* in the Mobile River, Baldwin County, Alabama. TMC were on site May 6-13, 2022.

2 APPROACH

TMC focused on the following areas for this project:

- Review of disarticulated timbers recovered from around the shipwreck and brought to the barge.
- Review of artifacts temporarily excavated and brought to the barge.
- Detailed assessment of four diagnostic artifacts chosen by the Alabama Historical Commission (AHC) for long-term preservation and curation.
- Review of temporary storage conditions on the barge for recovered artifacts.
- Collaboration with team members during the recovery and excavation for general handling, materials identification, temporary storage of artifacts, and reburial efforts.
- Liaison with Vincent Blouin, naval architect and marine engineer, in relation to site observations, materials deterioration and testing, and in situ preservation options.
- Computed radiography imaging of seven artifacts during the field deployment.
- Analysis and testing of wood samples from the wreck.
- Review of artifact photographs previously documented by SEARCH in the report 'Archaeological Investigation of 1Ba704, A Nineteenth Century Shipwreck Site in the Mobile River Baldwin and Mobile Counties Alabama, May 2019.
- Review of environmental and geotechnical data provided by SEARCH.

3 LIMITATIONS

Our investigation had limitations in considering *Clotilda*'s overall state of preservation. The most significant from a preservation standpoint was the small number of timbers, iron fasteners and artifacts included in the study, all of which were recovered from around the wreck and not from sections of the wreck buried in sediment. These timbers would be expected to be more decayed owing to their location, exposure, and disarticulation from the wreck. However, crucial understanding about the wreck's anticipated condition and the archaeological environment was gained from their examination.

Three wood core samples were removed from the ship's bilge. Two of the cores were specifically taken for DNA analysis, and one was acquired by TMC for wood testing. These were the only wood samples from parts of the ship buried in sediment. The cores represented a very small sample set but provided insight about the potential condition of the buried wood.

The small sample assemblage and number of mechanical tests carried out provided information about the structural integrity of the timbers tested. The results provided insight in relation to the waterlogged state of the wood and its structural integrity, which is an important first step in understanding the probable overall condition of the wreck. However, overall structural integrity cannot be inferred from these results and further investigation of structural concerns, predominantly on the state of the connections between timbers and the presence of cracks and fractures within and along structural elements, is needed to determine the wreck's overall structural integrity.

The difficult site conditions and short deployment meant that additional investigation of potentially diagnostic artifacts by radiography or other in situ assessment methods was not possible.

In determining the possibility of in situ preservation of the wreck, a significant limitation was that subsurface conditions directly surrounding the wreck are unknown. The authors have assumed that the soils are similarly loose to those investigated by two borings approximately 450 meters (1,500 ft.) upstream and downstream of the wreck for the purpose of providing preliminary in situ preservation options and modeling various scenarios.

4 METHODOLOGY

4.1 Review of On-Barge Conditions

TMC assisted team members with ongoing review of the on-barge storage conditions for temporarily recovered artifacts to ensure that optimal conditions were maintained as much as possible during the site deployment. Temporary wet storage included a 20' x 8' x 40" storage tank for large timbers, reinforced 5-gallon plastic pails, and polyethylene zip-lock bags of varying sizes for smaller artifacts and fragments. Water levels in the storage enclosures were monitored and changed as needed to maintain appropriate coverage of the artifacts, and to ensure that no algae growth formed.

We also collaborated with team members about general handling and lifting of wet materials, rigging, and tagging methods for fragile artifacts for recovery and reburial, as well as reburial issues as they arose. Where possible, we discussed various conservation and preservation topics with team members, particularly concerning recovered artifacts, deterioration of waterlogged materials, treatment options and other topics related to archaeological conservation.

4.2 Visual and Tactile Inspection

TMC conducted a visual and tactile assessment of approximately 50 timbers and artifacts temporarily recovered from the wreck site. The inspection was carried out in the holding tank after it was drained, on the barge deck for large timbers that did not fit into the tank, and/or wherever space allowed for smaller artifacts that were removed from storage enclosures for examination. The inspection provided preliminary materials identification and information about the wreck environment and the preservation of the materials, particularly the wood and iron.

4.3 Condition Assessment

A detailed condition assessment of sixteen (16) artifacts was carried out to supplement the findings of the visual/tactile inspection and gain a better understanding of deterioration mechanisms in effect at the wreck site. The artifacts are listed below in Table 1. These artifacts were closely evaluated to further understand the materials, fabrication methods, and degree of deterioration. The assessment was aided by magnification of 5x-10x when possible, and all artifacts were photographed digitally.

Table 1: Clotilda artifacts selected for condition assessment.

Artifact Number	Description	Material	Preserved Dimensions
WP 1.2.	Timber with fastener	Wood and iron	L: 45 cm (16 in) W: 15 cm (6 in) D: 15 cm (6 in) including drift
WP 3.1	Three fasteners	Iron	L: 36, 30, 20 cm ((14, 12, 8 in), Diam of heads: 4–5 cm (2 in)
WP 6.3	Two L-shaped brackets	Iron	Largest bracket - L: 53 cm (21 in), W: 15 cm (6 in), D: 13 cm (5 in)
WP 7.4	Section of the ship's steering mechanism	Wood, iron, rope	L: 165 cm (65 in) W: 31 cm (12 in) D: 23 cm (9 in) Diam. of wheel: 30 cm (12 in), Thick. of wheel: 5 cm (2 in)
WP 7.7	Semi-circular fitting	Iron	L: 16 cm (6 in), W: 12 cm (5 in), Thick: 3 cm (one in)
WP 11.3	Timber with red staining and large fastener	Wood, iron	L: 33 cm (13 in), W: 18 cm (7 in), D: 8 cm (3 in), Diam. of drift: 3 cm (1 in)
WP 12.1	Two timbers joined with fasteners	Wood, iron	L: 38 cm (15 in), W: 41 cm (16 in), including drift, D: 6 cm (2 in)
WP 20.1	Two light switches and wiring	Bronze, copper wire, insultation, iron	L: 13 cm (5 in), W: 9 cm (3.5 in), D: 5 cm (2 in).
WP 21.1	Fragment of shoe	Leather	L: 10 cm (4 in), W: 9 cm (3 in), Thick: 0.3 cm (0.12 in)
WP 22.1	Circular flange	Lead, rubberized textile, caulking, iron	Diam.: 18 cm (7 in), Thick.: 3 cm (one in)
WP 22.1	Hawse pipe	Lead, copper nails, wood	L: 40 cm (16 in), Diam: 14 cm (6 in)
WP 23.2	Wood with large fastener	Wood, iron	L: 74 cm (29 in), W: 46 cm (18 in), D: 8 cm (3 in).

Artifact Number	Description	Material	Preserved Dimensions
WP 24.1	Fitting	Iron	L: 15 cm (6 in), W: 5 cm (2 in), Thick: 2 cm (one in)
WP 25.1	Large fastener	Iron	L: 13 cm (5 in), Width of head: 6 cm (3 in)
WP 26.1	Two fragments of organic material	Unidentified	Piece with TMC: L: 9 cm (4 in), W: 8 cm (3 in); Piece at museum: 7 x 6 cm (2.7 x 2.4 in)
WP 27.1	Small piece of wood with nail holes	Wood	L: cm (2 in), W: 1 cm (0.3 in)



Figure 1: Assessment of recovered timbers and artifacts. Left image courtesy of the Alabama Historical Commission.

4.4 Artifacts Selected for Conservation Treatment

Four artifacts that help tell the story of *Clotilda*'s final voyage were selected by AHC as potential candidates for conservation treatment and curation. These are listed in Table 2. At the end of the field deployment, the artifacts were wrapped with wet towels and carefully transported by Resolve Marine and TMC to the History Museum of Mobile where they are in wet storage awaiting treatment.

Table 2: Clotilda artifacts selected by AHC for full conservation treatment.

Artifact Number	Description	Preserved Dimensions
WP 1.2	Small piece of wood with circular saw marks and an iron fastener	L: 45 cm (18 in), W: 15 cm (6 in), D: 15 cm (6 in) (incl. drift)
WP 7.4	Section of the steering mechanism; wood, cast iron and rope	L: 165 cm (65 in), W: 31 cm (12 in), D: 23 cm (9 in), Diam. of wheel: 30 cm (12 in)
WP 12.1	Two pieces of hull planking with iron fasteners	L: 38 cm (15 in), W: 41 cm (16 in) (incl. drift), D: 6 cm 2 in)
WP 22.1	Section of lead hawse pipe	L: 40 cm (16 in) Diam: 14 cm (6 in)

4.5 Radiography

Five artifacts and one concretion were chosen for radiography examination to provide more detailed information about the level of corrosion affecting the iron fasteners. The artifacts are listed in Table 3. A computed radiography (CR) inspection of the artifacts was performed on May 12 by Applied Technical Services, Inc. a full-service, non-destructive testing laboratory in Mobile. The artifacts that were inspected are listed in Table 3. CR is a non-destructive imaging technique using X-rays, gamma rays or other forms of radiation to visualize the internal structure of an artifact. The goal of the radiography was to help determine the level of corrosion of the iron, particularly the fasteners, and the corrosion risks in effect at the site, to assist in determining *Clotilda*'s overall level of preservation.

Radiography of the artifacts was performed using a Selenium 75 (Se-75) radiation source. 36 x 43 cm (14 x 17 in) high-resolution phosphorus imaging plates were used to capture the energy. The approximate source strength was 71.0 Curies (Ci). Ten images were captured with a source to object distance ranging from 51–71 cm (20–28 in). The varying distances were due to the geometry and variable thickness of the artifacts. Radiation exposure times ranged from 12-20 minutes, depending on the artifact and the area being X-rayed.

The images were processed on site using a portable Carestream HPX-1 Plus digital system. The measurement functions on the CR system were created from a reference standard of a known material and thickness. A steel ball bearing (2.7 cm, one in) diameter was placed on the imaging plate to create a reference ratio of 1:1 for the calibration of the system. A review of the radiography images was undertaken by TMC and Vincent Blouin.

Table 3: Clotilda artifacts chosen for radiography.

Artifact Number	Description	Preserved Dimensions
WP 3.1	Three iron fasteners	L: 36, 30, 20 cm (14, 12, 8 in), diam of heads: 4–5 cm (2 in)
WP 6.3	Iron L-shaped bracket	L: 53 cm (21 in), W: 15 cm (6 in), D: 13 cm (5 in)
WP 12.1	Two timbers joined with iron fasteners	L: 38 cm (15 in), W: 41 cm (16 in), including drift, D: 6 cm (2 in)
WP 24.1	Iron fitting	L: 15 cm (6 in), W: 5 cm (2 in), Thick: 2 cm (one in)
WP 25.1	Large iron fastener	L: 13 cm (5 in), Width of head: 6 cm (3 in)
Sample 8	Small fragment of iron concretion	L: 6 cm (3 in), W: 4 cm (2 in)



Figure 2: Lead radiography technician Buck Reed of Applied Technical Services, Inc. setting up the X-ray source (left) and processing the images (right).

4.6 Wood Sample Assemblage

TMC requested and was granted permission from the AHC to retain six wood samples, a piece of organic material, one concretion, and one wood core (core 3), for further testing. The samples were given sequential numbers by TMC for tracking purposes and are listed in Table 4 and shown in Figures 3 and 4.

- Wood samples 1-5 were removed by hand and electric saw from timber WP 17.1. Sample 1 was cut into smaller subsamples for mechanical testing. Sample 4 was given to State Archaeologist Stacye Hathorn for transfer to Dr Matthew Therrell at

- the University of Alabama for dendrochronology.
- Sample 6 was removed by hand saw from timber WP 5.2. The sample was cut into two subsamples for further testing.
- Sample 7 and the three wood cores were removed from the wreck site by Resolve Marine divers. Core samples 1 and 2 were retained for DNA analysis by Dr. Frankie West at Western Carolina University.
- Sample 8 was found in the mud and debris on the bottom of the holding tank.

Table 4: Samples from Clotilda retained by TMC.

Sample	Artifact Number	Description	Material	Dimensions	Weight
Sample 1	WP 17.1	Hull plank	Wood	L: 38 cm (15 in), W: 15 cm (6 in), D: 6 cm (2 in)	3,220 g (114 oz)
Sample 2	WP 17.1	Hull plank	Wood	L: 25 cm (10 in), W: 15 cm (6 in), D: 6 cm (2 in)	2,031 g (72 oz)
Sample 3	WP 17.1	Hull plank	Wood	L: 14 cm (6 in), W: 16 cm (6 in), D: 6 cm (2 in)	1,217 g (43 oz)
Sample 4	WP 17.1	Hull plank	Wood, retained by Stacye Hathorn for dendrochronology	L: 13 cm (5 in), W: 16 cm (6 in), D: 6 cm (2 in)	1,143 g (40 oz)
Sample 5	WP 17.1	Hull plank	Wood	L: 9 cm (4 in), W: 14 cm (6 in), D: 5 cm (2 in)	670 g (24 oz)
Sample 6	WP 5.2	Square beam	Wood	L: 40 cm (16 in), W: 7 cm (3 in), D: 7 cm (3 in)	1,725 g (61 oz)
Sample 7	WP 26.1	Unknown material	Fragment of organic material	L: 9 cm (4 in), W: 8 cm (3 in)	13 g (0.5 oz)
Sample 8	N/A	N/A	Fragment of iron concretion, no preserved metal	L: 6 cm (3 in), W: 4 cm (2 in), D: 4 cm (2 in)	62 g (2 oz)
Wood core 3	N/A	Incomplete wood core	Wood	H: 3 cm (1 in), Diam: 8 cm (3 in)	211 g (7 oz)

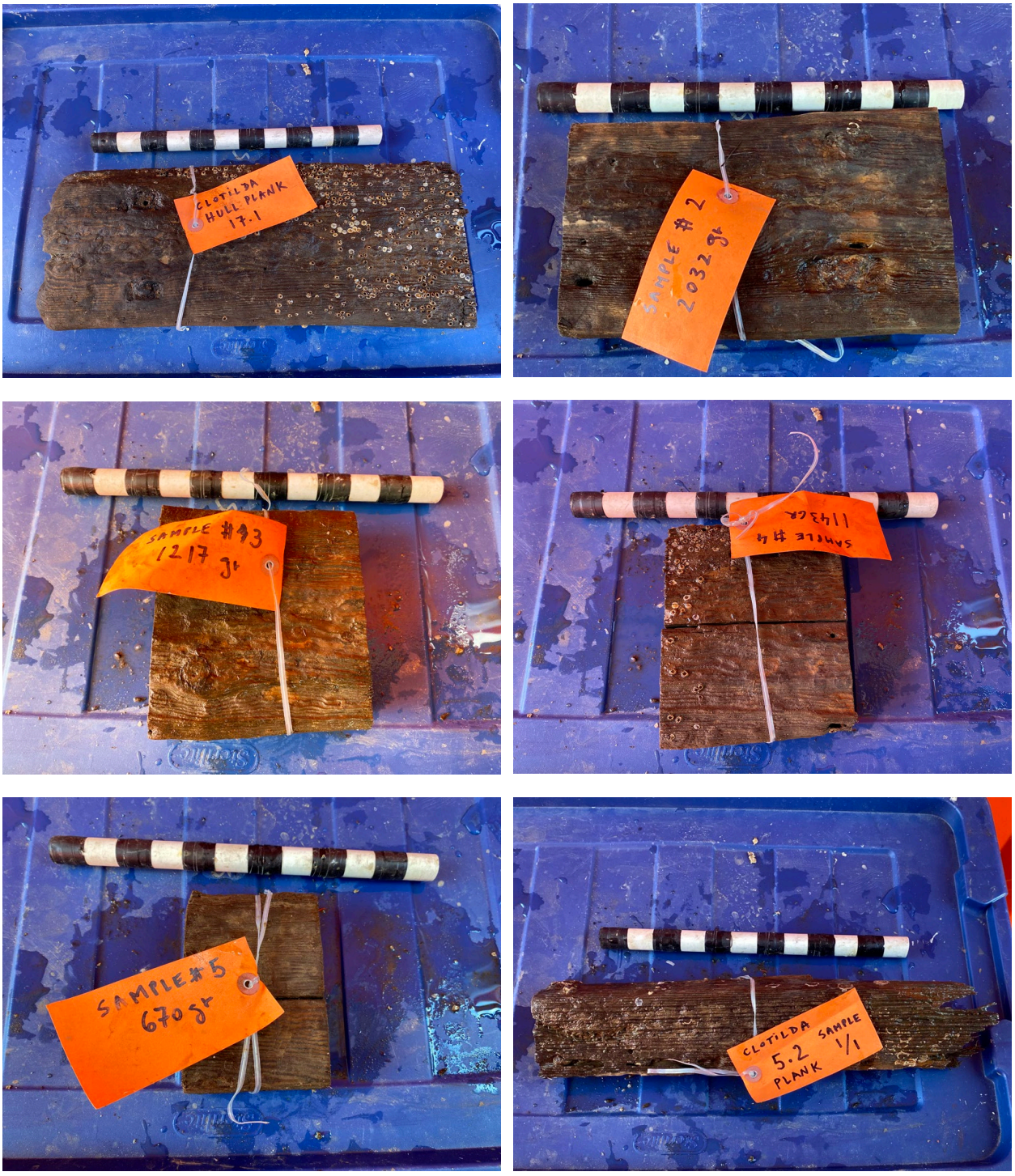


Figure 3: Wood samples 1-5 from WP 17.1 (top, middle, bottom left), sample 6 from WP 5.2 (bottom right).



Figure 4: Sample of organic material WP 26.1 (left), an iron concretion (middle) and wood core 3 (right).

4.7 Materials Testing

4.7.1 Wood Density

Mechanical testing of a selection of temporarily recovered timbers, wood samples removed from two timbers, and the three wood cores was performed using a Pilodyn wood density test instrument to measure the density and residual strength of the wood. The timbers tested are listed in Table 5. This technique is known as Needle Penetration Resistance. The Pilodyn instrument was developed to quickly determine the density and strength of dead and living wood, mostly in the forestry industry, but has been effectively used in assessing waterlogged wood from shipwrecks around the world (Gregory 1998, Gregory et al. 2007). The tool can rapidly and objectively measure the reduction in strength associated with deteriorated wood and is minimally invasive. A drawback is that it can only be used on flat surfaces, which was challenging due to the erosion and borer damage present on some timbers.

A Pilodyn 6J (6 Joule) Wood Tester (PROCEQ, Zurich Switzerland) with a 2.5mm (0.1 in) diameter steel pin was employed, see Figure 5. The instrument contains a spring-loaded pin that is fired into the wood with a constant energy of six joules. The depth of pin penetration is measured using a scale from 0-4 cm (0-1.6 in) that is mounted on the side of the instrument. The depth of penetration is used as an indicator of deterioration. Deeper pin penetration indicates a higher level of degradation and less residual density, and shallower pin penetration indicates a lower level of degradation and greater residual density.

An average of four tests were performed per timber, most of which were taken radially owing to accessibility in the tank, and access to a suitable flat surface on the wood to take a flat reading. All the measurements were carried out on timbers and samples after recovery, not directly underwater. Pilodyn readings were also obtained for the three wood core samples.

Table 5: Clotilda timbers tested by Needle Penetration Resistance.

Artifact Number	Description	Preserved Dimensions	Pilodyn Results
WP 4.3	Knee and piece of wood, attached together	L: 36 cm (14 in), W: 30 cm (12 in), D: 28 cm (11 in)	1. 2.8 cm (1.1 in, knee) 2. 2.0 cm (0.7 in, knee) 3. 0.9 cm (0.3 in, other timber) 4. 0.9 cm (0.3 in, other timber)
WP 5.2	Square beam with three fastener holes	L: 189 cm (74 in), W: 8 cm (3 in), D: 8 cm (3 in)	1. 0.4 cm (0.1 in) 2. 0.7 cm (0.2 in) 3. 0.4 cm (0.1 in) 4. 0.3 cm (0.1 in)
WP 5.3	Planking, evidence of charring	L: 104 cm (41 in), W:13 cm (5 in), D: 12 cm (5 in)	1. 1.0 cm (0.3 in) 2. 0.5 cm (0.1 in) 3. 1.0 cm (0.3 in) 4. 0.5 cm (0.1 in)
WP 6.2	Long timber, partially burned	L: 159 cm (63 in), W: 18cm (7 in), D: 8 cm (3 in)	1. 1.0 cm (0.3 in) 2. 1.0 cm (0.3 in) 3. 0.5 cm (0.1 in) 4. 0.8 cm (0.3 in)
WP 7.4	Section of the ship's steering mechanism	L: 165 cm (65 in), W: 31 cm (12 in), D: 23 cm (9 in) Diam. wheel: 30 cm (12 in)	1. 0.7 cm (0.2 in) 2. 1.0 cm (0.3 in) 3. 2.0 cm (0.7 in) 4. 0.9 cm (0.3 in)
WP 8.1	Hull plank, stained black, one fastener	L: 213 cm (84 in), W: 15 cm (6 in), D: 6 cm (2 in)	1. 0.8 cm (0.3 in) 2. 1.1 cm (0.4 in) 3. 0.8 cm (0.3 in) 4. 0.8 cm (0.3 in) 5. 2.0 cm (0.7 in)
WP 9.1	Plank	L: 122 cm (48 in), W: 23 cm (9 in), D: 5 cm (2 in)	1. 0.5 cm (0.1 in) 2. 0.5 cm (0.1 in) 3. 1.0 cm (0.3 in) 4. 0.5 cm (0.1 in)
WP 11.3	Timber with red staining and large fastener	L: 33 cm (13 in), W: 18 cm (7 in), D: 8 cm (3 in)	1. 2.0 cm (0.7 in) 2. 1.3 cm (0.5 in) 3. 1.3 cm (0.5 in) 4. 1.1 cm (0.4 in)
WP 12.1	Two timbers joined with fasteners	L: 38 cm (15 in), W: 41 cm (16 in), including drift, D: 6 cm (2 in)	1. 1.0 cm (0.3 in) 2. 1.0 cm (0.3 in) 3. 0.9 cm (0.3 in) 4. 0.8 cm (0.3 in)

Artifact Number	Description	Preserved Dimensions	Pilodyn Results
WP 13.1	Timber with two deep holes	L: 250 cm (98 in), W: 26 cm (10 in), D: 24 cm (9 in)	1. 0.5 cm (0.1 in) 2. 0.5 cm (0.1 in) 3. 0.5 cm (0.1 in) 4. 1.5 cm (0.5 in)
WP 16.1	Long deck beam	L: 391 cm (12'10 in), W: 25 cm (10 in), D: 23 cm (9 in)	1. 0.5 cm (0.1 in) 2. 0.5 cm (0.1 in) 3. 0.5 cm (0.1 in) 4. 1.0 cm (0.3 in)
WP 17.1	Charred timber	L: 183 cm (72 in), W: 15 cm (6 in), D: 4 cm (2 in)	1. 0.5 cm (0.1 in) 2. 0.7 cm (0.2 in) 3. 0.5 cm (0.1 in) 4. 0.6 cm (0.2 in)
WP 18.1	Hull plank	L: 427 cm (168 in), W: 18 cm (7 in), D: 6 cm (2 in)	1. 0.5 cm (0.1 in) 2. 0.5 cm (0.1 in) 3. 0.8 cm (0.3 in) 4. 0.5 cm (0.1 in)
WP 19.1	Beam from stern	L: 305 cm (120 in), W: 25 cm (10 in), D: 20 cm (8 in)	1. 0.5 cm (0.1 in) 2. 0.7 cm (0.2 in) 3. 0.7 cm (0.2 in) 4. 0.7 cm (0.2 in)
WP 23.1	Beam	L: 19 cm (8 in), W: 19 cm (8 in), D: 17 cm (7 in)	1. 0.3 cm (0.1 in) 2. 0.8 cm (0.3 in) 3. 0.3 cm (0.1 in) 4. 0.3 cm (0.1 in) 5. 2.0 cm (0.7 in)
Wood core 1	DNA analysis	Diam: 8 cm (3 in)	1. 0.3 cm (0.1 in) 2. 0.4 cm (0.1 in) 3. 0.5 cm (0.1 in)
Wood core 2	DNA analysis	Diam: 8 cm (3 in)	1. 0.2 cm (0.06 in) 2. 0.3 cm (0.1 in) 3. 0.3 cm (0.1 in)
Wood core 3	TMC analysis	Diam: 8 cm (3 in)	1. 0.4 cm (0.1 in) 2. 1.3 cm (0.5 in) 3. 2.4 cm (0.9 in)



Figure 5: Measuring the density of wood timbers WP 16.1 (left) and WP 7.4 (right) with a Pilodyn.

4.7.2 Moisture Content

Determining the moisture content of waterlogged wood helps to provide further information about its degree of degradation in addition to visual observation of the woods cross-sections and measurement of mechanical and physical properties. In general, increased porosity due to microbiological deterioration and other processes results in higher water content values and softer wood, due to a loss of cellulose in the wood cells.

Waterlogged wood that is deteriorated is often heavy, non-buoyant, spongy to the touch, visibly decayed with cross sections are dark in color. Both decayed and preserved regions can be visible on the same cross-section of wood, depending on the waterlogging and level of deterioration. Wood that is better preserved is often more lightweight, sometimes still buoyant, dense to the touch and visibly in better condition with visible features; cross sections usually show growth rings with a wood lighter in color with only a thin decayed region visible on a cross section.

A system for determining the Maximum Water Content, or U_{max}, of waterlogged archaeological oak (but applicable to other wood species) was developed by de Jong (1977) to determine the preservation state of the wood and was widely adopted by conservators for practical use to help assess the deterioration state of waterlogged wood. U_{max} is defined as the total water content in the wood, expressed as a percentage, compared to its dry wood value obtained by oven drying.

De Jong's classification (1977) uses three categories to describe the waterlogged state:

1. CLASS III - Wood containing <185% water. A sound core beneath a thin deteriorated layer.
2. CLASS II – Wood containing 185 - 400% water. A comparatively small core present.
3. CLASS I – Wood containing >400% water. Highly degraded wood predominates.

The following wood samples were investigated to determine the U_{max} for each sample.

- Timber WP 17.1
  - Wood sample 5.
  - Four subsamples of core wood from wood sample 1.
  - One subsample of the outer layer of wood sample 1.
- Timber WP 5.2
  - Wood sample 2.
- Wood core 3

Sample 5 from WP 17.1, subsample 1 from WP 5.2, and wood core 3 were oven-dried at 250° F (120 °C) over 6 hours until they reached a constant weight. The core subsamples and the outer layer subsample from WP 17.1 were oven-dried at 175° F (80 °C) over 4 hours until they reached a constant weight.

Tests compared actual moisture content values to maximum U_{max} values. The U_{max} was determined destructively using the following calculation:

$$U_{max} = \frac{\text{waterlogged weight} - \text{oven dried weight}}{\text{oven dried weight}} \times 100$$

4.7.3 Mechanical Tests

Mechanical tests were performed on two wood samples. Sample A from WP 5.2 (labeled sample 2 by TMC), and sample B from WP 17.1 (labeled sample 1 of 5 by TMC) to evaluate their mechanical properties. The goal was to measure the stiffness and strength of the samples to assess the structural integrity of some of the elements of the wreck. The stiffness of wood corresponds to the resistance to elastic deformation, while the strength is defined as the stress at which fracture of the wood occurs. The two testing methods used were the tensile test and the three-point bending test. A tensile test and a three-point bending test were used for Sample A, while only a three-point bending test was used for Sample B.

The two analyzed wood samples are shown in Figure 6. The wood is assumed to be yellow pine.

- Sample WP 5.2 labeled “CLOTILDA 5.2 SAMPLE 2/2”
- Sample WP 17.1 labeled “HULL PLANK 17.1 SAMPLE 1/5”



Figure 6: Wood samples tested for mechanical properties. Sample A from WP 5.2 (left), and sample B from WP 17.1 (right).

4.7.3.1 Visual and Tactile Inspection

Visual and tactile inspections of the wood samples suggests that:

- The exterior surfaces of each sample are highly irregular due to waterlogging, erosion, marine borer activity, and bacterial deterioration.
- Parts of the exterior surfaces are structurally sound while other parts are spongious and completely deteriorated.
- In general, each sample feels heavy, hard, and structurally sound, which suggests that the core is structurally well preserved.

4.7.3.2 Specimen Preparation

Both samples were cut into strips of various thicknesses, as shown in Figure 7 from which test subsamples were made. Figure 8 shows some of the subsamples: dog-bone subsamples for tensile tests and rectangular subsamples for three-point bending tests. The strips were purposely cut parallel to the wood fibers. Overall, six and eleven test subsamples were made from Samples WP 5.1 and WP 17.1, respectively. All subsamples were cut from the core of each wood sample and far enough from exterior surfaces, i.e., at least 5 mm (0.2 in) from the nearest deteriorated region (waterlogged or damaged by borers).

4.7.3.3 Testing Methods

A tensile test and a three-point bending test were used for Sample A, while only a three-point bending test was used for Sample B. The samples were cut parallel to the fibers so as to measure the mechanical properties in the direction of the fibers. Note that the properties in the other two directions (i.e., transversally to the wood fibers) are generally several orders of magnitude smaller than the properties along the fibers and are not meaningful representations of the state of the wood. All specimens were maintained wet at all times and tested wet.



Figure 7: Wood samples cut into strips. Sample A from WP 5.2 (left), and sample B from WP 17.1 (right.)



Figure 8: ***Dog-bone specimens for tensile tests from sample A WP5.2 (left) and rectangular specimens for three-point bending tests from samples A and B (right).***

4.7.3.4 Tensile Test

The tensile test is used to determine the main mechanical properties (i.e., stiffness and strength) of wood samples. The results of these tests help to assess the structural integrity of the core of the samples. The tensile test consists of applying an increasing force along the length of the subsample while measuring its extension, usually until fracture of the subsample, as seen in Figure 9.

The modulus of elasticity, E, can be determined from the slope of the linear portion of the force-extension curve and the dimension of the subsample as follows:

$$E = \frac{\Delta F \, L_{eff}}{\delta \, w \, t}$$

where ΔF is the change in force in the linear portion of the curve,
L_{eff} is the effective length of the subsample,
δ is the change in extension in the linear portion of the curve,
w is the width of the gauge section, and
t is the thickness of the gauge section.

The tensile strength, S_t, of the wood is determined as follows:

$$S_t = \frac{F_{max}}{w \, t}$$

where F_{max} is the maximum force applied on the subsample,
w is the width of the gauge section, and
t is the thickness of the gauge section.

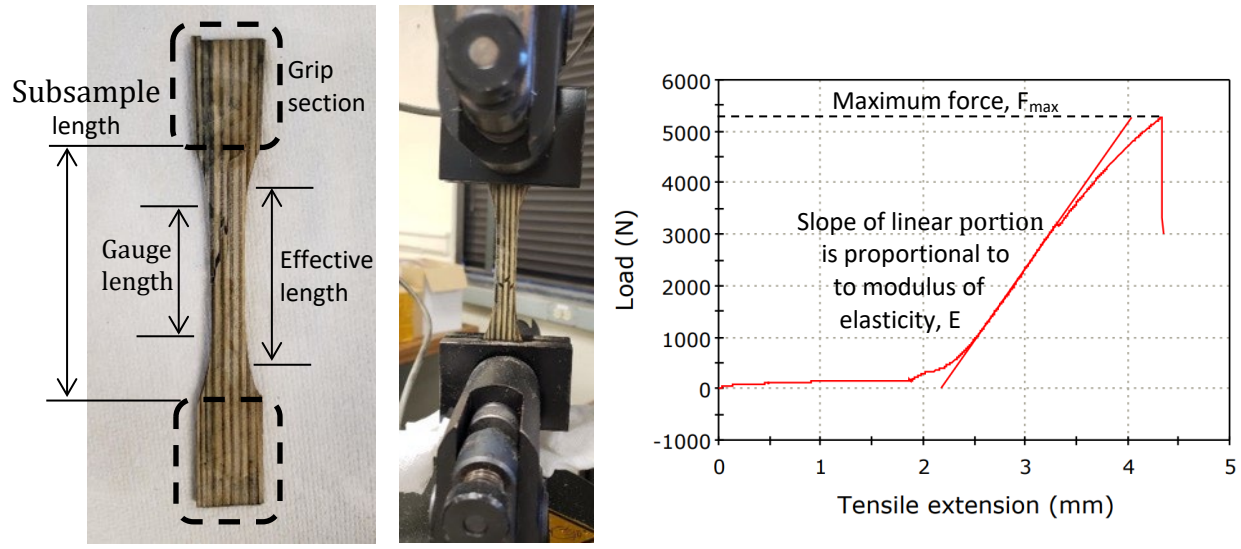


Figure 9. Tensile test. Dog-bone subsample (left), subsample in clamps (middle), force vs. extension curve (right).

The pros and cons of the tensile test include:

Pros:

- The mechanical properties of the wood (i.e., modulus of elasticity and strength) are linearly proportional to the subsample's dimensions. This means that the mechanical properties are not as highly sensitive to errors in measurement of dimensions as in other testing methods where the properties may depend quadratically or exponentially on dimensions.

Cons:

- The specimen must be cut into a specific dog-bone shape, which is not easy and may induce detrimental vibrations from the effect of the cutting tool.
- Slippage of the subsample in the clamps is sometimes significant.
- An extensometer must be used during the test to accurately measure the elongation of the gauge section of the subsample, which significantly increases the complexity of the experiment. No extensometer was used in this series of tests. Instead, the elongation of the entire subsample (provided by the tension tester) was used to estimate the elongation of the gauge section, which induced a source of error in the results. Also, the effective length of the subsample used in the modulus of elasticity formula (shown above) is an estimation of the amount of wood that contributes to resisting the load, which is somewhat subjective without further extensive analysis.

4.7.3.5 Three-point Bending Test

A three-point bending test is used to determine the main mechanical properties (i.e., stiffness and strength) of wood samples. The results of these tests help to assess the structural integrity of the core of the samples. The three-point bending test consists of applying an increasing force perpendicular to the length and at the center of the subsample while measuring its bending deflection, usually until fracture, as seen in Figure 10.

The modulus of elasticity, E, can be determined from the slope of the linear portion of the force-deflection curve and the dimension of the sub-sample as follows:

$$E = \frac{\Delta F \, L_{eff}^3}{4 \, \delta \, w \, t^3}$$

where ΔF is the change in force in the linear portion of the curve,
L_{eff} is the effective length of the subsample (i.e., distance between supports),
δ is the change in deflection in the linear portion of the curve,
w is the width of the subsample, and
t is the thickness.

The flexural strength, S_f, (also called the modulus of rupture) of the wood is determined as follows:

$$S_f = \frac{3 \, F_{max} L_{eff}}{2 \, w \, t^2}$$

where F_{max} is the maximum transversal force applied on the subsample,
L_{eff} is the effective length of the subsample (i.e., distance between supports),
w is the width of the sub-sample, and
t is the thickness.

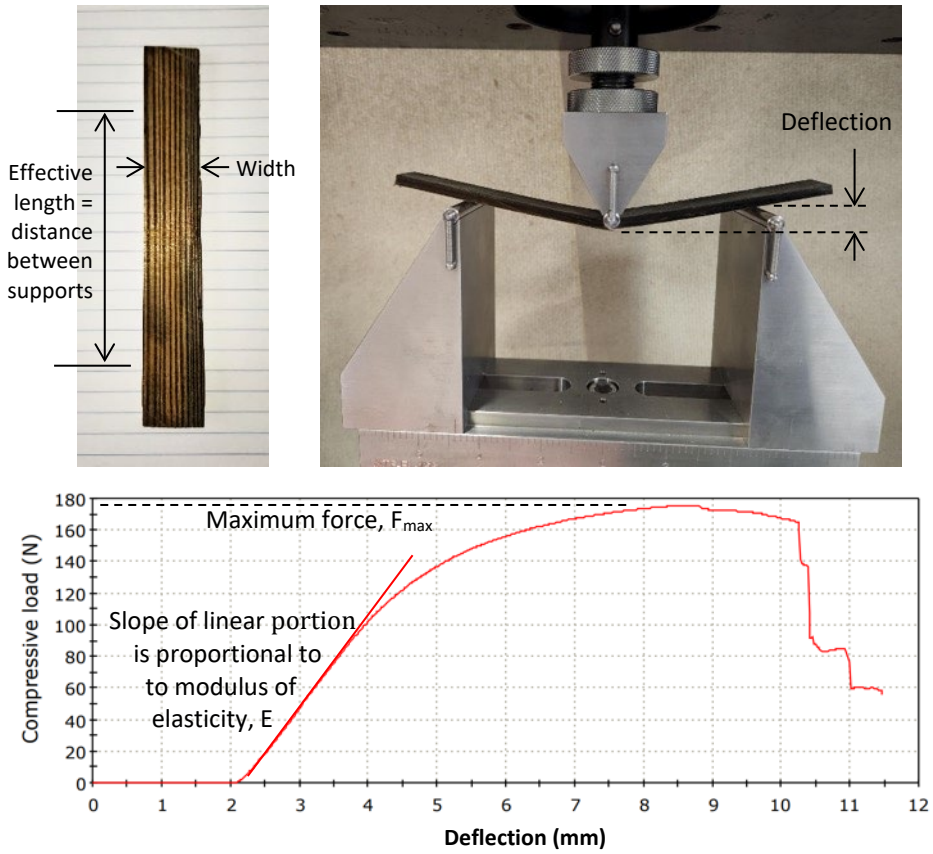


Figure 10. Three-point bending test. Rectangular subsample (top left), subsample in apparatus after failure (top-right), and force vs. deflection curve (bottom).

The pros and cons of the three-point bending test include:

Pros:

- The subsample only needs to be cut into a simple rectangular shape of uniform width and thickness.
- Slippage of the subsample is not an issue.
- The deflection of the subsample is generally readily available from the tensile machine (i.e., an extensometer is not necessary), which makes this testing method very reliable.

Cons:

- The mechanical properties of the wood, namely, the modulus of elasticity and the strength, are nonlinearly proportional to the subsample thickness (i.e., to the 3rd power). This means that the mechanical properties are highly sensitive to measurement errors.

4.8 Consultation with Marine Engineer

During the deployment, TMC consulted with remote project member Dr. Vincent Blouin, consulting naval architect and marine engineer, as observations about the recovered timbers and artifacts were made by TMC and the team. On May 10, a conference call was organized with remote team members Blouin and Michael Wood from Resolve Marine, to provide a project update and discuss observations made by the archaeological and recovery teams. The call included James Delgado, Michael Brennan, Timothy Dodson, Stacye Hathorn, Emily Benson and TMC. Various questions from Blouin and Wood were answered as best as possible pending collation of project data.

Following the field deployment, TMC met with Blouin in person and collaborated via conference calls to review project data, results of the mechanical tests on wood samples, and in situ preservation options.

4.9 Secondary Data Review

A review of photographs and related information concerning artifacts recovered by SEARCH from *Clotilda* in May 2019 was completed to understand the condition of artifacts that were previously recovered and compare their condition to the artifacts recovered during the 2022 field deployment. The review focused on photographs of the metal artifacts (Delgado 2019, 79-101). The artifacts recovered in 2019 are in storage at the History Museum of Mobile.

4.10 Environmental Data Review

Environmental data about the wreck site collected by SEARCH and other team members were reviewed following the field deployment and observations incorporated into this report. The following reports were reviewed:

- Geotechnical: 'M22-046 Clotilda Geotechnical Data Transmittal_sealed.pdf' on '*Geotechnical Investigation Summary and Subsurface Data Transmittal*', 'Geotech_grainsize.xlsx' by Southern Earth Sciences, Inc., March 25, 2022. 'A22-08402 XRD Report.pdf' by Activation Laboratories Ltd. On behalf of Southern Earth Sciences, Inc., July 22, 2022.
- Ecology: 'Clotilda_Ecological_Report.pdf' by Will Ballentine and Kelly M. Dorgan on '*Infaunal and fouling communities surrounding the Clotilda'*, Dauphin Island Sea Lab, Dauphin Island, Alabama, no date.
- Sensor's data: Files 'CTD.xlsx', 'Mobile1_ODV.xlsx', 'Mobile1_plot.png', 'Mobile2_ODV.xlsx', 'Mobile2_plot.png', and 'OBLA1_buoy.txt', collected and processed by Michael Brennan, SEARCH.
- Geochemistry: 'Mobile RiverPDFreport_far004-005.pdf' and '22-133-0015S0531006GET.xlsx' from Waypoint Analytical Marrero, Louisiana, May 26, 2022.

5 FINDINGS AND OBSERVATIONS

5.1 Artifact Condition Assessment

5.1.1 WP 1.2. Timber with Fastener

The artifact is a small piece of wood with one visible iron fastener still attached in situ.

The wood is heavily deteriorated overall and covered with biological colonization. There is evidence of burning with a blackened surface visible, as well as circular saw marks preserved on one side. A large iron drift is still attached to the wood, broken off at one end. The drift is corroded overall with brown/orange corrosion products visible on the surface.



Figure 11: Artifact WP 1.2.

5.1.2 WP 3.1 Three Fasteners

The artifacts are three large iron fasteners of varying size, not provenanced to a specific timber.

The fasteners are large drifts of varying preserved length. Two have mushroom-shaped heads and one has a flat head. The drifts are extremely corroded overall with orange and brown corrosion products visible. The surfaces are also partially covered with iron concretions and barnacles. All three drifts are broken along the shank, revealing a severely corroded wrought iron interior. The fasteners were selected for radiography, see section 5.4.3 and Figure 38.



Figure 12: Artifact WP 3.1.

5.1.3 WP 6.3 Two Brackets

The artifacts are two brackets made from forged angle iron. The small piece is a single piece of bracket, and the large piece is made from two pieces of angle iron joined with large rivets to form a T-shape.

The small bracket is broken at both ends and heavily covered with barnacles as well as hard concretions from the corrosion of the iron. Some small areas of iron surface are visible. There are at least two holes visible where rivets were probably attached. The iron is corroded overall with orange and brown corrosion products visible.

The large bracket is heavily covered with barnacles and hard concretions from the corrosion of the iron. At least one fastener hole is visible, as well as three heavily concreted bolts. The bracket is fabricated from wrought iron, as evidenced by delaminating layers of metal visible on the X-ray taken of this artifact. The surface is partially magnetic, indicating that there is still a metal core, but corrosion is extensive as visible on the X-ray image in Figure 39. Additional observations from X-ray of the large bracket artifact are included in section 5.4.3.



Figure 13: Artifact WP 6.3. Small bracket (top) and large bracket (bottom).

5.1.4 WP 7.4 Section of Ship's Steering Mechanism

The artifact was identified as part of the ship's steering mechanism and is made from wood, cast iron and rope.

The artifact is a large piece of wood with a circular cast iron pulley attached at one end. The grooved wheel has a central hub and a spoke-like structure. The wood is heavily deteriorated and worn due to marine wood borer activity and erosion. Several iron drifts and a spike remain attached to the wood. The cast iron pulley is heavily concreted with barnacles and thick orange/brown corrosion products. Remains of a rope were wound around the pulley. The surface of the wheel is delaminated and broken off in several places. A temporary storage tank was constructed from plywood with a thick polyethylene liner to house WP 7.4 on the barge, prior to removal.



Figure 14: Artifact WP 7.4. Preserved rope is visible in the image at bottom right.

5.1.5 WP 7.7 Bracket

The artifact is an iron bracket or fitting, semi-circular in shape. The bracket is possibly made from a cast iron bar, rectangular in section, that was bent into a U-shape. The ends are slightly bulbous and may preserve bolt heads.

The bracket is corroded overall with bulky orange and dark brown corrosion products visible. There is a thin concretion on the surface. The function of this artifact is unclear.



Figure 15: Artifact WP 7.7.

5.1.6 WP 11.3 Timber with Red Staining and Large Fastener

The artifact is a piece of shaped wood with red staining and a large iron drift attached.

The artifact is flat on one side and gently curved on the other. One end of the wood is stained red. The wood has a few barnacles adhered to the surface and is overall in good condition. There are some splits and losses, and holes where additional fasteners may have been attached. The iron drift is corroded overall with orange and brown corrosion products visible and is lightly concreted. The tip of the drift appears to be broken off.



Figure 16: Artifact WP 11.3.

5.1.7 WP 12.1 Two Timbers Joined with Fasteners

The artifact consists of two pieces of wood with two large iron drifts attached to the wood.

One piece of wood is a rectangular section of hull planking, and the other is a piece of what appears to be bracing, commonly called a ship's knee. The artifact was X-rayed during the site visit and an iron nail and small metal tack were also observed (not visible with the naked eye). Additional observations from X-ray of this artifact are included in section 5.4.3. and Figure 40.

The knee is heavily abraded with wood loss and heavy erosion visible on all sides. The planking is broken, there is borer damage, and numerous splits. A thin piece of what could be corroded metal sheet or caulk is visible on the knee. The identity of this material is unknown. The artifact is very dense and fragile.



Figure 17: Artifact WP 12.1.

5.1.8 WP 20.1 Two Light Switches and Wiring

The artifacts are a pair of bronze or brass electrical boxes, one of which has original wiring attached.

The boxes are rectangular in shape with a circular switch and rectangular toggle, and two attachment points for rivets or nails on each side. The box with original wiring has a large circular knob as well as a switch.

The boxes are stained corroded overall, with some staining from barnacle growth. Both are filled with river mud. The insulation on the electrical wiring is split and falling off and one end of the wire is encased in a large iron concretion. At the end of the site deployment the lights were placed back on the wreck in the weighted and covered milk crate.



Figure 18: Artifact WP 20.1.

5.1.9 WP 21.1 Fragment of Shoe Leather

The artifact is a small piece of leather from the sole of a shoe.

The leather is black in color and irregular shaped. Approximately half of the sole is preserved with a finished edge visible. The finished edge has regular small, slanted holes, some of which appear to be filled with stitching. The leather is cracked in some areas. It is slightly hard but pliable. Embedded mud is visible overall, particularly in the holes.



Figure 19: Artifact WP 21.1.

5.1.10 WP 22.1 Circular Flange

The artifact is a circular flange, recovered with the lead hawse pipe. The flange is made of lead, iron, rubberized textile, and caulking.

The center of the flange is a cylindrical pipe, part of which is preserved in situ. Both sides of the flange have pieces of a rubber gasket partially preserved around the exterior, as well as fragments of woven material adhered closer to the center, with caulk in between. Four holes around the exterior preserve iron corrosion products from bolts that have partially corroded. A small fragment of wood is preserved.

The flange is partially covered with thick barnacles, similar to the hawse pipe. The rubber gasket is very fragile and lifting from the surface. The flange is very heavy indicating fairly good preservation of the lead. The clean, brittle fracture of the pipe to which the flange was attached, and the absence of colonization from barnacles on half of the break edge, indicates that the flange had suffered mechanical damage at some point in the past and but only recently sheared from the pipe (see left image in Figure 20).



Figure 20: Artifact WP 22.1.

5.1.11 WP 22.1 Hawse Pipe

The artifact is a section of lead hawse pipe with a small piece of wood preserved in situ.

The lead is heavily concreted with thick barnacles covering the interior and exterior surfaces: no exposed lead is visible. The ends of the pipe are slightly flared, and copper nails are visible around the circumference on one end. A small section of wood is preserved, attached by several nails. The nails are bent at different angles and are lightly corroded. The wood fragment is splintered and very fragile.



Figure 21: Artifact WP 22.1.

5.1.12 WP 23.2 Wood with Large Fastener

The artifact is a small piece of wood with a very long iron drift attached.

The wood is slightly tapered at one end. It is fairly good condition overall. At one point the drift separated from the wood. The iron is corroded overall and is covered with a thick concretion and barnacle growth. The concretion is black in color, but orange and brown corrosion products are also visible. The tip of the drift was extremely corroded, with a thickness of less than one cm (0.4 in).



Figure 22: Artifact WP 23.2.

5.1.13 WP 24.1 Fitting

The artifact is an iron fitting but could not be more precisely identified.

The fitting is flat and rectangular in shape and cross section. It is completely covered by a hard iron concretion, barnacles and sediment, with some orange and brown iron corrosion products visible. The artifact was X-rayed which revealed a rectangular shape with a rounded fastener, possibly a rivet, attached to one end, as shown in Figure 38.



Figure 23: Artifact WP 24.1.

5.1.14 WP 25.1 Large Fastener

The artifact is a large iron fastener.

The fastener is heavily concreted overall and there are orange and brown corrosion products visible. The artifact was X-rayed which revealed that it is a threaded bolt with a flat head, fairly well preserved inside the concretion, as shown in Figure 38.



Figure 24: Artifact WP 25.1.

5.1.15 WP 26.1 Two Fragments of Organic Material

The artifacts are two pieces of what appears to be organic material. At the time of writing, the identification of the material was still in progress. The two pieces were recovered from inside the hold by a Resolve Marine diver. The dive team encountered a set of articulated 10 x 10 cm (4 x 4 in) posts on each side of the hold that appear to conform to the location and spacing of the platforms utilized on slave ships for the stowing of captives. As relayed by the diver to the dive operations team, a mass of this material was found in that location.

The two samples are slightly different as shown in Figure 25. One is dark brown in color on one side, with a reverse side that is light brown and black in color with a fibrous texture and clear cream colored fibers visible on the surface. This piece is rigid and appears to be a laminate, has a clear textile-like woven structure visible on the side that is dark brown in color. The other piece is less rigid, with the texture and feel of wet cardboard, is lighter brown in color on both sides and does not have a weave structure visible. This piece has a very fibrous surface with clearly visible cream colored long fibers on the surface and edges.



Figure 25: Artifact WP 26.1.

5.1.16 WP 27.1 Small Piece of Wood with Nail Holes

The artifact is a small piece of wood with at least two preserved nail holes and was pulled from the dredge screen.

The wood is broken overall so it is unclear what the original dimensions were. The wood grain runs lengthwise along the artifact, and it is in fairly good condition overall.



Figure 26: Artifact WP 27.1.

5.2 The Burial Environment

5.2.1 Sediment Cover

It is unclear how much sediment covers *Clotilda* and whether the height of the sediment varies throughout the year. Based on the condition of the disarticulated timbers and the presence of marine borers and barnacles, the timbers have been exposed to open water and not covered with sediment for some time. As a general rule, the deeper the artifacts are buried in sediment the more protected they are from degradation due to erosion, corrosion, biocolonization, and microbial decay (Peacock 2006, 259). Sufficient sediment coverage creates an anoxic environment that restricts biocolonization and is favorable to long-term preservation. Fluctuating sediment levels will also result in intermittent biocolonization and degradation of the wreck.

The absence of wood borer activity on the three wood core samples removed from the bilge indicate that sediment coverage in this area, estimated to be around 1.2 m (4 ft) (Delgado 2022), may be sufficient to reduce oxygen levels and prevent biocolonization from fungi and bacteria.

5.2.2 Soil Stability

Investigation of two soil borings near the wreck site by Southern Earth Sciences, Inc. (Delgado 2022) determined that the subsurface soils near *Clotilda* are comprised of soft and loose soils with poor supporting properties to a depth of approximately 10 to 14 m (32 to 46 ft.). The borings were taken approximately 457 m (1,500 ft.) upstream and 457 m (1,500 ft.) downstream from the wreck. Standard Penetration Tests were performed in excess of 15 m (50 ft.) below the existing mudline in two locations, GT-1 and GT-2, in the vicinity but not directly next to the wreck.

The results show that the subsurface conditions and basic soil mechanics vary greatly with location and elevation. Very loose to loose silty sand was found down to approximately 12 m (38 ft.) for GT-1 and approximately 5 m (18 ft.) for GT-2. Sand and pea gravel are found around 12 m (38 ft.) for GT1 and 9 m (28 ft.) for GT-2. As shown in Figure 27, three main layers were identified based on consistency (or relative density) of the soil with a "very loose" layer below the mudline, followed by a "loose" layer and a "medium dense" layer.

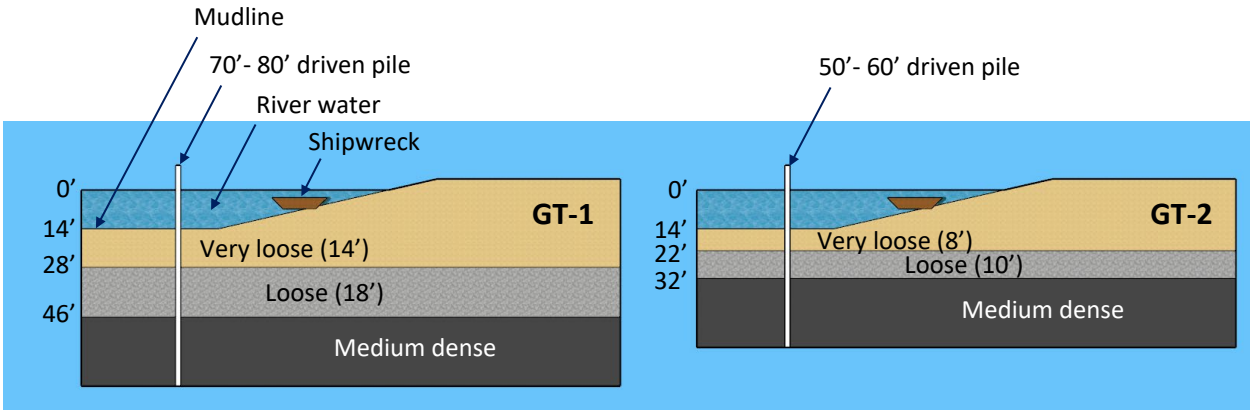


Figure 27: Cross-sectional interpretation of the two geotechnical boring tests (Delgado 2022). GT-1 (left), GT-2 (right). Hypothetical driven piles and the shipwreck are shown to illustrate dimensional proportions.

Assuming that similar conditions exist closer to the wreck, these findings have important implications for designing suitable in situ preservation methods. A stable foundation for in situ protection could only be achieved by using driven piles down to 14 m (45 ft.) to reach coarser grained soils based on the data of GT-2 and down to 18 m (60 ft.) or deeper based on the data of GT-1.

5.2.3 Water Parameters

Assessment of the recovered artifacts and review of available environmental data provided by SEARCH confirmed initial observations about *Clotilda*'s burial environment. The data confirmed that the site is brackish (somewhat salty) resulting from a mixture of seawater and fresh water and is apparently subject to rapid fluctuations depending on tides,

precipitation, and other weather conditions. The brackish environment has direct implications for the stability of the materials, both wood and metal, particularly conditions that are reflected in the biological colonization of the wood, and corrosion of the fasteners, both of which have direct bearing on the state of preservation and structural stability of the wreck.

Based on the sensors data, (Delgado 2022) the salinity on site ranged from 2.0 parts per thousand (ppt) to 23.5 ppt, as shown in Figure 28. To put these values into perspective, fresh water has a salinity value of 0.5 ppt and seawater has an average salinity of 35 ppt. The salinity variability at the wreck site is illustrated by the graph below.

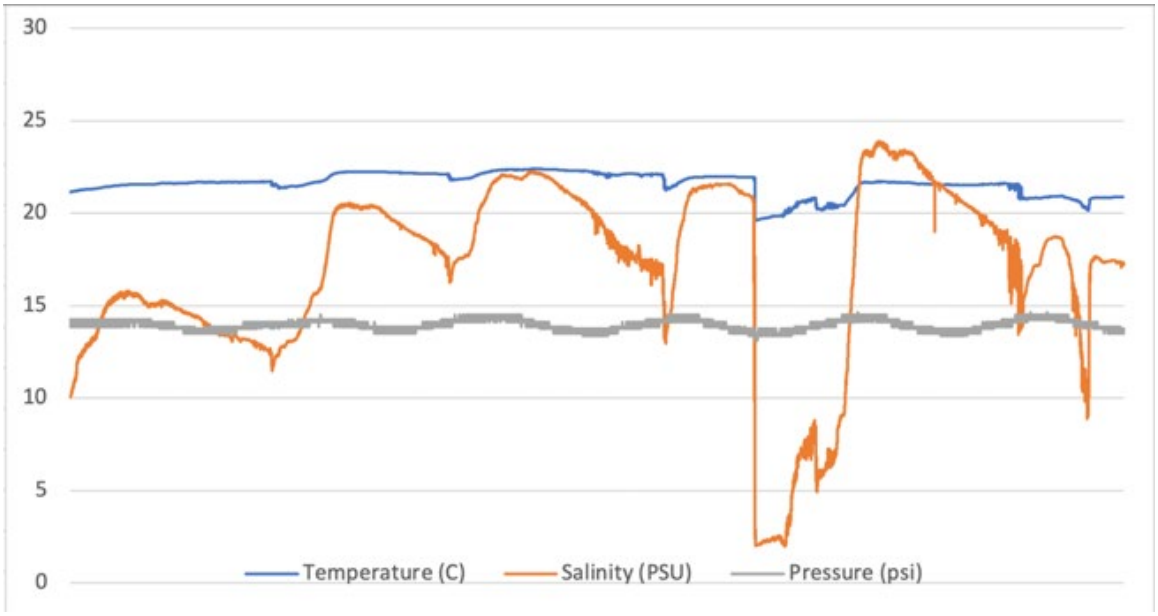


Figure 28: Salinity expressed in parts per thousand over time on Clotilda (image courtesy of SEARCH).

5.3 Timbers

5.3.1 Mechanical Damage

Extensive mechanical damage of the wood was found. Breaks and losses (some of which were quite major), large and small cracks, splintering, and extensive erosion were observed, as visible in Figures 29 and 30. Some of the timbers also displayed evidence of burning and associated wood loss. The reason for the cracks observed on certain timbers is unclear. However, the cracks are unlikely to have occurred while the timbers were submerged, suggesting that they may have been caused by drying of the wood. The cracks could have formed after only a few days of exposure to air and direct sunlight as a result of low water levels. Overall, the damage may have significantly affected the structural integrity of the ship's timbers. Substantial damage may have been caused by the removal of the copper sheathing (Delgado 2019, 70) as suggested by the image on the right in Figure

29.



Figure 29: Structural damage of disarticulated timbers. Sample 1 from WP 17.1 after cleaning displays severe radial checks and splits (left and center). The black color of the wood is due to bacteria, not fire. Severe splitting in WP 16.1 (right).



Figure 30: Structural damage of disarticulated timbers. Severe splits in WP 16.1 (left), WP 13.1 (center), and WP 23.3 (right).

Mechanical damage to the ship's timbers may have been caused by a combination of factors. These include the burning and sinking of the ship, post-scuttling activity above or near the ship, a direct impact from a vessel, looting or other activities at the site, or severe weather events, any of which could have caused significant damage, exposure, or scattering of the timbers, making them more susceptible to deterioration.

Erosion was found to be widespread on the timbers examined, which were mostly recovered from the port or river channel side of the ship or were laying on top of the wreck. The port side of *Clotilda* lies in an eroded channel in the mud and was severely scoured (Delgado 2019, 75-76). The ongoing scouring pattern on the port side may eventually erode the sediment currently supporting the hull and end up destabilizing the wreck, causing more physical stress as well as potential movement of artifacts. It should

also be stressed that the activity of wood boring organisms facilitates wood erosion by weakening the wood fibers and accelerating mechanical damage.

A study by Jacobsen et al. (2012) has shown that erosion and scour can deeply affect site dynamics and have a direct impact on the loss of material and interpretation of an archaeological site. As the fine-grained sediment and protective particles (silt or clay) become dislodged by the current and transported away from the site in suspension, only the heaviest (and less cohesive and protective) particles such as sand and gravel tend to stay in place. The scouring pattern is non-linear and can change depending on interrelated factors such as high-energy events, storm surges, climate change and human intervention. Loss of sediment cover causes more wood exposure and an increase of oxygen in the newly exposed areas resulting in increased biological colonization, particularly from marine wood borers, and corrosion of the metal fasteners.

Finally, two small timbers were examined that exhibited evidence of burning and physical damage. These timbers were very fragile and required careful handling.

Wood core 3 examined by TMC did not appear to show any original mechanical damage.

5.3.2 Biological Colonization

Wood exposed to sea water is progressively colonized by a range of biological organisms including bacteria, diatoms, fungi, micro algae, molluscan, crustacean colonizers, and marine wood borers.

5.3.2.1 Marine Wood Borers

Marine borers are by far the most damaging of these organisms and can cause enormous destruction of wooden shipwrecks by burrowing into wood immersed in salty or brackish water, digesting the cellulose, tunneling into the wood, and eventually destroying the wood unless it remains buried. Borers require sufficient oxygen and salinity for their survival; however, they can live in areas where the salinity is low.

Investigation of live samples of infaunal and fouling communities (Delgado 2022) identified the wood boring isopod *Sphaeroma terebrans.* The salinity tolerance of *Sphaeroma terebrans* ranges from 4 – 28 ppt range (Delgado 2022), which makes it particularly adapted to the wreck site and represents a major threat to any unburied parts of the wreck.

Evidence of old and new marine borer damage was visible on the disarticulated timbers as seen in Figure 31, with some pieces showing heavy damage combined with erosion. The damage was unmistakable during visual inspection and was also confirmed from radiography of artifact WP 12.1, seen in Figure 34, which revealed the degree of borer damage within the wood. Woodborer damage may have significantly affected the original size and structural integrity of the ship's exposed timbers, depending on how widespread it is.

Timber 17.1 which was sampled for mechanical testing showed very little evidence of woodborer damage. No borer damage was observed on the three wood cores recovered from the bilge, which confirms that any part of the wreck that is sufficiently buried is protected from borers due to low oxygen levels in the sediment. Examination of sediment cores collected by Resolve Marine divers at the bow, mid ship, and stern of the wreck did not identify any infauna in the sediment that would represent a direct risk to the wood timbers from *Clotilda*.

The absence of borer damage on the wood cores removed from the bilge suggests that conditions below the mudline are anoxic due to sufficient sediment coverage, which would be expected. However, this is speculative and based on a very small number of samples. It is likely that exposed timbers located at a higher elevation, particularly closer to the bow, would be more prone to borer damage. Intermittent exposure of the wood, for any reason, can expose the timbers to borer colonization and dramatically increase the risk of irreversible damage to the wreck.

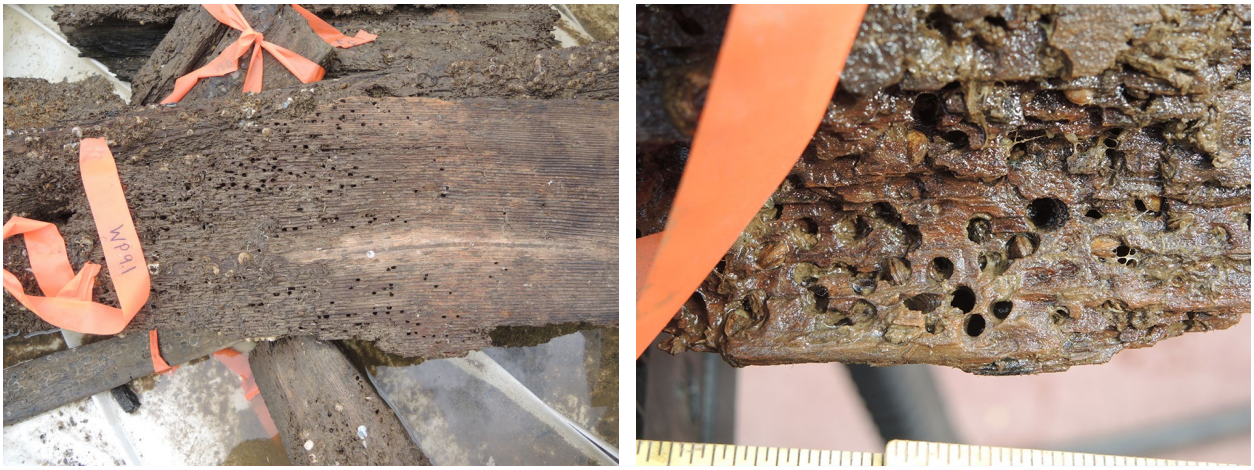


Figure 31: Small holes characteristic of marine borer damage in WP 9.1 (left) and WP 7.4 (right), typical of the disarticulated timbers.

5.3.2.2 Barnacles

Both live and dead colonies of barnacles, identified as *Amphibalanus subalbidus* (Delgado 2022) were visible on the wood, distinguished by their color, level of colony die out, and activity. Some of the timbers were completely covered with colonies, others only partially covered, as seen in Figure 32. The live colonies were cream to white in color, and often opened or closed in the storage tank and/or when touched. Dead colonies appeared dark brown to black in color and were more irregular in numbers. Additional fouling organisms on recovered wood, namely the false mussel *Mytilopsis leucophaeta*, and tube-building amphipods (*Corophiidae*) were also identified (Delgado 2022).

Barnacles are small arthropods that thrive exclusively in marine environments, particularly

shallow and tidal waters, attaching themselves to hard surfaces like wood by secreting hard calcium plates that completely encase them (NOAA "What are Barnacles?"). Barnacles cannot grow in fresh water or water without oxygen. The presence of live barnacle colonies suggests that oxygenated, saline conditions were prevailing in the vicinity of the timbers when they were colonized. This was confirmed by the salinity readings, discussed in section 5.2.3. Black coloration of the dead barnacles indicates that these timbers were exposed, for some time, to near anoxic conditions (very low oxygen levels), or fresh water, possibly killing the colonies. A reduction in oxygen levels is likely due to the redistribution of sediment on the wreck depending on the prevailing currents and sediment budget.

Barnacles were not observed on the wood cores recovered from the ship's bilge, indicating that sediment coverage in this area may be sufficient to restrict oxygen and prevent colonization.



Figure 32: Barnacle colonization on WP 13.1 (left) and WP 18.1 (right), typical of the disarticulated timbers.

5.3.2.3 Fungi and Bacteria

The likelihood of biocolonization on the timbers by fungi, bacteria (particularly sulphate-reducing bacteria), and other microorganisms, is high and should be confirmed through characterization of the bacterial and fungal communities in wood samples from both disarticulated and in situ timbers on the wreck. These organisms play a somewhat minor role compared to the damage and loss of archaeological information caused by marine borers. However, bacteria and fungi colonization can damage the wood on which they grow, a process that is much slower than direct damage from marine borers, but one that will affect the long-term preservation of the wood (Gregory 1998). Biocolonization by aerobic bacteria (organisms that survive in oxygenated environments) is most active in the first few centimeters (less than one in) of sediment, but as oxygen levels drop, anaerobic bacteria (organisms that survive in low oxygen environments) dominate, extending to a depth of at least 50-62 cm (20 – 24 in) (Gregory 1998, Pearson 1987, Florian 1987, 15).

Sulfate-reducing bacteria is also likely to be present in the sediment, further deplete the oxygen content (Muyzer 2008). These bacteria use the oxygen for oxidative enzymatic metabolic activities to produce hydrogen sulfide, which gives the wood a black color (visible in Figure 29) and distinctive smell of rotten eggs. Other bacteria such as cavitation, erosion or tunneling bacteria will attack specific areas of the cell wall and globally increase the porosity of the wood and its water content making it more fragile and prone to shrinkage when exposed to the air without appropriate treatment (Blanchette et al. 1990, 147-174).

5.3.3 Wood Density

In general, the wood examined from *Clotilda* that had not been damaged by marine borers had a thin and spongey deteriorated outer layer and a dense core. This was apparent during sampling of two timbers. Timber WP 17.1 required an electric circular saw for sectioning due to its density. After sampling timber WP 5.2, visible in Figure 33, the wood smelled strongly of pine resin. This timber appears to have the characteristics of old growth lumber and is assumed to be yellow pine. The exact sub species of yellow pine is unknown at this time. Given the time-period of the ship and based on the determination of the growth rings per inch it is possible that some of the timbers on *Clotilda* may be made of heart pine which is the heartwood of the longleaf pine tree (Southern Pine Inspection Bureau "Density of Wood" 2022). While the number of growth rings per inch is not necessarily a reliable indicator of wood density and stiffness, this information is still relevant in determining the residual properties of the timbers used to build *Clotilda* (Irby et al. 2020).

On the timbers tested, an average penetration depth of 0.90 cm (0.35 in) was obtained with the Pilodyn, as indicated in Table 5. Based on these results and the mechanical tests performed on wood samples from timber WP 17.1 and WP 5.2, the wood appears to have retained many of its original mechanical properties.

An average penetration depth of 0.70 cm (0.27 in) was obtained with the Pilodyn on the three wood cores removed from the bilge by the Resolve Marine divers. This result appears to be indicative of a slightly lower degradation level of the cores compared to the disarticulated timbers and overall better protection afforded by the sediment coverage in the bilge area, which would be expected.

Radiography of artifact WP 12.1 also revealed the degraded state of the wood, in this case, in contact with metal fasteners, and damaged by marine borers, as visible in Figure 34. The borer activity has a direct impact on the wood density and overall mechanical properties of the wood.



Figure 33: View of a cross section from subsample 1 from WP 5.2 immediately after sectioning (left) and close up view of the growth rings per inch (right).

5.3.4 Moisture Content

The maximum moisture content, or U_{max}, value of the samples tested was as follows.

- Wood sample 5 from timber WP 17.1 - 125%.
- Four core subsamples from WP.17.1 (sample 1) – an average of 116%.
- One subsample from the outer layer of WP.17.1 (sample 1) - 175%
- Subsample 1 from timber WP 5.2 - 58%.
- Wood core 3 (removed from the bilge) - 62%.

Based on de Jong's classification (1977), all samples tested belong to Class III (a U_{max} of less than 185%), which is defined as the least waterlogged wood category. The moisture content of the four core subsamples from WP.17.1 at 116% is not far from the overall value recorded for sample 5 from the same timber at 125%. The maximum moisture content measured in the outer layer subsample from WP.17.1 at 175% still belongs to Class III and seems to confirm that the wood is marginally waterlogged with a dense core and a thin degraded outer layer.

We were not able to test the moisture content of core 1 and 2 (which were retained for DNA analysis) to compare with core 3.

5.3.5 Mechanical Properties

The following discussion summarizes the report in Appendix A.

5.3.5.1 Sample WP 5.2 – Tensile Tests

The tensile tests were not as successful as the three-point bending tests because of the

drawbacks of the method listed in section 4.7.3.4. The main issues were slippage of the subsamples in the clamps and also the subjective estimation of the effective length. Out of the four subsamples from sample WP 5.2, two were successfully tested (i.e., negligible slippage) and the corresponding mechanical properties are:

E = 5.54 GPa (stand. dev. = 0.04 GPa)
S_t = 97.01 MPa (stand. dev. = 12.71 MPa)

5.3.5.2 Sample WP 5.2 – Three-Point Bending Tests

Two specimens from sample WP 5.2 were tested successfully and the corresponding mechanical properties are:

E = 9.90 GPa (stand. dev. = 0.23 GPa)
S_t = 77.40 MPa (stand. dev. = 0.85 MPa)

5.3.5.3 Sample WP 17.1 – Three-Point Bending Tests

Nine specimens from sample WP 17.1 were tested successfully and the corresponding mechanical properties are:

E = 8.91 GPa (stand. dev. = 1.10 GPa)
S_t = 52.44 MPa (stand. dev. = 4.15 MPa)

The test results are listed in Table 6. The mechanical properties of pine (averaged over 16 common species of pine) from the literature are also listed for comparison.

Table 6: Summary of the three-point-bending test results and expected values.

Wood Sample	Test	Number of sub-samples	Modulus of Elasticity		Strength	
			E (GPa)	Stand. dev. (GPa)	S_t or S_f (MPa)	Stand. dev. (MPa)
WP 5.2	Tensile	2	5.54	0.04	97.01	12.71
WP 5.2	3-Point Bend	2	9.90	0.23	77.40	0.85
WP 17.1	3-Point Bend	9	8.91	1.10	52.44	4.15
Pine	Ref: U.S. Dept. of Agriculture 1999	16 species of pine	Avg = 10.5 Range = 8.2 - 13.7 (12% moisture content)		Avg = 77.7 Range = 57 - 112 (12% moisture content)	

The measured properties (i.e., modulus of elasticity and strength) are within the range of the properties of typical pine species, which suggests that the core of each sample is in good condition. In this context, the "core" of a structural element is defined as the portion

that is at least 0.5 cm (0.2 in) below the exterior surface and any wood damaged by marine borers or bacteria.

5.3.5.4 Effect of Moisture Content

With an average U_{max} of 116% for the four core subsamples from timber WP 17.1 (sample 1), this value is well above 12% which is the moisture content of air-dried pine wood used in the tests of the Department of Agriculture. Wei-Lian et al. (2021) showed that moisture content reduces the mechanical properties in beech wood. Even though their research was not specific to pine wood, the effect of water is also expected to reduce the mechanical properties of pine.

More specifically, moisture has two effects on the mechanical behavior of wood. On the one hand, moisture decreases stiffness and strength, which is generally detrimental. On the other hand, moisture increases ductility (i.e., the ability to absorb shock and deformation), which is beneficial. Since the tested stiffness and strength are high, it can be concluded with confidence that the core of the wood tested is in good condition and that any effect of the potentially high moisture content would be beneficial thanks to increased ductility.

5.3.5.5 Important Final Statement

It should be clearly noted, however, that these mechanical tests only confirm the high structural integrity of the core of the structural elements of the wreck (e.g., beams, poles, and planks). They do not suggest in any way that the shipwreck has any structural integrity as a whole. The structural integrity of the shipwreck as a whole depends predominantly on the state of the connections between elements as well as the presence of cracks and fractures in structural elements. Therefore, if further structural investigation is performed, it should be focused on the assessment of the connections between elements and on the identification of large cracks and fractures within and along the structural elements.

5.3.6 Radiography

In addition to providing information about the corrosion state of the metal fasteners, the radiographic inspection of artifact WP 12.1, which is an assembly of two pieces of wood (possibly a knee), revealed the extent of deterioration caused by marine borers. In Figure 34, the extent of borer damage is indicated by the white arrows. Small holes, tunneling and wood loss are clearly visible, confirming the deterioration observed visually. It is unclear how this fragment separated from the hull. Mechanical damage, localized failure from borers, erosion, fire damage, or a combination of factors, are all possibilities.

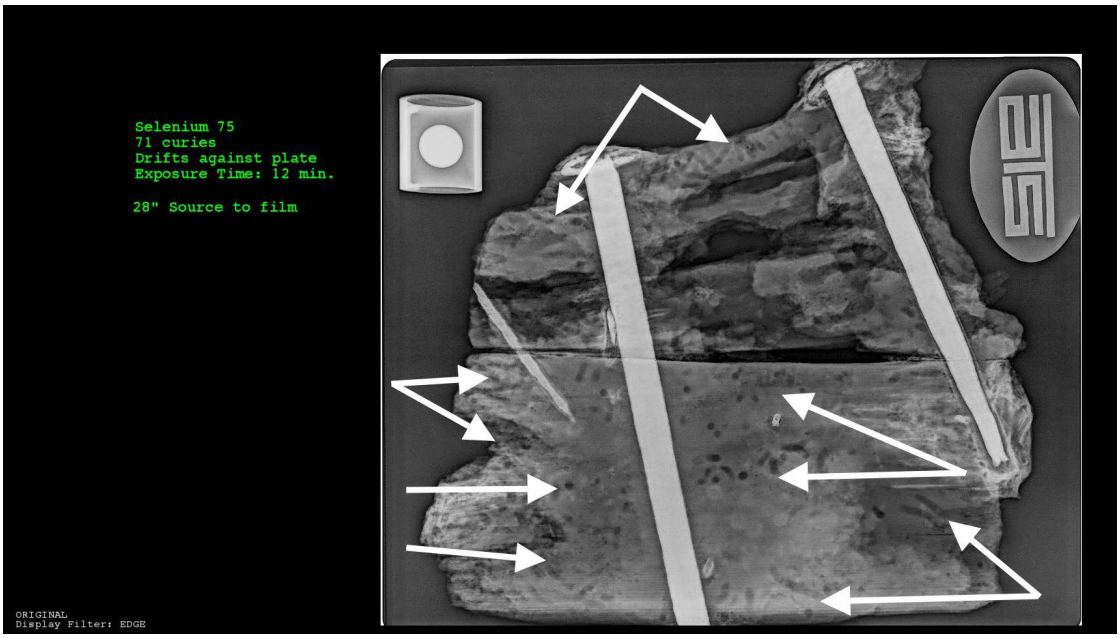


Figure 34: X-ray image of WP 12.1 revealed widespread wood borer activity indicated by the white arrows.

5.3.7 Samples

Materials testing of the wood samples is reported in sections 5.3.3, 5.3.4 and 5.3.5. Radiography of sample 8, a concretion, is reported in section 5.4.3. Analytical results for the sample of organic material were not available at the time of writing. It is anticipated that the Smithsonian's Museum Conservation Institute will analyze the sample.

5.3.8 Previously Recovered Artifacts

A review of photographic images of timbers recovered by SEARCH in 2019 (Delgado 2019, 81-91) provided information that concurred with our visual and tactile assessment. In general, the erosion patterns and deterioration are in agreement with what TMC observed on the timbers recovered in 2022.

5.4 Metal Fasteners and Artifacts

5.4.1 Corrosion

Archaeological metallic artifacts are subject to corrosion in freshwater, brackish, and marine burial environments. The degree of corrosion depends on many factors including the type of metal, the salinity of the site (freshwater is usually less corrosive to metals than marine or brackish waters), whether the artifact is in contact with other metals (bi-metallic corrosion) or organic materials, and whether dissolved oxygen is present in the vicinity of the object. The location of the artifact on site and the depth of burial all play an important

role in the long-term preservation of metal artifacts.

When cast and wrought iron corrode, a concretion, which is a hard shell of calcium carbonate and iron corrosion products, usually forms around the artifact and creates a microenvironment independent of the surrounding environment (Scott and Eggert 2019, 123). Concretions are hard shells that form around iron artifacts in marine or brackish environments, and are a mixture of iron corrosion products, sand, and calcium carbonate secreted by colonizing marine organisms. Certain concretions, particularly those containing corroded wrought iron artifacts, can retain a print of the original shape of the object even if the artifact has completely corroded. The thickness and hardness of the concretion is usually a good indication of a higher corrosion rate. As a result, concretions are less likely to form in freshwater environments.

In general, the corrosion rate of the wrought iron fasteners will vary depending on a number of factors including their position on the wreck, whether buried or embedded in wood, and the amount of dissolved oxygen available. Localized corrosion could also be accelerated by the proximity of wrought iron components to more noble metals such as copper sheathing due to galvanic corrosion.

All iron artifacts recovered from *Clotilda* exhibited varying levels of corrosion ranging from moderate to severe, and many were broken or damaged. Some artifacts were concreted, while others exhibited a surface covered with corrosion products that were orange, red, brown, or black in color. Numerous broken concretions were also found, with voids inside indicating that a fastener previously encased in the concretion had fully corroded, as shown in Figure 4.

On many timbers, severe corrosion or total dissolution of the iron fasteners was observed, and/or corrosion had drastically reduced the diameter of the fasteners still attached to the timbers. This was visible on timbers WP 7.2, 18.1, 13.1, and 23.2. Many timbers exhibited broken drifts sticking out of the wood, fastener holes filled with iron corrosion products where drifts had disintegrated in place, or corroded fragments of iron brackets or other fastenings that were still attached to the surface. These timbers included WP 1.3, 16.2, 13.1, 16.1, 23.3, and 7.4. In the case of artifact WP 7.4 which is a section of the steering mechanism composed of wood, cast iron and rope, the cast iron was severely corroded, and a fragment of the cast iron wheel appears to have broken off during recovery. In wood sample WP 5.2 (sample 1) the complete corrosion of an iron nail was observed, visible in Figure 35. This timber sample split in half during sectioning, revealing a void in the shape of the original nail.

A piece of iron fastener retrieved from wood sample WP 17.1 (sample 2) was allowed to dry out without any stabilization treatment to assess its level of instability. The sample began to ‘weep’ or ‘sweat’ after only a few days of exposure to the air, with droplets of orange-brown liquid visible on the surface. The droplets indicate a high concentration of chloride-containing salts. Weeping iron is attributed to the hydroscopic nature of iron chloride salts that can completely corrode the metal if not appropriately conserved after

recovery (Selwyn 2004, 107).

Artifacts WP 22.1, a lead hawse pipe and flange, were almost completely covered with barnacles and marine growth, visible in Figures 20 and 21. The flange also had iron corrosion products visible on the surface, indicating that an iron component, such as a bolt or other fastener, was present. The presence of live barnacles is a clear indication that these artifacts were recovered from an area of the wreck that was fully oxygenated, in other words, not buried.

Lead generally shows good corrosion resistance in oxygenated sea or brackish waters due to the presence of sulfate ions that form a protective and adherent layer on its surface. Under these conditions lead is readily colonized by marine growth. Lead is vulnerable to attack by organic acids that can form in the presence of wood or decaying marine organisms which can lead to active corrosion if not properly conserved or stored. When exposed to anaerobic or polluted waters, lead corrosion is expected to be higher than in oxygenated conditions (Pearson 1987).

No copper alloy artifacts directly attributed to the wreck were recovered. However, two light switch boxes were recovered that may have been attached to the wreck or a nearby tree, possibly as hazard lights, seen in Figure 18. The switch boxes are made of a copper alloy, probably naval brass. One box was attached to a large iron concretion, possibly the junction box, via insulated wire. Both boxes were fairly well preserved, with oxidized surfaces and minimal corrosion overall. Naval brass is an alloy particularly resistant to corrosion.

Copper and its alloys form a wide category of metals that typically include bronze (Cu/Sn) and brass (Cu/Zn). Corrosion in seawater varies depending on their composition and burial conditions. Both copper and brass sheets were used to protect wooden hulls from marine borers and fouling organisms. Copper alloys rarely form thick corrosion products and concretions underwater due to the toxicity of copper, and they are prone to erosion. The preservation of any surviving metal sheathing on *Clotilda* could not be examined but may still be preserved in the parts of the hull still buried in the sediment. Note that if fragments of sheathing are preserved, increased corrosion is expected due to the presence of sulfide ions, if the parts of the hull where the sheathing survives are buried in anaerobic conditions.

These examples of metallic corrosion on artifacts from *Clotilda* demonstrate that variable localized conditions in effect on the wreck will continue to have a significant impact on the long-term state of preservation, particularly of the iron artifacts.



Figure 35: Complete corrosion of a nail observed in sample 1 from WP 5.2 (left), and corrosion of fasteners in WP 16.1 (right)



Figure 36: Severely corroded fasteners (left) and a concretion of a completely corroded fastener (right).



Figure 37: Corrosion of iron components in WP 16.1 (left) and WP 23.3 (right).

5.4.2 Previously Recovered Artifacts

Photographs of artifacts previously recovered by SEARCH from *Clotilda* in 2019 showed similar corrosion levels ranging from moderate to severe (Delgado 2019, 92-101). In particular, some of iron drifts were reduced to thin needles and many timbers were colonized by barnacles indicating burial in an oxygenated environment.

5.4.3 Radiography

Radiographic inspection of seven artifacts confirmed the extent of the corrosion observed visually, particularly of the iron fasteners. Note that dense materials like metals will block most of the X-rays and will appear black on an X-ray image whereas areas of low density such as wood or corroded metals will appear as shades of grey to black.

The inspection confirmed that artifacts WP 3.1 (three fasteners) and WP 25.1 (a bolt), were fabricated from wrought iron. Elongated fibers typical of the forging process for wrought iron are seen on the X-ray image in Figure 38. WP 25.1 (A in Figure 38) was heavily concreted. The original outline of the bolt head is preserved in the concretion, marked on the image with a yellow arrow pointing to a void that is represented by the dark area around the head which is an area of low density. The white areas on the X-ray image denote what is left of the metal.

The fasteners have a thinner concretion layer (B, C and D in Figure 38). These artifacts were lightweight indicating a loss of density. X-ray results showed localized corrosion causing loss of the tapered end, exposing the metal fibers to further corrosion. The heads of fasteners B and D are also severely corroded, as indicated by the yellow arrows. The head of fastener C is entirely missing due to corrosion and lack of a protective concretion. The largest average diameter of the fasteners based on three measurements taken using the calibrated X-ray measuring tool is 1.7 cm (0.7 in).

Artifact WP 6.3, a large and heavy bracket, was heavily concreted. The X-ray image of this artifact, seen in Figure 39, confirmed that the bracket was fabricated from three pieces of wrought iron joined with a large bolt. The iron is delaminating. Four additional fastener holes are visible on one of the flat sides as well as a piece of metal between the joint of the iron pieces. The edges are heavily corroded, with loss of metal and fibrous layers of metal visible where corrosion was severe.

The X-ray of artifact WP 12.1, an assembly of two pieces of wood (possibly a knee), revealed two large fasteners in the wood as well as the remains of what appears to be an iron nail and small metal tack, visible in Figure 40. The fasteners are corroded overall, with several areas of severe localized corrosion, indicated by the yellow arrows on Figure 40. The head of one fastener appears to have separated. The X-ray also showed that the iron corrosion products have infused into the wood, visible as white areas around the tapered end of the drift on the right in Figure 40. X-ray of sample 8, a fragment of concretion visible in Figure 38, showed complete dissolution of the metal fastener.

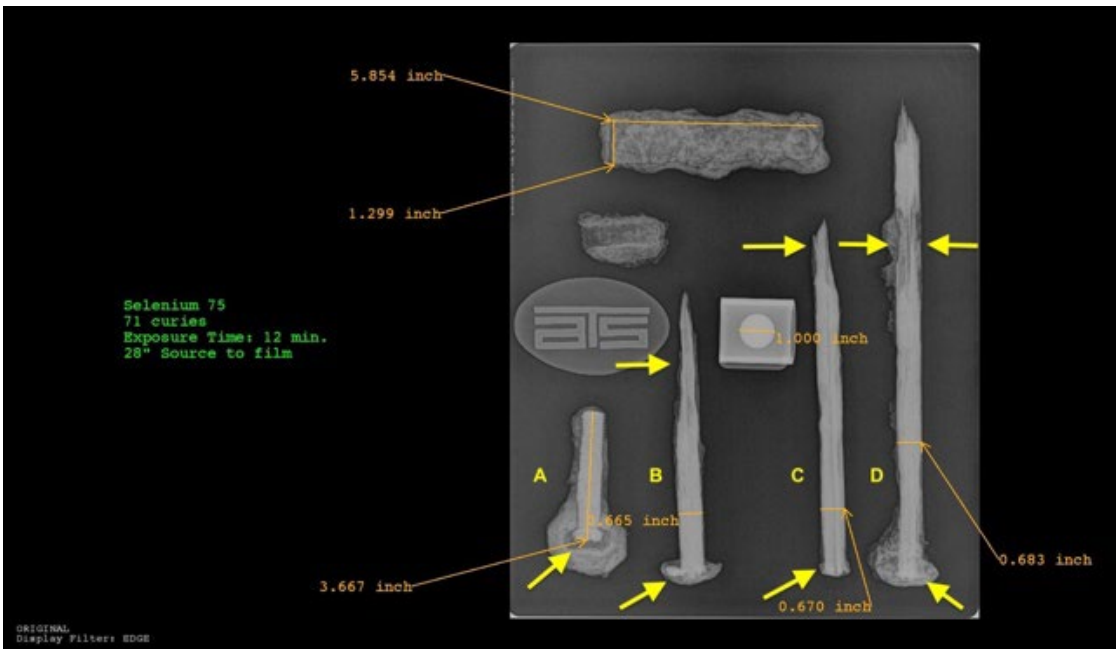


Figure 38: X-ray image showing areas of corrosion and loss as indicated by the yellow arrows. WP 25.1 (A) and WP 3.1 (B, C and D).

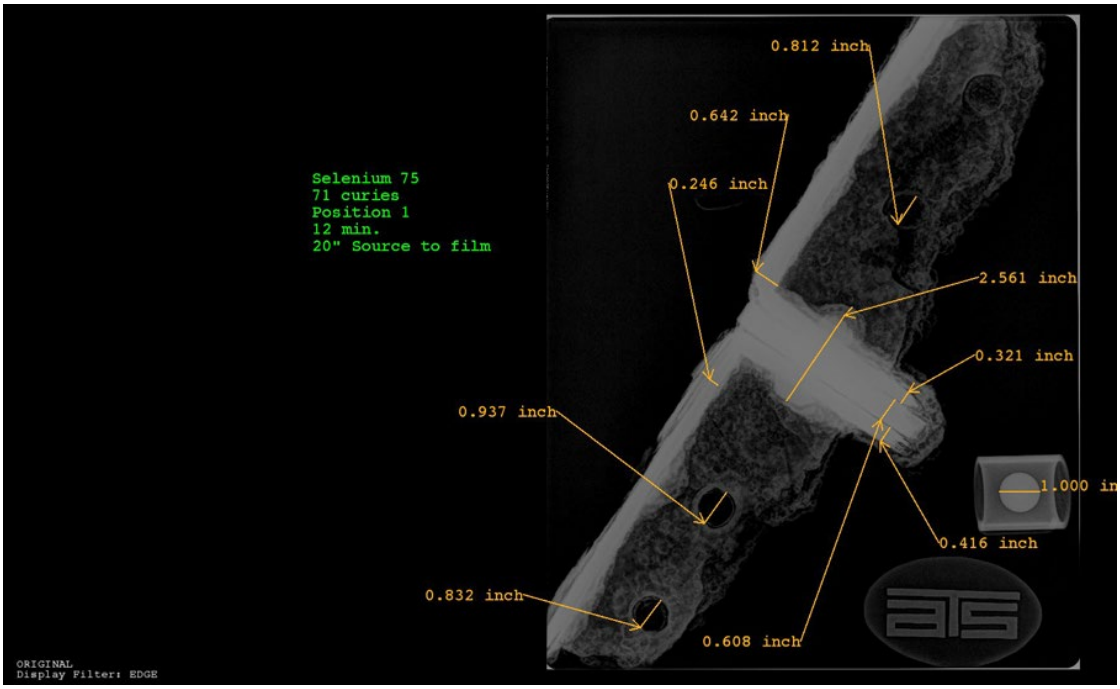


Figure 39: X-ray image of artifact WP 6.3 showing fabrication details and corrosion of the wrought iron.

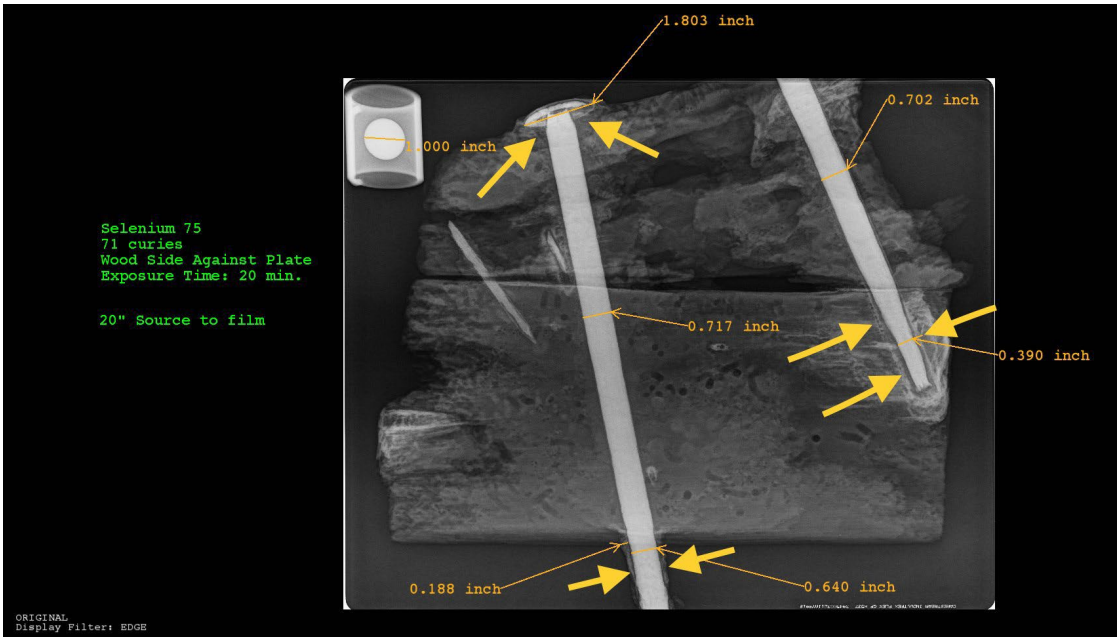


Figure 40: X-ray image of artifact WP 12.1 showing areas of corrosion as indicated by the white arrows.

5.5 Summary: Findings and Observations

The material evidence assembled during this investigation revealed that there are several

key deterioration processes in effect at the wreck site. The study was based on assessment of a limited number of disarticulated timbers, fasteners, and artifacts. The structural integrity and stability of the wreck overall, and particularly the parts still buried in sediment, could not be directly assessed. However, there is cause for concern and need for further investigation.

Clotilda is situated in shallow, medium to high energy brackish water, which means that the ship is particularly vulnerable to marine borers, biological colonization, erosion of exposed wood, corrosion and scouring (sediment erosion), and loss of the protective sediment cover. These conditions are already affecting the wreck and are likely in flux and vary with prevailing climatic and environmental conditions. However, the level of damage observed indicates that certain processes have been in effect for quite some time.

Damage caused by potential human disturbance could not be specifically attributed or ruled out during this study; however, destructive events at the wreck site have been documented (Delgado 2019, 70), and these incidents pose a significant and ongoing risk to *Clotilda*'s physical survival.

Mechanical testing of timber samples indicated that *Clotilda*'s timbers appear to be marginally waterlogged and quite dense, with predominantly well-preserved material and good structural integrity. However, many of the timbers examined displayed severe borer damage and erosion. On the eight samples tested for moisture content, the results indicated a low moisture content which correlated with the visual evaluation of these three timbers. However, the results may not be reflective of the shipwreck as a whole or the degradation patterns in timbers from other parts of the ship, particularly those that remain buried or colonized by fungi and bacteria.

The presence of wood checks and deep splits on both small and large timbers, some going through the entire thickness of the wood, is concerning and could significantly affect the structural stability of the wreck if widespread. The severe splitting of the wood and other mechanical damage may suggest periodic exposure to the air during low river water levels. Biocolonization from marine borers, barnacles and most likely bacteria and fungi, have caused further physical damage to *Clotilda* and will continue indefinitely unless the wreck is reburied in situ.

Corrosion of metallic artifacts, particularly the iron fasteners, is widespread and varies from moderate to severe to total loss and can be attributed to localized burial conditions, specifically the levels of dissolved oxygen on the site. The variation in the decay levels observed on the fasteners would be expected on such a complex wreck site. While radiography of WP 12.1, suggests that the metal fasteners still embedded in timbers may be less corroded than those recovered individually, this must be further investigated. Complete corrosion of an embedded nail, shown in Figure 35, provides a clue that localized burial conditions on the wreck may be conducive to complete loss of structural integrity of the fasteners, given the right conditions. However, without further investigation, only general conclusions can be drawn.

There is not enough evidence at this stage to determine whether corrosion alone has caused localized structural failure of the disarticulated timbers examined. More likely, corrosion in combination with other factors, such as the scuttling of the ship in 1860, human disturbance, environmental conditions favorable to biological colonization, and scouring of the sediment, have contributed to the separation of timbers from the wreck. Detached timbers that are not fully buried in sediment are susceptible to further deterioration, including rapid corrosion of the fasteners, further supporting in situ preservation efforts and reburial as quickly as possible.

6 IN SITU PRESERVATION OF *CLOTILDA*

The material evidence observed and investigated during this study provided preliminary data for understanding the condition of *Clotilda* and some of the major risks threatening the wreck and the archaeological site. Based on the evidence assembled, in situ preservation, which involves physical protection of the wreck and reburial in an anoxic (near zero oxygen) environment, is the most ethical, least damaging, and scientifically responsible strategy at this time.

Preliminary recommendations to achieve in situ preservation of the wreck and safeguard the site are offered. These recommendations address physical security and reburial, the two most immediate needs for survival of the wreck. They build on the site preservation practices already in place and identify knowledge gaps where further investigation is needed. It is hoped that these recommendations lay the groundwork for further collaborative discussions.

6.1 In Situ Preservation of Underwater Cultural Heritage

The preservation of shipwrecks in situ follows current best practices in archaeological site preservation and stewardship for the protection of underwater cultural heritage resources. Our preference for in situ preservation of *Clotilda* is based on several decades of dealing with historical and archaeological artifacts and materials, including underwater cultural heritage. It is also based on the significance of the archaeological site as a memorial and place of remembering for descendants of the enslaved transported on *Clotilda*, considerations that must be integral to all in situ preservation practices.

Several leading international organizations incorporate in situ preservation as a first option in their guidelines for underwater cultural resources including most importantly the United Nations Educational, Scientific, and Cultural Organization (UNESCO) via the *UNESCO Convention on the Protection of the Underwater Cultural Heritage* and the Annex (UNESCO 2001), and the International Committee on Monuments and Sites (ICOMOS) via the *Charter on the Protection and Management of Underwater Cultural Heritage* (ICOMOS 1996).

In situ preservation includes the physical methods and management practices, as well as legal frameworks, employed to protect and preserve underwater cultural heritage at the site where it was discovered. It is a component in the management of underwater cultural heritage and is frequently applied as a first step in managing these resources. The process encompasses identifying the major physical, biological, chemical, human and other threats to a shipwreck or underwater archaeological site and implementing management practices that will eliminate, slow or arrest deterioration as much as possible. Reburial is one of the primary in situ preservation methods applied on wooden shipwreck sites. In situ preservation methods are specific to each archaeological site and require a custom management plan.

Preserving underwater cultural heritage in situ is important for a number of reasons, including ensuring that the material is preserved for future research as well as avoiding significant costs associated with excavation, recovery, and long-term conservation and curation (Staniforth and Shefi 2010, 1549). Based on similar projects, conservation may take several decades and cost millions of dollars to complete, in addition to the cost of building, staffing, and maintaining an appropriate facility for conservation, curation and exhibition of the material. In situ preservation will also minimize the risks associated with large-scale recovery of the wreck.

Without any protective measures, *Clotilda* will continue to deteriorate indefinitely and be vulnerable to irreversible damage from macro and microorganisms, as well as partial or complete loss of the surviving hull from impacts with vessels and floating objects, vandalism or severe weather events.

6.2 In Situ Preservation Long-Range Plan

Observations made during this investigation provided preliminary data for understanding the level of deterioration and some of the major risks facing *Clotilda*. Further research is needed to build a comprehensive intervention plan for the wreck and the archaeological site, compiled into a long-range planning document for in situ preservation. The long-range plan should lay out all information available about the condition of the wreck and its environment, including information gained from recent archaeological and environmental investigations, and should include sections on risk management, an engineering study to confirm options for reburial and protection of the wreck, and a reburial plan based on the outcome of the engineering study.

Systematic long-term scientifically based monitoring of the site is important and will contribute to an understanding of the effectiveness of the strategy employed, as well as when and where changes need to be made for optimal site management. How the monitoring will be carried out, by whom, how often, and what equipment and materials are needed, should be addressed in the long-range plan.

6.2.1 Risk Management

In situ preservation incorporates risk management into management processes for the protection of underwater cultural heritage. Risk management of cultural heritage assets employs similar tools and processes to other fields such as public health, banking and finance, and technology to systematically identify, analyze, and prioritize risks, and what action is required for risk mitigation. It is a continuous process of monitoring the risks and adjusting the actions needed to mitigate and/or minimize their impact on the wreck. Risk analysis and mitigation ensure better use of resources and optimal conditions for preserving cultural heritage (Pendersoli, Antomarchi and Michalski, 2016).

This investigation revealed many of the major threats facing *Clotilda*, however, additional risks associated with the wreck and the archaeological site should be classified and

recorded via a risk assessment so that strategies for mitigation are planned into long-term site management. These risks include criminal activity at the wreck site, damage and physical loss associated with the wrecks location in an active inland waterway, and threats resulting from climate change and catastrophic weather events.

6.2.2 Engineering Assessment

A full engineering study of the archaeological site is urgently needed to determine the design of appropriate structural systems to support reburial and physical protection of the wreck. The subsurface soils in the immediate vicinity of *Clotilda* are unknown and may present challenges for designing appropriate methods to achieve preservation in situ. This is discussed in section 6.3.1.

The study should include comments from maritime archaeological conservators, maritime archaeologists, environmental scientists, civil engineers, and project partners, as appropriate. Results of the engineering study should be included in the long-range preservation plan for the site.

6.3 Preliminary Considerations for *Clotilda*

Long-term in situ preservation of *Clotilda* requires implementing two main objectives.

1. Physical protection and safety of the wreck to prevent loss and/or irreversible damage from impacts with vessels and large drifting logs, vandalism, or a severe weather event.
2. Reburial of the wreck to a sufficient depth to create anoxic conditions and prevent damage to the wood from marine borers, limit fungi and bacterial colonization of the wood, and reduce corrosion of the iron fasteners.

The following discussion summarizes the preliminary options in Appendix B; further details are included in the Appendix B report.

6.3.1 Potential Site Limitations

Investigation of two soil borings approximately 450 meters (1,500 ft.) upstream and downstream of the wreck site determined that subsurface soils in the areas tested are comprised of soft, loose sands with poor supporting properties potentially extending to more than 15 m (50 ft.) (Delgado 2022). The consistency of the soils directly around *Clotilda* are currently unknown. However, if they are also loose and unstable, this will have critical implications for reburial and the type of support systems that can be implemented to protect the wreck.

Loose soils around the wreck would likely require installation of marine driven piles to create a stable foundation for reburial and for creating a physical barrier to protect the wreck. One of the drawbacks of driving piles near the shipwreck is the potential

disturbance from the vibrations created by the process of hammering the piles down using a hydraulic or diesel hammer. This should be investigated during the detailed engineering study, as recommended in Appendix A.

The following preliminary in situ preservation options and engineering models are based on loose subsurface soils present at the wreck site, as previously discussed in this report.

6.3.2 Dealing with the River Current

The shipwreck is exposed to the river current as well as potential impact from any floating object. The shape of a protective barrier should account for the potentially high current-induced forces and impact with a shape that would smoothly divert the current and any floating object. Figure 41 shows three different shapes for physical barrier.

A rectangular shape (purple) with sharp corners would be easier to construct than the other options. However, the upstream side of the barrier would have to resist tremendous pressure from the river current and would be somewhat vulnerable due to full exposure to direct impacts from floating objects. Also, the corners would induce scour vortex shedding that would potentially erode sedimentation on the downstream side.

A rounded shape (yellow) would be the best use of space by minimizing the volume inside the barrier. The rounded corners would reduce vortex shedding and would potentially divert floating objects, which would reduce the vulnerability of the barrier. Also, the rounded or oval shapes provides intrinsic stiffness and strength against exterior pressure. The drawbacks are the potentially more difficult construction and the relatively large upstream surface area exposed to current pressure and floating objects.

A curved shape (red) is the preferred shape to minimize the current-induced forces and impacts from floating objects. The shape of the barrier on the upstream side would allow the water current and any floating object to bounce smoothly away from the barrier. The forces applied to the barrier and its foundation system would be reduced significantly. The main drawback is the large volume inside the barrier.

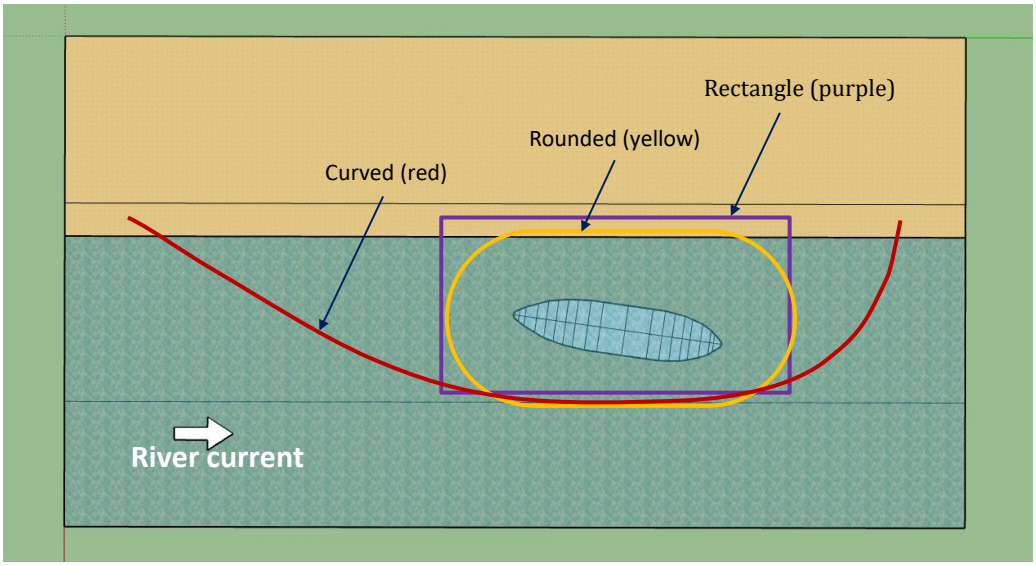


Figure 41: Top view of the site and different shapes for a physical barrier.

6.3.3 Physical Protection

Clotilda's location in shallow waters makes the wreck exceptionally vulnerable to damage and possibly partial or complete loss of the surviving hull. Specific concerns include improper vessel piloting close to the wreck, anchoring, or dragging anchor on or near the wreck, river dredging, looting and vandalism.

The potential subsurface soil constraints also present significant challenges for implementing a long-term physical protection strategy. As discussed above, a viable foundation system for a physical barrier would most likely include driven piles (possibly self-driving suction piles) to stabilize the site and form a solid foundation. The number of piles needed depends on the water current forces applied on the physical barrier as well as the intensity of potential impacts from floating objects that the barrier is expected to resist. The impact intensity depends on the size, weight, and speed of the floating object. Assuming that an object moves at a relatively small speed 8 kph (5 mph), the varying impact intensity (from "small" to "extremely large") could be:

- Small: impact from a tree log or a 6 m (20 ft.) vessel
- Medium: impact from a 15 m (50 ft.) vessel (50 tons)
- Large: impact from a 37 m (120 ft.) vessel or barge (750 tons)
- Extremely large: impact from a 59 m (195 ft.) barge (1,500 tons)

At this point of the project, the targeted impact intensity has not been defined since it depends on many aspects that were not considered in this study, such as the financial cost of implementation.

The following preliminary design approaches for installing a protective barrier are listed in order of increasing impact resistance.

6.3.3.1 Three-Foot Deep Physical Barrier

The idea is to minimize the number of driven piles. In the example shown in Figure 42, the barrier is installed only on the upstream side of the wreck using six piles with 12 m (40 ft.) spacing. The barrier is relatively shallow (e.g., 1 m/3 ft. deep) to minimize the current-induced pressure and can either be floating to accommodate changes in water elevation or fixed to the piles to add stiffness to the system. Some of the water would be diverted away from the wreck while the rest would flow under the barrier.

This barrier would protect the wreck from most small impacts as it would divert small objects that float on the surface. However, the water that flows under the barrier may slightly accelerate and induce greater scouring. Also, this barrier would not provide any protection against medium or larger impacts.

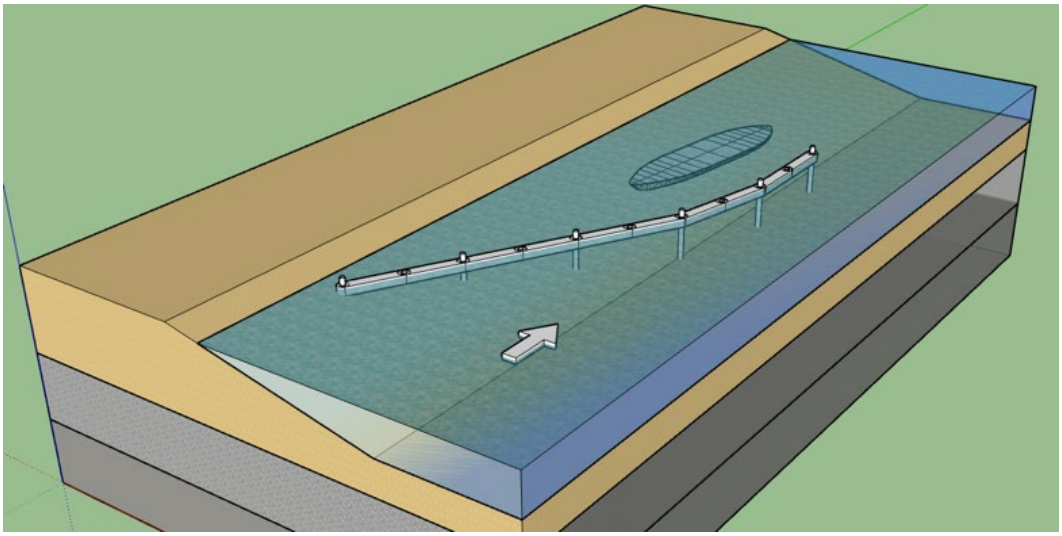


Figure 42: Three-foot deep physical barrier anchored to 6 driven piles with 12 m (40 ft.) spacing.

6.3.3.2 Six-Foot Deep Physical Barrier

The design shown in Figure 43 is an upgrade of the previous design with twice as many piles and a deeper barrier. The main advantage is that it may protect the wreck from medium impacts. On the downside, scouring may occur as a result of the waterflow being modified and may accelerate under the barrier.

The barrier may be constructed from different materials including precast concrete or steel, in which case the panels would be rigidly fixed to the piles.

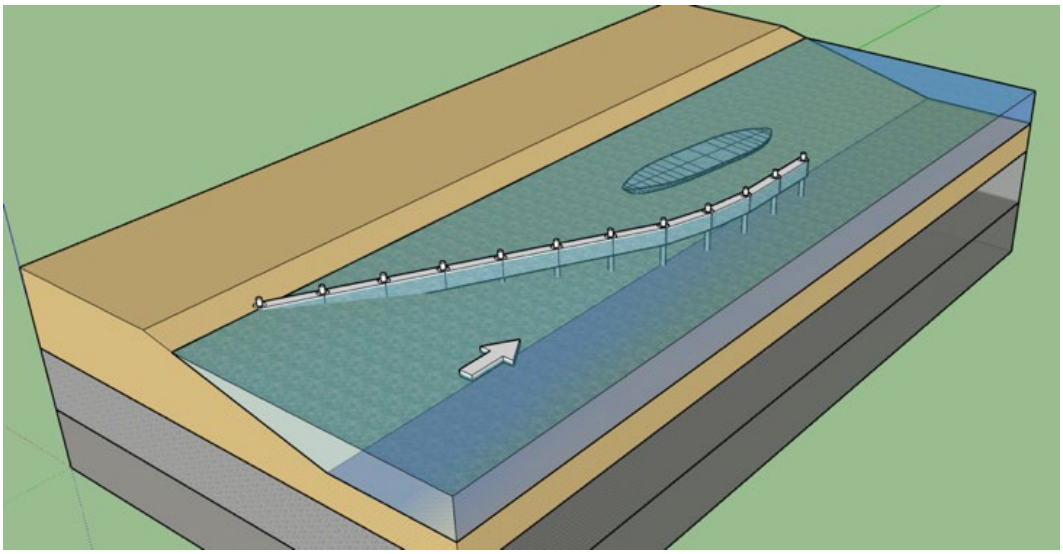


Figure 43: Six-foot deep physical barrier anchored to 12 driven piles with 6 m (20 ft.) spacing.

6.3.3.3 Full-Depth Physical Barrier

In this design shown in Figure 44, the barrier would completely block off the water current and protect the wreck from medium impacts. The barrier wall would be buried into the sediment to a depth that would prevent scouring to occur under the wall.

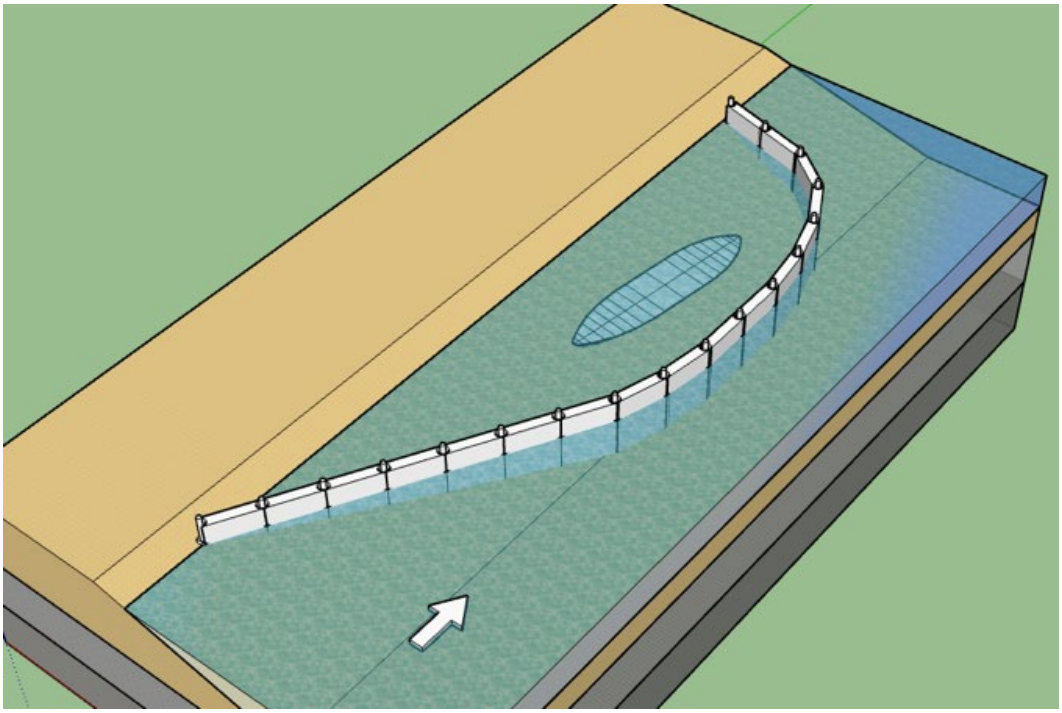


Figure 44. Full-depth physical barrier anchored to 18 driven piles with 6 m (20 ft.) spacing.

6.3.3.4 Buttressed Full-Depth Physical Barrier (Cofferdam)

The design shown in Figure 45 is an upgrade of the previous design with buttresses as reinforcement installed on most piles. In this example, additional piles are driven 3 m (10 ft.) away from the original piles and each buttress connects rigidly to each pair of piles as shown in Figure 46. The total number of piles is now 31. This option may protect the wreck from medium to large impacts. If the soils around the wreck are loose, this may be the only viable option for reburial. The cost would most likely be significant.

This design may allow dry excavation, if contemplated. However, assuming that a cofferdam can be installed, and the water can be pumped-out to expose the wreck, the river water would most likely flow under the cofferdam and re-enter the site at a very high soil flow rate due to the potentially high permeability of the sediment. Water and mud pumps would have to be sized accordingly and would most likely run for the entire duration of the excavation. Walking on the exposed riverbed would be challenging if not impossible without sinking. Floating walkways may have to be installed on the soil around the wreck.

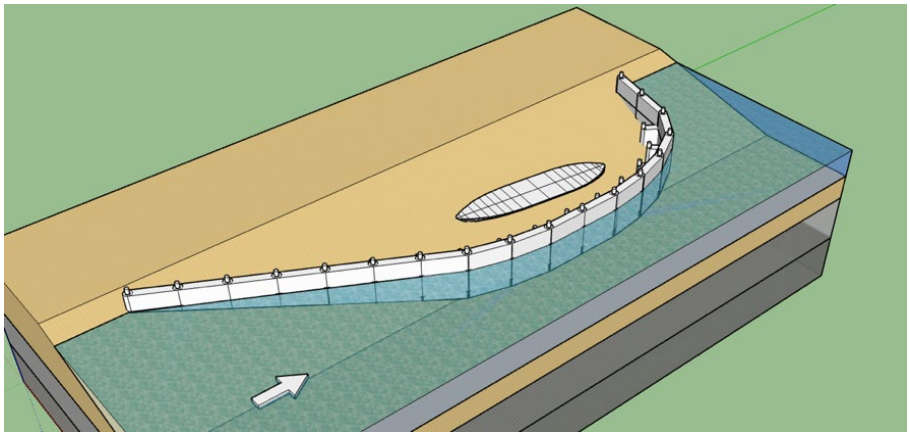


Figure 45: Buttressed full-depth physical barrier (cofferdam) with 31 driven piles and 6 m (20 ft.) spacing.

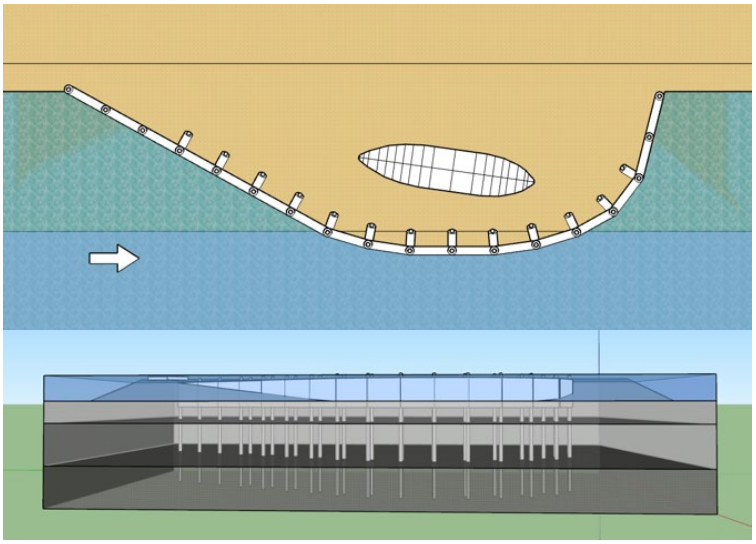


Figure 46: Top view and side view of a buttressed cofferdam with 31 driven piles.

6.3.3.5 Non-Viable Options

For the sake of completeness, two options initially considered but deemed non-viable are shown in Figure 47. The first option is a dam around the wreck made of large boulders piled in a pyramid shape. This would be one of the few, if not the only option, that would protect the wreck from extremely large impacts. However, as indicated by the geotechnical evaluation (Delgado 2022), the subsurface soils may not be sufficiently dense to support the weight of the large boulders, especially when piled up into a wall. All boulders would eventually sink into the mud a few dozen feet deep.

The second option is a wall of concrete interlocking blocks. In this example, the blocks are 2 x 2 x 1 m (6 x 3 x 3 ft.). For the same reason, the entire structure (which is extremely dense) would sink slowly into the mud.

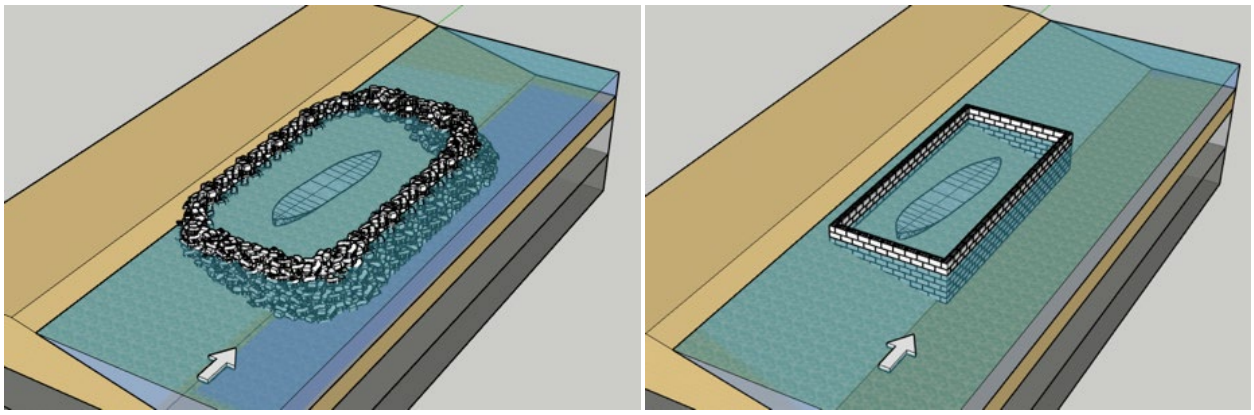


Figure 47: Non-viable options. Boulder dam (left), and rectangular concrete block wall (right).

6.3.4 Reburial

One of the key practices employed in situ preservation of underwater cultural heritage is reburial of the surviving wreck in its archaeological location coupled with observation and monitoring to track the long-term effectiveness of methods applied. As pointed out by Ford et al. (2016), how quickly a shipwreck is buried and whether it remains buried is a major determinant of its long-term preservation.

To accomplish reburial, it is necessary to recreate as closely as possible the environmental conditions required for long-term preservation of the wreck's materials. An anoxic environment with sediment covering at least 50 cm (1.6 ft.) above the wreck's highest point of elevation is needed to limit biocolonization and reduce corrosion (Gregory 2008, 2, Peacock 2006, 259). Monitoring equipment should be installed to better understand the environment over time and adjust protective measures accordingly.

A suitable burial environment not only reduces the risk of colonization by marine borers,

bacteria and fungi by reducing oxygen levels, it also provides physical protection against erosion and human interaction. Reducing erosion will prevent further disarticulation of the hull by supporting it more evenly. As scouring of the sediment, erosion of the wood and corrosion of the fasteners are prevented, the risk of disarticulation of the hull will be dramatically reduced.

The protection of shipwrecks can sometimes be achieved by using simple methods of reburial such as covering the site with sediment or sandbags or stretching a marine geotextile fabric liner or other material over the wreck (Veth et al. 2016, Richards et al. 2016). However, if subsurface soils around *Clotilda* are similar to those already investigated (Delgado 2022), it is highly unlikely that these methods of protection can be successfully employed, as discussed in section 6.3.3.5. In addition, the wreck's location in shallow waters, and the difficulties of anchoring geotextile to effectively prevent gradual erosion at the interface between the textile and the sediment, means that reburial using traditional methods is unlikely to succeed.

Given the potential limitations of the subsurface soils, installation of a buttressed full-depth physical barrier - essentially a cofferdam structure - may be the only feasible way to rebury the wreck in an anoxic environment conducive to long-term preservation. Critically, the structure would also provide physical security of the wreck, accomplishing the two main objectives for long-term in situ preservation of *Clotilda*.

The following figures illustrate the potential reburial process.

In Figure 48, the buttressed full-depth physical barrier (cofferdam) is elevated to accommodate potential changes in water elevation and sufficient sediment coverage for reburial of the wreck. As discussed above, reburial to a height of at least 50 cm (1.6 ft.) above the wreck's highest point of elevation is required to limit biolcolonization and reduce corrosion.

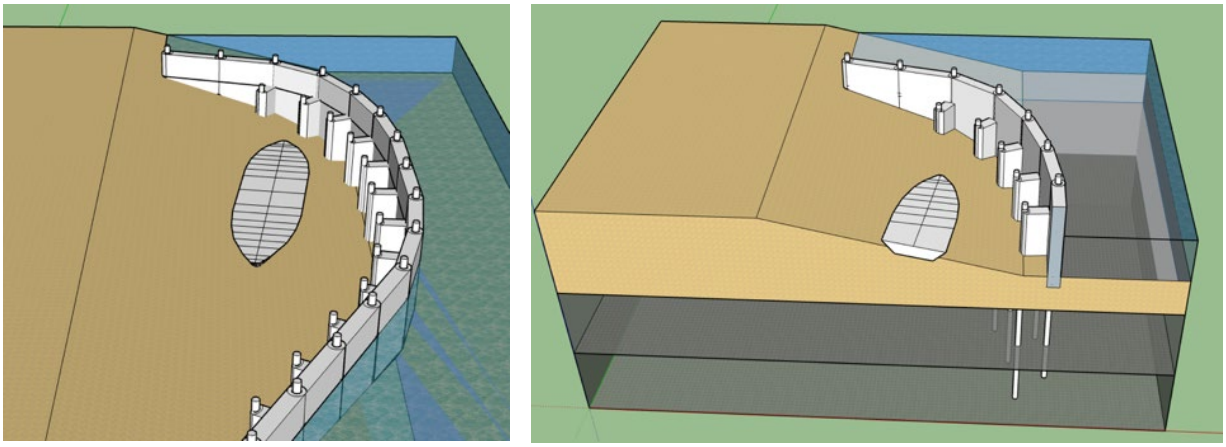
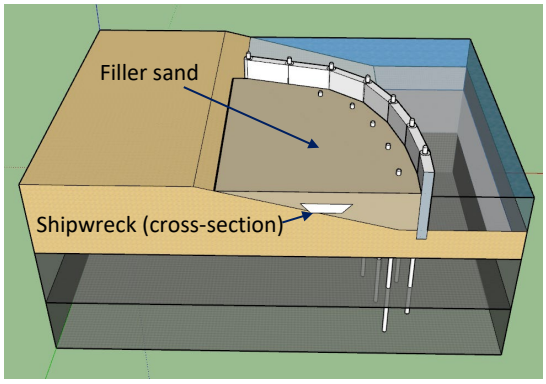


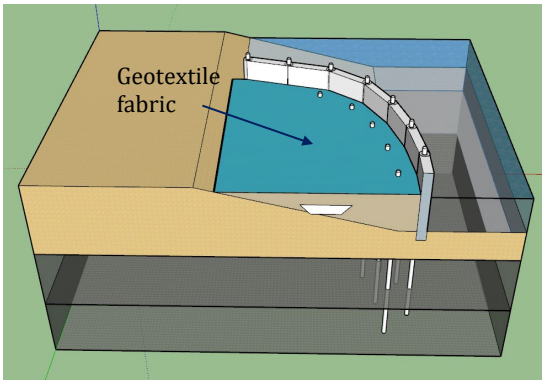
Figure 48: The buttressed full-depth physical barrier (cofferdam) with elevated walls. Complete model (left) and sectioned model (right).

Figure 49 illustrates the potential steps for reburying the wreck within the buttressed full-depth physical barrier, ensuring sufficient sediment coverage. Optimal preservation conditions would be established around the wreck by filling the cofferdam with suitable backfilling materials (such as sand and gravel) that would need to have the same density as the original sediment. Once filled, the exterior water pressure applied on the cofferdam wall will be counter-balanced by the pressure from the filler materials, which should completely relieve the structural loads applied on the driven piles

Step 1: The cofferdam is filled with sand until the wreck is completely buried several feet deep to achieve an anoxic environment. The density of the sand should be similar to that of the sedimentation layer below it to limit the chance that the sand sinks into the sediment.



Step 2: A geotextile fabric is installed on top of the sand as a supporting surface for the layer of gravel that will then be installed on top of it. The geotextile fabric would work as a permeable barrier between the gravel and the sand. The way the fabric meets and wraps around the cofferdam wall and the piles will need to be addressed.



Step 3: Spread a layer of gravel above the geotextile layer. Sensors and monitoring devices may have to be installed at various locations near the wreck to ensure that the environment is anoxic at all times.

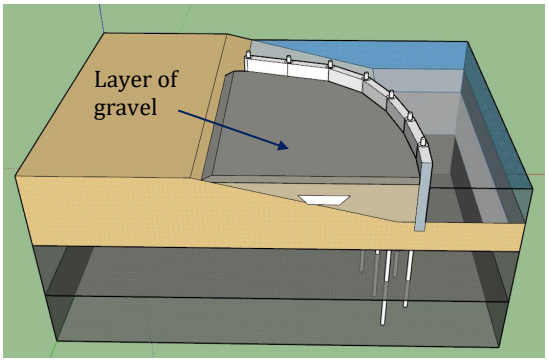


Figure 49: Potential steps for reburial of the wreck.

The reburial process as shown in Figure 49 is sufficiently robust to assume that minimal degradation would occur due to water infiltration, erosion, and scouring. As long as the physical barrier (cofferdam) is sufficiently watertight, the only infiltration of water would come from below, through the sediment layer. However, the pressure applied by the water-saturated backfilling material would prevent, or at least minimize, water infiltration from below. Rain and storm water would infiltrate into the gravel, through the permeable geotextile fabric, and into the sand. A monitoring protocol may have to be devised to identify the location of sand erosion due to rainwater infiltration over time.

The process in Figure 49 is feasible under the condition that the sediment has sufficient cohesive strength to counter the weight of the backfilling material above it. If the cohesive strength of the sediment is too low, the backfilling material may push the sediment downward and outward under the cofferdam wall towards the riverbed, which may disturb the wreck over time. To prevent this phenomenon, the cofferdam wall may have to be driven deep enough into the sediment to reach a denser sediment layer and effectively hold the entire site in place.

To carry out long-term monitoring, the cofferdam design should allow access to the site to collect test samples and to make any necessary modifications based on site conditions. Monitoring would include observing oxygen, ammonium and nitrate content in the sediment, pH, redox potentials, water levels, and identifying the location of sand erosion due to rainwater infiltration over time.

6.3.5 Summary of Potential Options

All options discussed in sections 6.3.3 and 6.3.4 are listed in Table 7 with their pros and cons.

Table 7: Summary of all physical protection and reburial options.

Option	Pros	Cons
Three-foot deep / 6 piles (Figure 42)	• Protection against small impacts • Few driven piles • Limited environmental impact	• Does not protect against medium impacts • Does not prevent erosion and scouring around the wreck • No reburial option
Six-foot deep / 12 piles (Figure 43)	• Protection against medium impacts • Few driven piles • Limited environmental impact	• Does not protect against large impacts • Does not prevent erosion and scouring around the wreck • No reburial option
Full-depth / 18 piles (Figure 44)	• Protection against medium impacts	• Does not protect against large impacts • No reburial option

	• Prevents erosion and scouring around the wreck	• Significant impact on environment and river flow
Buttressed full-depth / 31 piles (Figure 45 – 49)	• Protection against large impacts • Allows reburial • Allows excavation • Prevents erosion and scouring around the wreck	• Does not protect against extremely large impacts • Large number of driven piles • Significant impact on environment and river flow
Boulder dam (Figure 47)	Non-viable because it cannot be supported by excessively loose sediment	
Block wall (Figure 47)	Non-viable because it cannot be supported by excessively loose sediment	

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

The material evidence assembled during this investigation reveals that there are several key deterioration processes in effect at the wreck site. The study was based on assessment of a limited number of disarticulated timbers, fasteners, and artifacts and the results cannot be extrapolated to the entire wreck. The structural integrity and stability of the wreck overall, and particularly the parts still buried in sediment, could not be directly assessed. However, there is cause for concern and need for further investigation.

The study affirms that in situ preservation is an appropriate approach for *Clotilda.* This strategy requires a two-fold approach. The first step is immediate physical protection of the wreck, and the second is reburial in an oxygen-free environment. Reburial may be challenging if subsurface soils close to the wreck are loose.

7.1.1 Deterioration and Structural Integrity

- Potential physical damage from potential impacts with floating objects, vandalism, looting, or severe weather events poses a significant and ongoing risk to *Clotilda*'s survival.
- The location of the wreck in shallow, medium to high energy brackish water is causing continuous loss of sediment cover, scouring, erosion of the wood, corrosion, colonization from marine borers and biological deterioration.
- The structural integrity of the shipwreck as a whole depends primarily on the state of the connections between elements as well as the presence of cracks and fractures in structural elements.
- Mechanical damage of the wood is extensive, particularly wood checks, severe cracks, and deep splits. The structural integrity of the wreck may be significantly affected if this type of damage is widespread.
- Biological damage is widespread on the disarticulated timbers. By far the most damaging are the marine borers that may have significantly affected the original size and structural integrity of the ship's timbers. Old and recent damage indicates that borer activity has been in effect for quite some time and will continue unless the ship is effectively reburied in an oxygen free environment.
- Biocolonization of the wood by barnacles is widespread. Colonization by bacteria and fungi, and other microorganisms, which are also a threat to the long-term preservation of the wood, are suspected. Test results from sediment samples covering the wreck are pending.
- Mechanical testing of wood samples from disarticulated timbers confirmed that the core of the wood has good structural integrity and a low moisture content. However, these results do not suggest in any way that the shipwreck has any structural integrity as a whole since it predominantly depends on the state of the connections

between all elements of the hull. As a result, the results may not be reflective of degradation patterns on the rest of the ship.
- Corrosion of metal fasteners varies from moderate to severe to total loss. It is unclear whether corrosion alone has caused localized structural failure of the disarticulated timbers.

7.1.1.1 Recommendations

- Further investigation of timbers and fasteners is necessary to determine the overall structural integrity of *Clotilda*.
- Investigation should focus on the assessment of the connections between elements and on the identification of large cracks and fractures within and along the structural elements.
- In situ X-ray inspection would help verify the extent of corrosion of the fasteners in the hull.
- Identification of fungal and bacterial communities in both disarticulated and in situ timbers from the wreck should be carried out to help determine the reburial parameters.

7.1.2 Preservation In Situ

Preliminary recommendations indicate that a buttressed cofferdam structure may be the most likely method to successfully achieve reburial and protect the wreck from physical damage if the subsurface soils around *Clotilda* are loose, as suggested by geotechnical investigation of two soil borings near the wreck.

7.1.2.1 Recommendations

- Physical protection and reburial of the wreck are urgently needed.
- The subsurface soil parameters directly surrounding the wreck should be determined by investigation of additional soil borings. The results will determine which in situ preservation method is most appropriate for *Clotilda*.
- A comprehensive engineering study is needed to determine the design of suitable structural systems to support reburial and physical protection of the wreck, and the feasibility of implementation. Any option for installing a physical barrier and reburying the wreck may involve a significant number of driven piles. The study should include comment from maritime archaeological conservators, maritime archaeologists, environmental scientists, civil engineers, and other specialists and project partners, as appropriate.
- A long-range in situ preservation plan is needed that incorporates a detailed risk assessment of the wreck and the archaeological site, classifying all potential risk events and the strategies needed for long-term risk mitigation. This is a continual process that should be ongoing over time, and involve maritime archaeological conservators, maritime archaeologists, and project partners, as appropriate.

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9 APPENDICES

Appendix A: Mechanical Testing of Selected Wood Samples from *Clotilda*

Appendix B: Physical Protection and Reburial of *Clotilda*: Preliminary Options

MECHANICAL TESTING OF SELECTED WOOD SAMPLES FROM *CLOTILDA*

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Submitted To: Terra Mare Conservation, LLC

August 17, 2022

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INTRODUCTION

Mechanical tests were performed on two selected wood samples from the *Clotilda* to evaluate their mechanical properties. The goal was to measure the stiffness and strength of the samples to assess the structural integrity of some of the elements of the wreck.

The two analyzed wood samples are shown in **Figure 1**. The wood is assumed to be yellow pine.

- Sample A from timber WP 5.2 labeled "CLOTILDA 5.2 SAMPLE 2/2" by Terra Mare Conservation (TMC)
- Sample B from timber WP 17.1 labeled "HULL PLANK 17.1 SAMPLE 1/5" by TMC



Figure 1. Wood samples tested for mechanical properties. Left: sample A; Right: sample B.

VISUAL AND TACTILE INSPECTION

Visual and tactile inspections of the wood samples suggests that:

- The exterior surfaces of each sample are highly irregular due to water logging, erosion, wood borers and bacterial deterioration.
- Parts of the exterior surfaces are structurally pristine while other parts are spongious and therefore completely deteriorated.

- In general, each sample feels heavy, hard, and structurally sound, which suggests that the core is structurally well preserved.

SPECIMEN PREPARATION

Both samples were cut into strips of various thicknesses, as shown in Figure 2 from which test subsamples were made. Figure 3 shows some of the subsamples: dog-bone subsamples for tensile tests and rectangular subsamples for three-point bending tests. The strips were purposely cut parallel to the wood fibers.

Overall, six (6) and eleven (11) test subsamples were made from Samples A and B, respectively. All subsamples were cut from the core of each wood sample and far enough from exterior surfaces, i.e., at least 5 mm from the nearest deteriorated region (waterlogged or damaged by borers).



Figure 2. Wood samples cut into strips. Left: sample A; Right: Sample B.

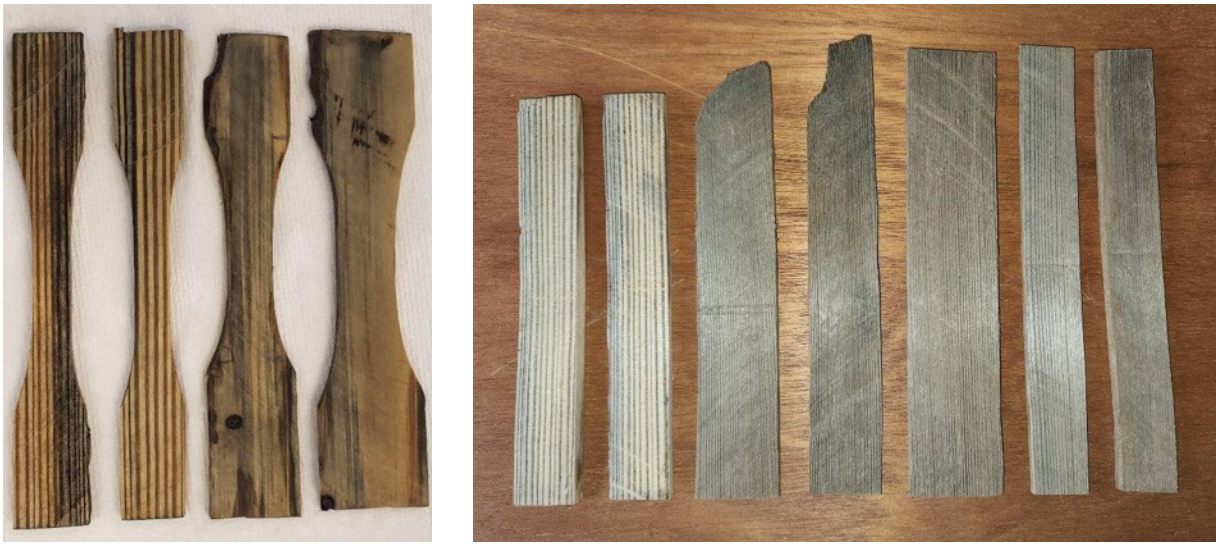


Figure 3. Left: dog-bone specimens for tensile tests from sample A; Right: rectangular specimens for three-point bending tests from samples A and B.

TESTING METHODS

A tensile test and a three-point bending test were used for Sample A, while only a three-point bending test was used for Sample B. The samples were cut parallel to the fibers so as to measure the mechanical properties in the direction of the fibers. Note that the properties in the other two directions (i.e., transversally to the wood fibers) are generally several orders of magnitude smaller than the properties along the fibers and are not meaningful representations of the state of the wood. All specimens were maintained wet at all times and tested wet. In addition, Pilodyn penetration tests were performed on the two samples.

Tensile Test

The tensile test consists of applying an increasing force along the length of the specimen while measuring its extension, usually until fracture of the specimen (See Figure 4).

The modulus of elasticity, E, can be determined from the slope of the linear portion of the force-extension curve and the dimension of the subsample as follows:

$$E = \frac{\Delta F \, L_{eff}}{\delta \, w \, t}$$

where ΔF is the change in force in the linear portion of the curve,
L_{eff} is the effective length of the specimen,
δ is the change in extension in the linear portion of the curve,

w is the width of the gauge section, and
t is the thickness of the gauge section.

The tensile strength, S_t, of the wood is determined as follows:

$$S_t = \frac{F_{max}}{w\,t}$$

where F_{max} is the maximum force applied on the subsample,
w is the width of the gauge section, and
t is the thickness of the gauge section.

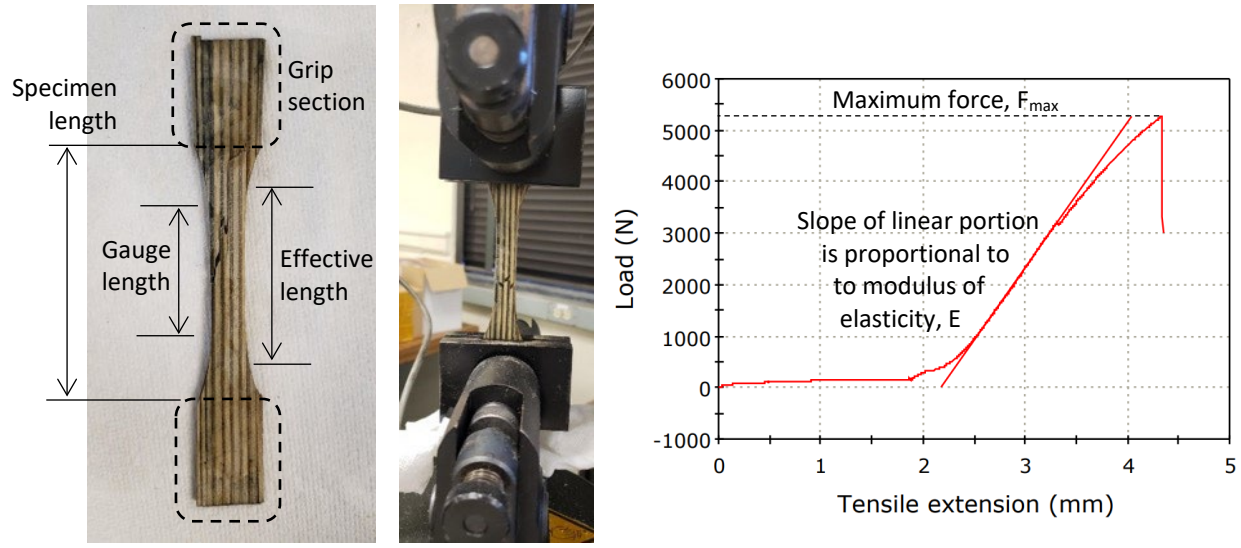


Figure 4. Tensile test: Left: dog-bone subsample; Middle: subsample in clamps; Right: Force vs. extension curve.

The pros and cons of the tensile test include:
Pros:

- The mechanical properties of the wood (i.e., modulus of elasticity and strength) are linearly proportional to the subsample's dimensions. This means that the mechanical properties are not as highly sensitive to errors in measurement of dimensions as in other testing methods where the properties may depend quadratically or exponentially on dimensions.

Cons:

- The subsample must be cut into a specific dog-bone shape.
- Slippage of the subsample in the clamps is sometimes significant.
- An extensometer must be used during the test to accurately measure the elongation of the gauge section of the subsample, which significantly increases the complexity of the experiment. No extensometer was used in this series of tests. Instead, the elongation of the entire subsample (provided by the tension tester) was used to estimate the

elongation of the gauge section, which induced a source of error in the results. Also, the effective length of the subsample used in the modulus of elasticity formula (shown above) is an estimation of the amount of wood that contributes to resisting the load, which is somewhat subjective without further extensive analysis.

Three-Point Bending Test

A three-point bending test is used to determine the main mechanical properties (i.e., stiffness and strength) of wood samples. A three-point bending test consists of applying an increasing force perpendicularly the length and at the center of the subsample while measuring its bending deflection, usually until fracture of the subsample.

The modulus of elasticity, E, can be determined from the slope of the linear portion of the force-deflection curve and the dimension of the specimen as follows:

$$E = \frac{\Delta F \, L_{eff}^3}{4 \, \delta \, w \, t^3}$$

where ΔF is the change in force in the linear portion of the curve,
L_{eff} is the effective length of the subsample (i.e., distance between supports),
δ is the change in deflection in the linear portion of the curve,
w is the width of the subsample, and
t is the thickness.

The flexural strength, S_f, (also called the modulus of rupture) of the wood is determined as follows:

$$S_f = \frac{3 \, F_{max} L_{eff}}{2 \, w \, t^2}$$

where F_{max} is the maximum transversal force applied on the subsample,
L_{eff} is the effective length of the subsample (i.e., distance between supports),
w is the width of the subsample, and
t is the thickness.

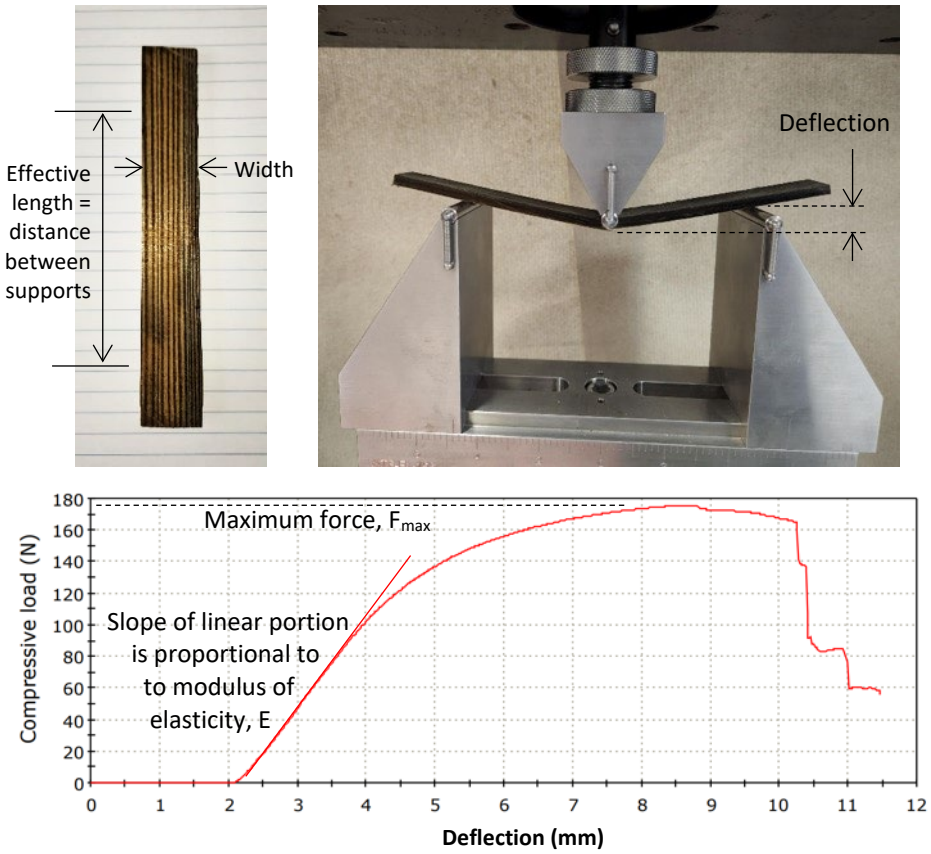


Figure 5. Three-point bending test: Top-left: rectangular subsample; Top-right: subsample in apparatus after failure; Bottom: Force vs. deflection curve.

The pros and cons of the three-point bending test include:

Pros:

- The subsample must be cut into a simple rectangular shape of uniform width and thickness.
- Slippage of the subsample is not an issue.
- The deflection of the subsample is generally readily available from the tensile machine (i.e., an extensometer is not necessary), which makes this testing method very reliable.

Cons:

- The mechanical properties of the wood, namely, the modulus of elasticity and the strength, are nonlinearly proportional to the specimen thickness (i.e., to the 3rd power). This means that the mechanical properties are highly sensitive to measurement errors.

RESULTS

Sample A WP 5.2 Tensile Tests

The tensile tests were not as successful as the three-point bending tests because of the drawbacks of the method listed above. The main issues were slippage of the subsamples in the clamps and also the subjective estimation of the effective length. Out of the four (4) subsamples of Sample A, two (2) were successfully tested (i.e., negligible slippage) and the corresponding mechanical properties are:

E = 5.54 GPa (stand. dev. = 0.04 GPa)
S_t = 97.01 MPa (stand. dev. = 12.71 MPa)

Sample A WP 5.2 Three-Point Bending Tests

Two (2) subsamples from Sample A were tested successfully and the corresponding mechanical properties are:

E = 9.90 GPa (stand. dev. = 0.23 GPa)
S_t = 77.40 MPa (stand. dev. = 0.85 MPa)

Sample B WP 17.1 Three-Point Bending Tests

Nine (9) subsamples from Sample B were tested successfully and the corresponding mechanical properties are:

E = 8.91 GPa (stand. dev. = 1.10 GPa)
S_t = 52.44 MPa (stand. dev. = 4.15 MPa)

DISCUSSION

The test results are listed in Table 1. The mechanical properties of pine (averaged over 16 common species of pine) from the literature are also listed for comparison purposes.

Table 1. Summary of test results and expected values

Wood Sample	Test	Number of subsamples	Modulus of Elasticity		Strength	
			E (GPa)	Stand. dev. (GPa)	S_t or S_f (MPa)	Stand. dev. (MPa)
A	Tensile	2	5.54	0.04	97.01	12.71
A	3-Point Bend	2	9.90	0.23	77.40	0.85
B	3-Point Bend	9	8.91	1.10	52.44	4.15
Pine	Reference [1]	16 species of pine	Avg = 10.5 Range = 8.2 - 13.7 (12% moisture content)		Avg = 77.7 Range = 57 - 112 (12% moisture content)	

The measured properties (i.e., modulus of elasticity and strength) are within the range of the properties of typical pine species, which suggests that the core of each sample is in very good condition. In this context, the "core" of a structural element is defined as the portion that is at least 5 mm below the exterior surface and any wood degraded by waterlogging and active marine borers and bacteria.

Effect of moisture content

With an average U_{max} of 116% for the four core subsamples from timber WP 17.1 (sample 1), this value is well above 12% which is the moisture content of air-dried pine wood used in the tests of the Department of Agriculture. Wei-Lian et al. (2021) showed that moisture content reduces the mechanical properties in beech wood. Even though their research was not specific to pine wood, the effect of water is also expected to reduce the mechanical properties of pine.

More specifically, moisture has two effects on the mechanical behavior of wood. On the one hand, moisture decreases stiffness and strength, which is generally detrimental. On the other hand, moisture increases ductility (i.e., the ability to absorb shock and deformation), which is beneficial. Since the tested stiffness and strength are high, it can be concluded with confidence that the core of the wood tested is in good condition and that any effect of the potentially high moisture content would be beneficial thanks to increased ductility.

Important final statement

It should be clearly noted, however, that these mechanical tests only confirm the high structural integrity of the core of the structural elements of the wreck (e.g., beams, poles, planks). They do not suggest in any way that the shipwreck has any structural integrity as a whole. At this point, the structural integrity of the shipwreck as a whole depends predominantly on the state of the connections between elements as well as the presence of cracks and fractures in structural elements. Therefore, if further investigation of the structure is performed, it should be focused on the assessment of the connections between elements and on the identification of large cracks and fractures within and along the structural elements.

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PHYSICAL PROTECTION AND REBURIAL OF *CLOTILDA*
PRELIMINARY OPTIONS

PREPARED BY: Vincent Blouin, Independent Consulting Engineer
SUBMITTED TO: Terra Mare Conservation, LLC
October 20, 2022

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INTRODUCTION

The goal of this report is to propose and illustrate means of in-situ protection of the *Clotilda* shipwreck.

Three aspects are considered:

- Physical protection:
    - Protect the shipwreck and surrounding sedimentation from impacts from recreational vessels, barges, trees, and any object floating in the river, and
    - Divert the water current to prevent erosion of the sedimentation and abrasion of exposed shipwreck elements.
- Reburial:
    - Protect the wreck from biological activity (from bacteria, marine borers, and barnacles and other organisms) and corrosion of metallic elements by significantly reducing exposure to oxygen.

It is unclear at this point of the *Clotilda* project if any, some, or all of these protection measures will be considered for further investigation and implementation. Furthermore, the geotechnical evaluation performed by Southern Earth Sciences, Inc. (Delgado 2022) near the archaeological site suggests that the subsurface soil may be too loose to successfully implement a long-term in-situ protection plan. Therefore, this report is a high-level preliminary study of several hypothetical scenarios and options with expected pros and cons.

GEOTECHNICAL EVALUATION

A geotechnical evaluation was performed by Southern Earth Sciences, Inc. (Delgado 2022) at two different locations near the site in the Mobile river [1]. The two sample tests, labeled GT-1 and GT-2, were bored down in excess of 60 feet below the water surface. The two tests show similarities in terms of soils layers but significant differences in terms of thickness of each layer. The water depth was 14’ and the soil was silty sand for the most part. As shown in Figure [*1*], three main layers were identified based on consistency (or relative density) of the soil with a “very loose” layer below the mudline, followed by a “loose” layer and a “medium dense” layer.

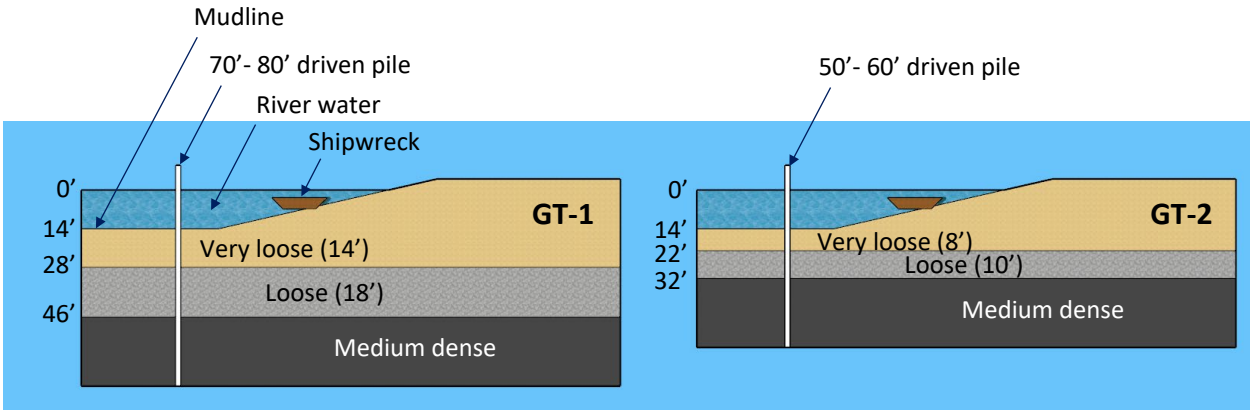


Figure 1. Cross-sectional interpretation of the two geotechnical boring tests performed by Southern Earth Sciences, Inc (Delgado 2022). [1] (left: GT-1, right: GT-2). Hypothetical driven piles and the shipwreck are shown to illustrate dimensional proportions.

The two first layers (“very loose” and “loose”) present significant challenges for the implementation of a long-term in-situ protection plan as described below:

Impossibility of implementing a shallow foundation system: The riverbed (i.e, mudline) is very loose, which means that it cannot be used to support a foundation system. Any concrete block, boulder, or sandbag would sink through the loose sediment until it reaches the depth where the relative density of the soil can generate sufficient buoyancy on the sinking object to compensate for its weight (which would most likely be at least 46’ deep for GT-1 and 32’ deep for GT-2). Therefore, it is safe to say that the foundation of a physical barrier would most likely have to include driven piles.

GRAPHIC ILLUSTRATIONS

This report includes several illustrations of the shipwreck, river, shore, soil layers, and various systems. While the scale of each object is respected, the dimensions are approximative and should not be considered as final or even proposed dimensions. All illustrations are used to provide a visual and more intuitive description of each system under consideration. Figure 2 shows a three-dimensional view of the river, the shore, the water current, and the shipwreck partially buried in sediment. Note that the shape of the shipwreck is idealized and none of the loose pieces of timber currently spread around the actual wreck are shown. The dimensions of the model shipwreck are 80’ in length and 20’ in width.

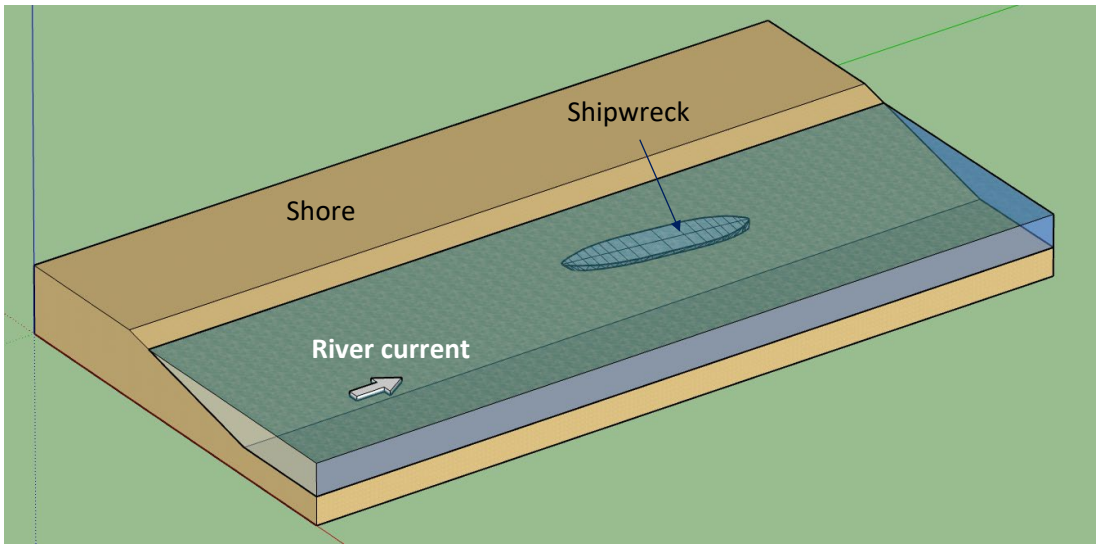


Figure 2. Illustration of the river, the current, the shipwreck, and the shore.

DEALING WITH THE RIVER CURRENT

The shipwreck is exposed to the river current as well as potential impact from any floating object. The shape of a protective barrier should account for the potentially high current-induced forces and impact with a shape that would smoothly divert the current and any floating object. Figure 3 shows three different shapes for physical barrier.

A rectangular shape (purple) with sharp corners would be easier to construct than the other options. However, the upstream side of the barrier would have to resist tremendous pressure from the river current and would be somewhat vulnerable due to full exposure to direct impacts from floating objects. Also, the corners would induce scour vortex shedding that would potentially erode sedimentation on the downstream side.

A rounded shape (yellow) would be the best use of space by minimizing the volume inside the barrier. Also, the rounded corners would reduce vortex shedding and would potentially divert floating object, which would reduce the vulnerability of the barrier. Also, the rounded or oval shape provides intrinsic stiffness and strength against exterior pressure. The drawbacks are the potentially more difficult construction and the relatively large upstream surface area exposed to current pressure and floating objects.

A curved shape (red) is the preferred shape to minimize the current-induced forces and impacts from floating objects. The shape of the barrier on the upstream side would allow the water current and any floating object to bounce smoothly away from the barrier. The forces applied to the barrier and its foundation system would be reduced significantly. The main drawback is the large volume inside the barrier.

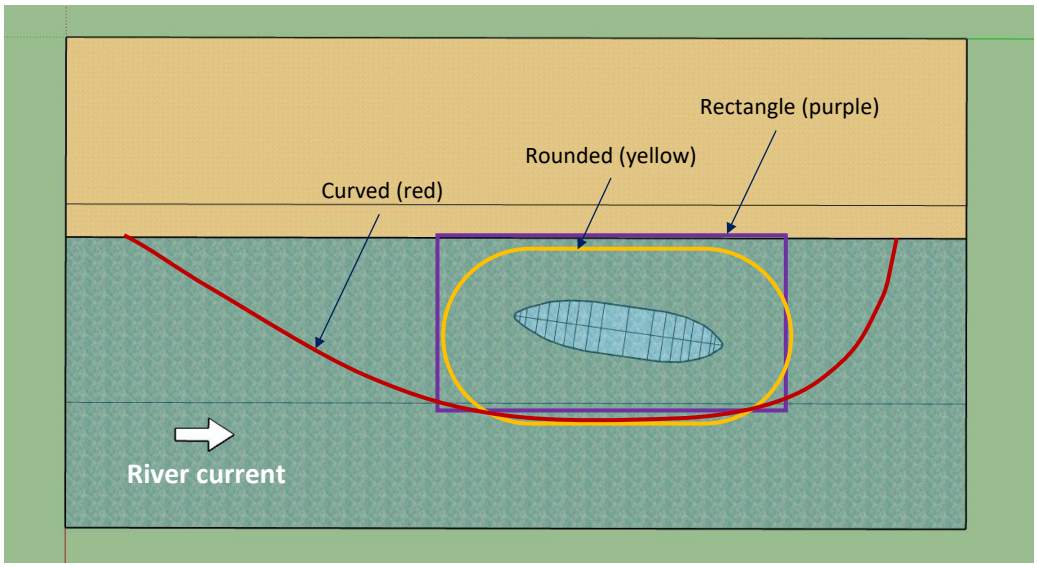


Figure 3. Top view of the site and different shapes for a physical barrier.

PHYSICAL PROTECTION

As mentioned above, a viable foundation system for a physical barrier should most likely include driven piles. Figure 4 shows 18 piles driven through the three soil layers to reach the medium dense layer. In this illustration, the piles are assumed to be precast concrete or steel with a 20-inch diameter and installed with a spacing of 20 feet between piles.

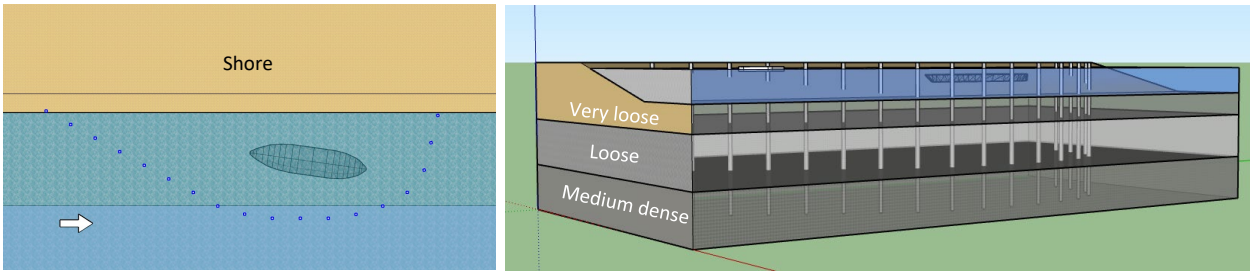


Figure 4. Series of driven piles with 20-foot spacing long enough to reach the medium dense layer. Left: top view showing the series of piles in a curved shape. Right: three-quarter view of the piles through all soil layers.

One of the drawbacks of driving piles near the shipwreck is the potential disturbance from the vibrations created by the process of hammering the piles down using a hydraulic or diesel hammer. The hammering force is generally adjusted to reduce vibrations as much as possible based on the application. The geotechnical evaluation of the site measured the "SPT N" value, which quantifies the bearing capacity of the soil of each layer. Based on the numbers (see geotechnical report [*1*]), the very loose and loose layers do not provide much bearing capacity compared to the medium dense layer. This is why the piles should be driven all the way down to and through the medium dense layer.

It should be noted that driven piles are generally designed to work in compression with limited bending load. In this case, the water current and potential impact from floating objects would induce significant bending loads. Therefore, an extensive engineering study should be done to first confirm that this foundation system is appropriate and to properly design it in terms of number and length of the piles.

Another point for consideration is the distance of the driven piles to the wreck. They should be as far as possible from the wreck to minimize disturbance from hammering vibrations. On the upside, the vibration is initiated at that depth of the medium dense layer (i.e., where the resistance to driving the pile down is located) and decreases quadratically with the distance traveled. Since the medium dense layer is 25 to 45 feet below the wreck the source of vibration is relatively far from the wreck, which may be sufficient to assume that the wreck would not be significantly disturbed by driving piles down.

The number of piles depends on the water current forces applied on the physical barrier as well as the intensity of potential impact from floating objects that the barrier is expected to resist. The impact intensity depends on the size, weight, and speed of the floating object. The following examples try to describe the varying impact intensity (from "small" to "extremely large") assuming that the objects move at a relatively small speed (say, 5 mph):

- Small: impact from a tree log or a 20-ft vessel
- Medium: impact from a 50-ft vessel (50 tons)
- Large: impact from a 120-ft vessel or barge (750 tons)
- Extremely large: impact from a 195-ft barge (1500 tons)

At this point of the project, the targeted impact intensity has not been defined since it depends on many aspects that are not considered in this study, such as the financial cost of implementation. Therefore, the following design options for a protective barrier are listed in order of increasing impact resistance.

Three-foot deep physical barrier: The idea is to minimize the number of driven piles. In the example shown in Figure 5, the barrier is installed only on the upstream side of the wreck using six piles with 40-ft spacing. The barrier is relatively shallow (e.g., 1 m, 3-ft deep) to minimize the current-induced pressure and can either be floating to accommodate changes in water elevations or fixed to the piles to add stiffness to the system. Some of the water would be diverted away from the wreck while the rest would flow under the barrier. This barrier would protect the wreck from most small impacts as it would divert small objects that float at the surface. However, the water that flows under the barrier may slightly accelerate and induce greater scouring. Also, this barrier would not provide any protection against medium or larger impacts.

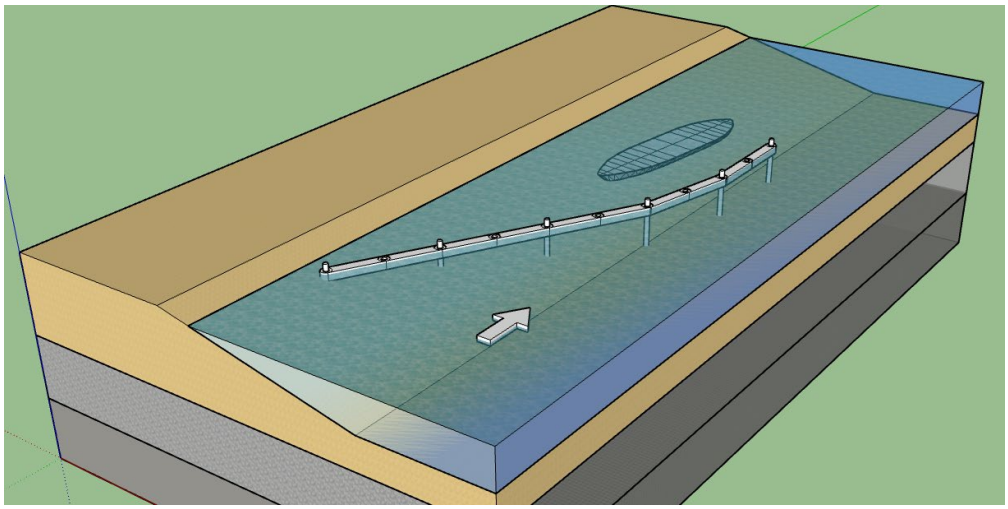


Figure 5. Three-foot deep physical barrier anchored to 6 driven piles with 40-foot spacing.

Six-foot deep physical barrier: The design shown in Figure 6 is an upgrade of the previous design with twice as many piles and a deeper barrier. The main advantage is that it may protect the wreck from medium impacts. On the downside, scouring may occur as a result of the waterflow being modified and may accelerate under the barrier. The physical barrier may be constructed from different materials including precast concrete or steel, in which case the panels would be rigidly fixed to the piles.

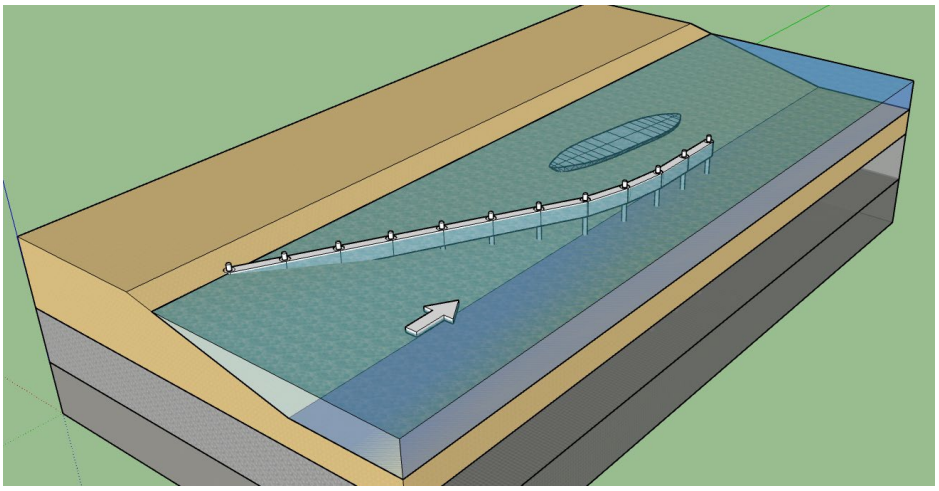


Figure 6. Six-foot deep physical barrier anchored to 12 driven piles with 20-foot spacing.

Full-depth physical barrier: In this design, the barrier would completely block off the water current and protect the wreck from medium impacts. The barrier wall would be buried into the sediment to a depth that would prevent scouring to occur under the wall.

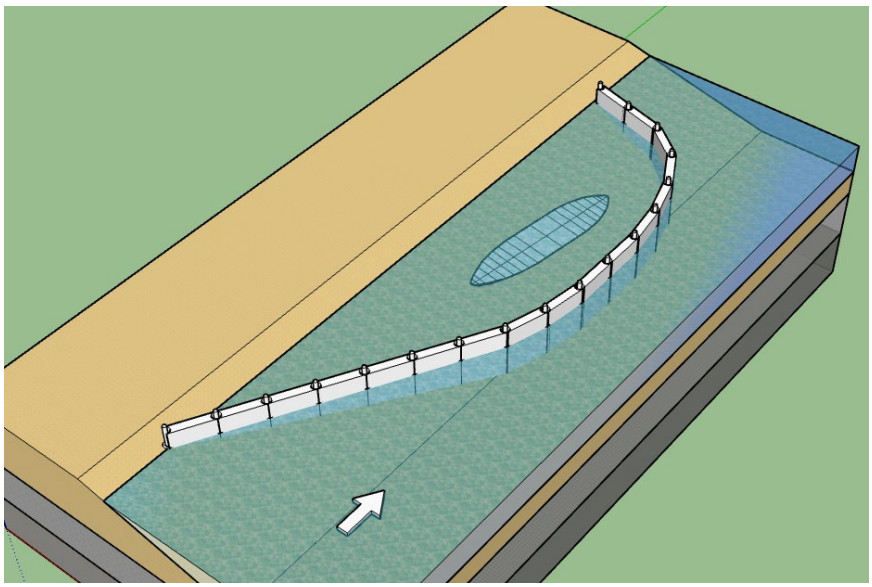


Figure 7. Full-depth physical barrier anchored to 18 driven piles with 20-foot spacing.

Buttressed full-depth physical barrier (cofferdam): The design shown in in Figure 8 is an upgrade of the previous design with buttresses as reinforcement installed on most piles. In this example, additional piles are driven 3 m (10 ft) away from the original piles and each buttress connects rigidly to each pair of piles as shown in Figure 9. The total number of piles is now 31. This option may protect the wreck from medium to large impacts.

This design may allow dry excavation, if contemplated. However, for dry excavation of *Clotilda*, assuming that a cofferdam can be installed, and the water can be pumped-out to expose the wreck, the river water would most likely flow under the cofferdam and re-enter the site at a very high soil flow rate due to the potentially high permeability of the sediment. Water and mud pumps would have to be sized accordingly and would most likely run for the entire duration of the excavation. Walking on the exposed riverbed would be challenging if not impossible without sinking since it would be very loose mud. Floating walkways may have to be installed on the soil around the shipwreck.

If the soils around the wreck are loose, a buttressed full-depth physical barrier may be the only viable option for reburial of the wreck. The cost of implementing such a physical barrier would most likely be significant.

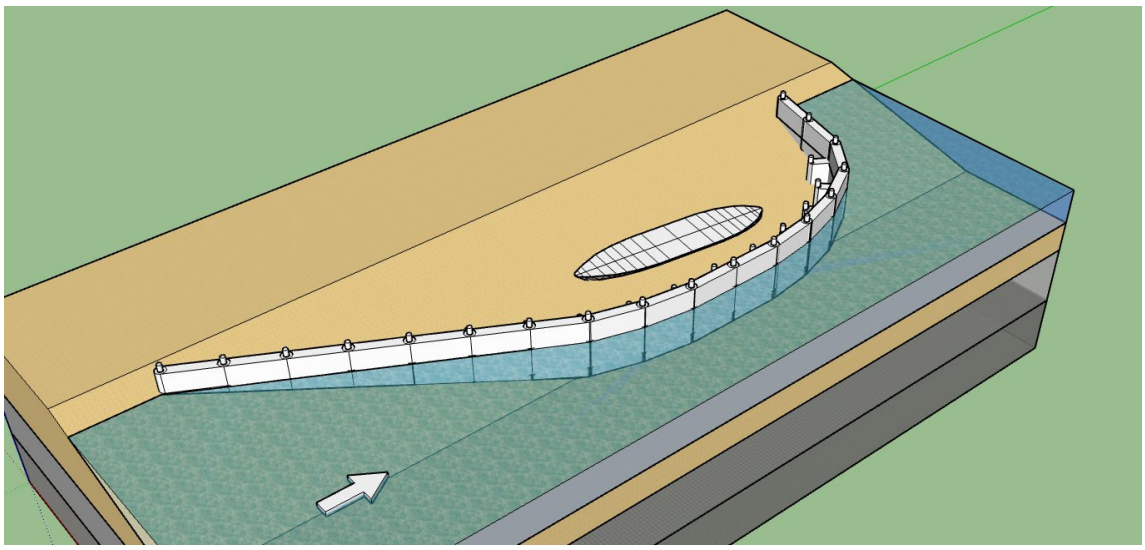


Figure 8. Buttressed full-depth physical barrier (cofferdam) with 31 driven piles and 20-foot spacing.

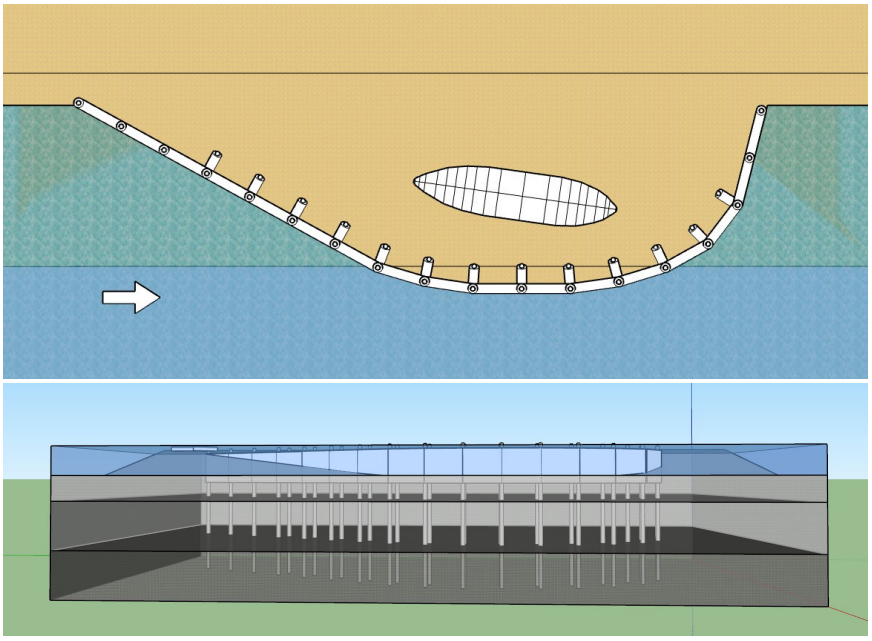


Figure 9. Top view and side view of a buttressed cofferdam composed of 31 driven piles.

Non-viable options: For the sake of completeness, two options were initially considered but deemed non-viable are shown in Figure 10. The first option is a dam around the wreck made of large boulders piled in a pyramid shape. This would be one of the few, if not the only option that would protect the wreck from extremely large impacts. However, as described in the geotechnical evaluation section of this report, the sedimentation layers are not sufficiently dense to support the weight of the large boulders, especially when piled up into a wall. All boulders would eventually sink into the mud a few dozen feet deep. The second option is a wall of concrete

interlocking blocks. In this example, the blocks are 6’x3’x3’. For the same reason, the entire structure (which is extremely dense) would sink slowly into the mud.

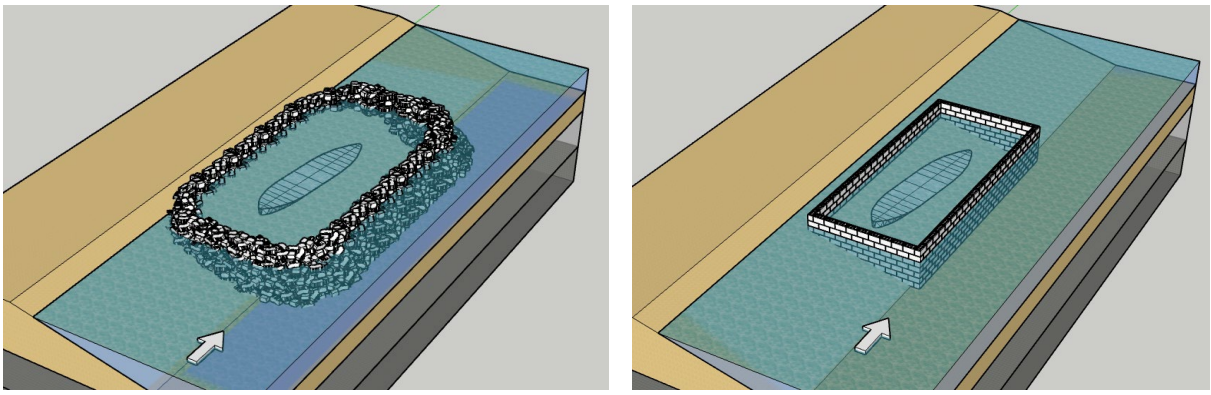


Figure 10. Non-viable options. Left: Boulder dam. Right: Rectangular concrete block wall.

REBURIAL

Reburial of the wreck be considered for long-term in-situ preservation. The process consists of completely burying the wreck sufficiently deep under sediments to maintain an anoxic environment. The following figures illustrate the process.

In Figure 11, the buttressed physical barrier is elevated to accommodate potential changes in water elevation and sufficient sediment coverage for reburial of the wreck. Figure 12 illustrates the potential steps for reburying the wreck. Optimal preservation conditions would be established around the wreck by filling the cofferdam with suitable backfilling materials (such as sand and gravel) that would need to have the same density as the original sediment. Once filled, the exterior water pressure applied on the cofferdam wall will be counter-balanced by the pressure from the filler materials, which should completely relieve the structural loads applied on the driven piles.

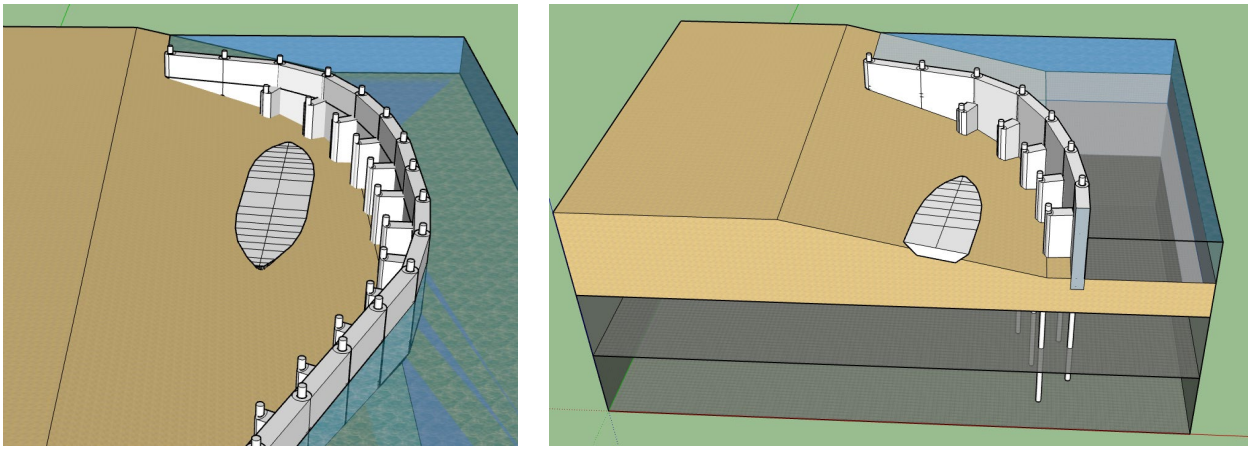


Figure 11. Buttressed full-depth physical barrier (cofferdam) with elevated walls. Left: Complete model. Right: Sectioned model.

The reburial process shown in Figure 12 is sufficiently robust to assume that minimal degradation would occur due to water infiltration, erosion, and scouring. As long as the physical barrier is sufficiently watertight, the only infiltration of water would come from below, through the sediment layer. However, the pressure applied by the water-saturated backfilling material would prevent, or at least minimize, water infiltration from below. Rain and storm water would infiltrate into the gravel, through the permeable geotextile fabric, and into the sand. A monitoring protocol may have to be devised to identify the location of sand erosion due to rainwater infiltration over time.

The process shown in Figure 12 is feasible under the condition that the sediment has sufficient cohesive strength to resist the pressure induced by the weight of the sand and gravel above it. If the cohesive strength of the sediment is too low, two things may occur:

(1) The sand would sink into the sediment layer and would not be able to hold the layer of gravel. To prevent this phenomenon, the density of the sand should be similar or even smaller than that of the sediment.
(2) The weight of the sand and gravel would push the sediment downward and outward under the cofferdam wall towards the riverbed, which may disturb the wreck over time. To prevent this phenomenon, the cofferdam wall may have to be driven deep enough into the sediment to reach a denser sediment layer and effectively hold the entire site in place.

Step 1: The cofferdam is filled with sand until the wreck is completely buried several feet deep to achieve an anoxic environment. The density of the sand should be similar to that of the sedimentation layer below it to limit the chance that the sand sinks into the sediment.

Step 2: A geotextile fabric is installed on top of the sand as a supporting surface for the layer of gravel that will then be installed on top of it. The geotextile fabric would work as a permeable barrier between the gravel and the sand. The way the fabric meets and wraps around the cofferdam wall and the piles will need to be addressed.

Step 3: Spread a layer of gravel above the geotextile layer. Sensors and monitoring devices may have to be installed at various locations near the wreck to ensure that the environment is anoxic
at all times.

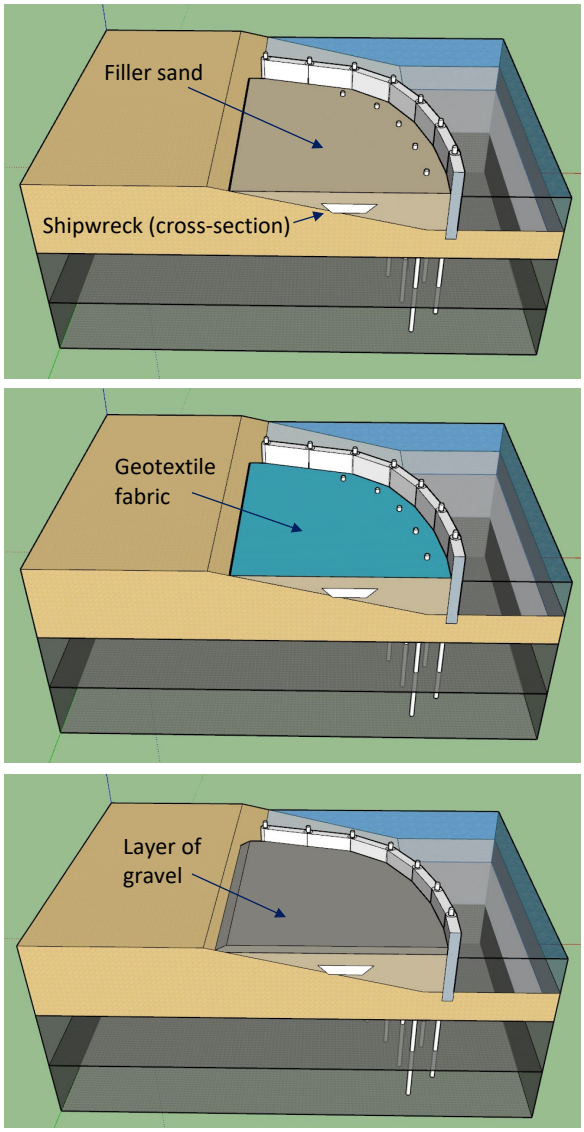


Figure 12. Potential steps for reburial the wreck.

SUMMARY OF ALL OPTIONS

All options discussed above are listed in **Table 1** with their pros and cons.

Table 1. Summary of all physical protection and reburial options.

Option	Pros	Cons
Three-foot deep / 6 piles (Figure 5)	• Protection against small impacts • Few driven piles • Limited environmental impact	• Does not protect against medium impacts • Does not prevent erosion and scouring around the wreck • No reburial option

Six-foot deep / 12 piles (Figure 6)	• Protection against medium impacts • Few driven piles • Limited environmental impact	• Does not protect against large impacts • Does not prevent erosion and scouring around the wreck • No reburial option
Full depth / 18 piles (Figure 7)	• Protection against medium impacts • Prevents erosion and scouring around the wreck	• Does not protect against large impacts • No reburial option • Significant impact on environment and river flow
Buttressed full depth / 31 piles (Figure 8, 9, 11 and 12)	• Protection against large impacts • Allows reburial • Allows excavation • Prevents erosion and scouring around the wreck	• Does not protect against extremely large impacts • Large number of driven piles • Significant impact on environment and river flow
Boulder dam (Figure 10)	Non-viable because it cannot be supported by the excessively loose sediment	
Block wall (Figure 10)	Non-viable because it cannot be supported by the excessively loose sediment	

CONCLUSION

As described above, in-situ conservation of the *Clotilda* shipwreck is possible. However, it is expected to be challenging if loose sedimentation is present below the wreck. Any option for installing a physical barrier to protect the wreck and permit reburial may involve a significant number of driven piles. Several design options were investigated and described in this report. However, further geotechnical, and extensive engineering studies should be performed in the next phase of this project to confirm the feasibility of the proposed options and identify potentially simpler designs.

REFERENCES

[1] Delgado, J. 2022. *"Phase III Investigation of the Clotilda Wreck Site (1Ba704), Baldwin County, Alabama.",* Report to the Alabama Historical Commission.

ANNEX D:

Field and Artifact Photographs



Resolve Commander **moving the barge to the wreck site (Daniel Fiore/Alabama Historical Commission).**



The barge on site, with diver about to deploy (Daniel Fiore/Alabama Historical Commission).



Dive operations from the Conex box command center (Daniel Fiore/Alabama Historical Commission).



Tree removal using the crane after the diver rigged the tree for lifting (Daniel Fiore/Alabama Historical Commission).



Resolve diver returning to the barge post-dive (Daniel Fiore/Alabama Historical Commission).



Lift basket for timbers on site as diver guides it into the water (Daniel Fiore/Alabama Historical Commission).



Resolve barge supervisor Ed Yenni during dive operations (Daniel Fiore/Alabama Historical Commission).



Archaeological diver Kamau Sadiki, assisted by Jay Haigler, prepares for a dive on the wreck (Daniel Fiore/Alabama Historical Commission).



Archaeologists documenting and recovering disarticulated timbers from the wreck along the starboard side of the hull in the shallows (Daniel Fiore/Alabama Historical Commission).



Basket with timbers being lifted to place them on the barge for analysis and documentation (Daniel Fiore/Alabama Historical Commission).



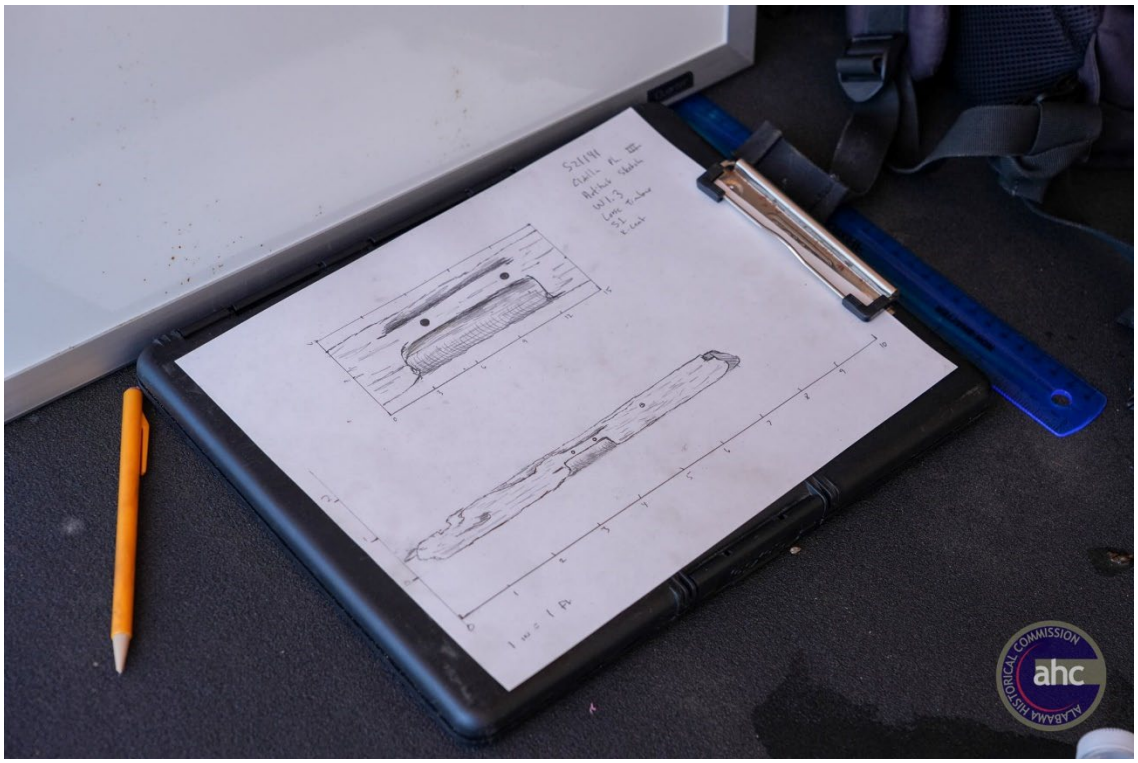
Team moving one of the large timbers during initial assessment and documentation (Daniel Fiore/Alabama Historical Commission).



A recovered timber on deck for initial documentation (Daniel Fiore/Alabama Historical Commission).



Archaeologist Bria Brooks documents an artifact on the barge (Daniel Fiore/Alabama Historical Commission).



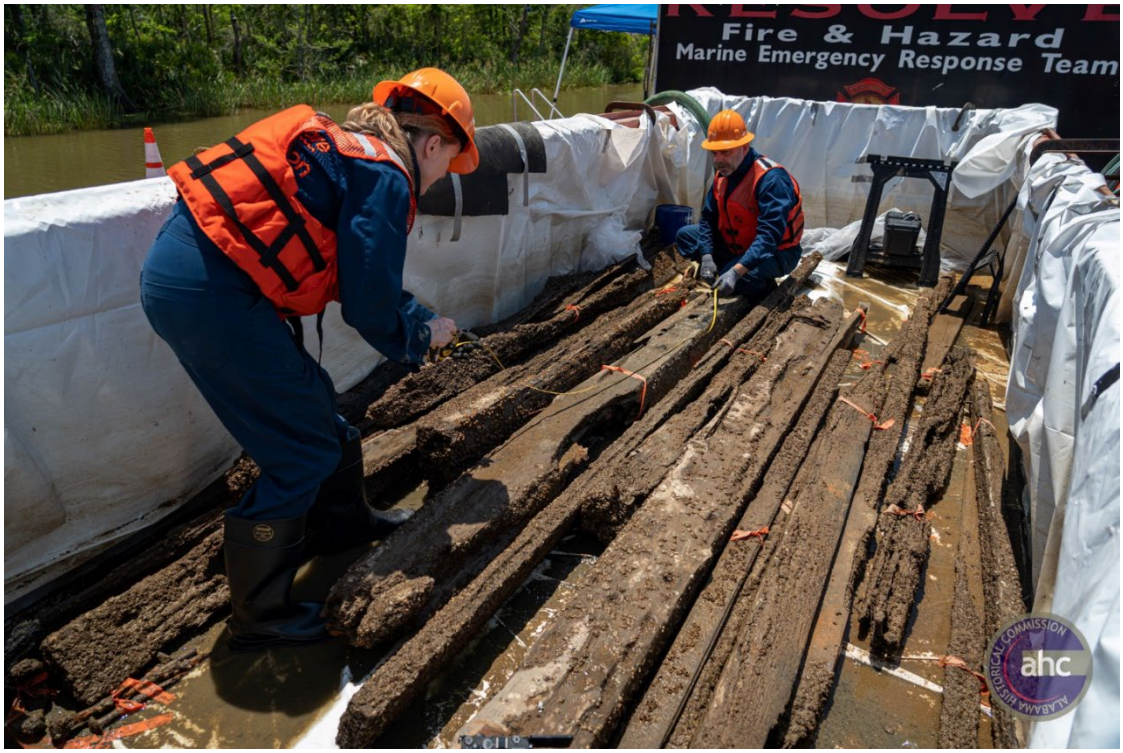
Field sketch of artifact WP 1.3 by archaeologist Kyle Lent (Daniel Fiore/Alabama Historical Commission).



Jay Haigler, Kamau Sadiki, Stacye Hathorn, James Delgado and Austin Burkhard discuss the contents of one of the baskets with disarticulated timbers lifted from the wreck (Daniel Fiore/Alabama Historical Commission).



Mike Brennan preparing sample jars for biological sampling of the wreck (Daniel Fiore/Alabama Historical Commission).



Conservators Claudia Chemello and Paul Mardikian assess timbers in the temporary wet storage tank on the barge prior to it being filled with river water (Daniel Fiore/Alabama Historical Commission).



Paul Mardikian uses a Pilodyn to assess the level of water saturation on a timber (Daniel Fiore/Alabama Historical Commission).



A section of aft deck beam with a fragment of decking attached by its iron fastener (Daniel Fiore/Alabama Historical Commission).



Will Ballentine from Dauphin Island Sea Lab sifts through a sediment core material from the site; in addition to twigs and plant material, charcoal from the fire that burned *Clotilda* was also noted in screening (Daniel Fiore/Alabama Historical Commission).



Ayana Flewellen, with Joseph Grinnan, Kyle Lent and Austin Burkhard during screening operations during the limited test excavation inside the hold (Daniel Fiore/Alabama Historical Commission).



Pete Kelsey conducting an initial photogrammetric scan of a timber from the site (Daniel Fiore/Alabama Historical Commission).



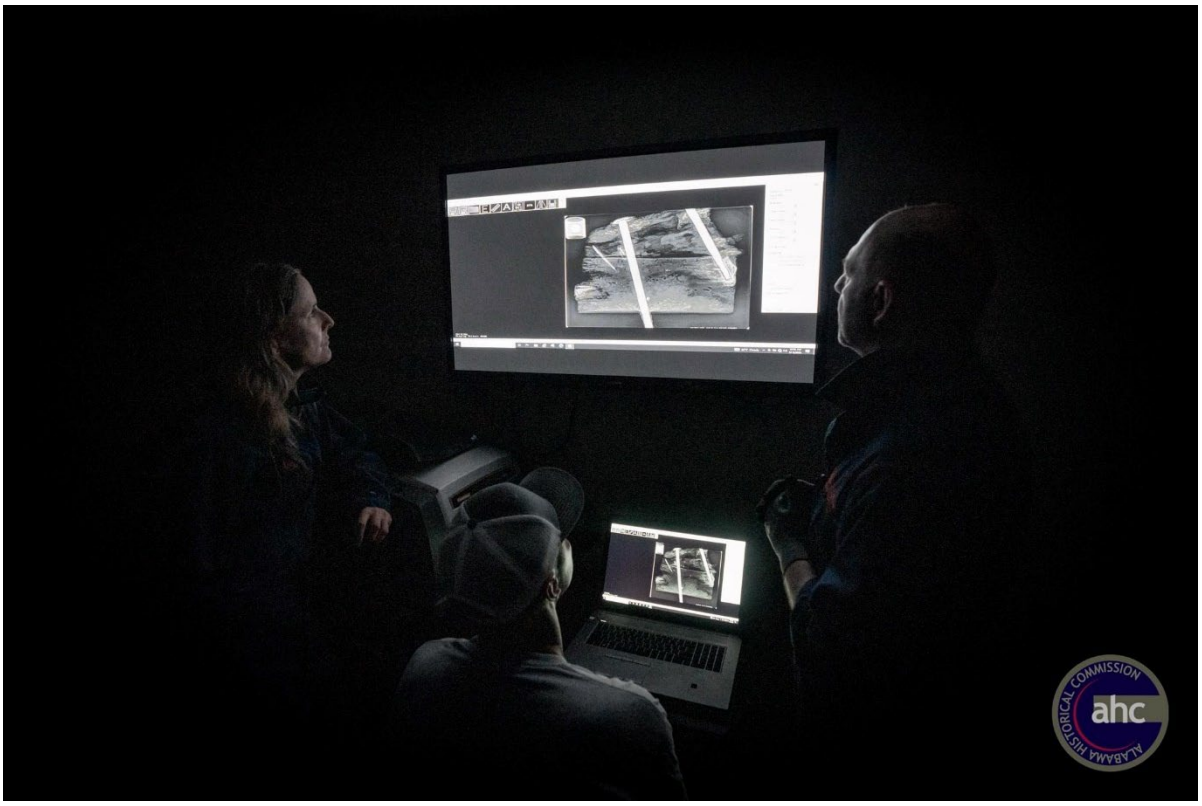
Claudia Chemello and Kyle Lent documenting small finds on the barge (Daniel Fiore/Alabama Historical Commission).



Ayana Flewellen, Justin Dunnavant and Bria Brooks screening sediment during the limited test excavation inside the hold (Daniel Fiore/Alabama Historical Commission).



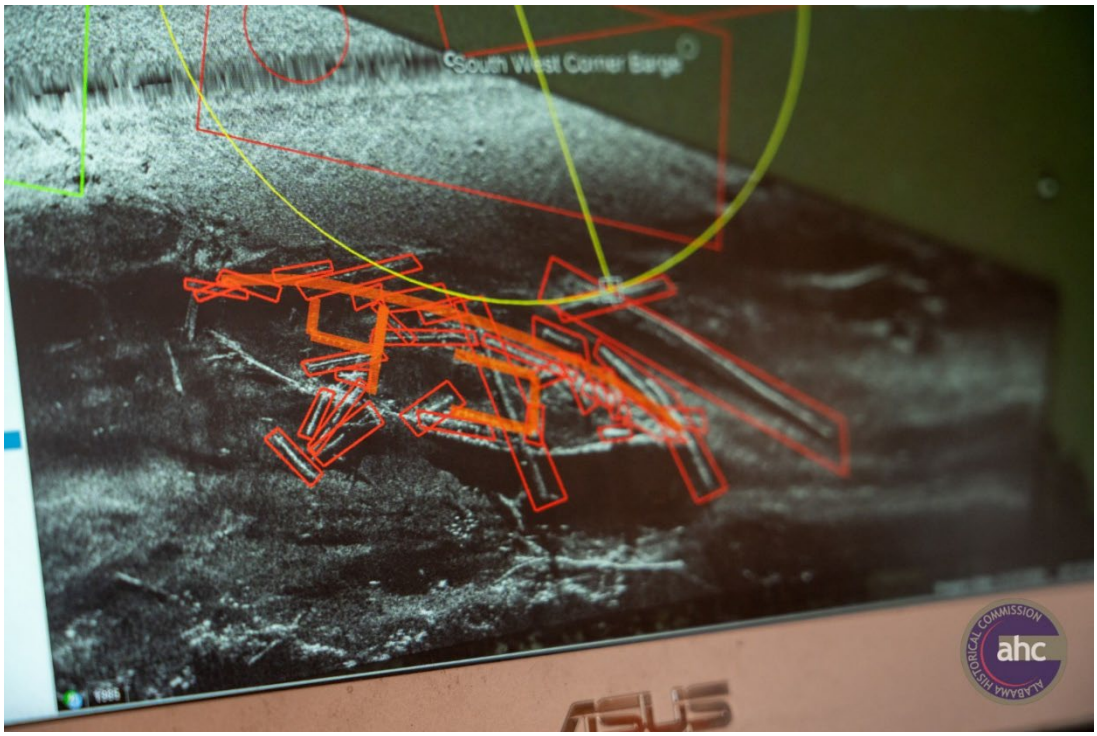
Recovery of the likely starboard wale from the wreck (Daniel Fiore/Alabama Historical Commission).



X-raying artifact WP 12.1 (Daniel Fiore/Alabama Historical Commission).



Recovered iron fasteners prior to X-ray documentation (Daniel Fiore/Alabama Historical Commission).



Realtime computer plotting of the wreck during operations, with trees to be assessed for removal marked in red, with vessel structure in orange, and the wreck and barge, and the radius of the recovery crane all noted (Daniel Fiore/Alabama Historical Commission).



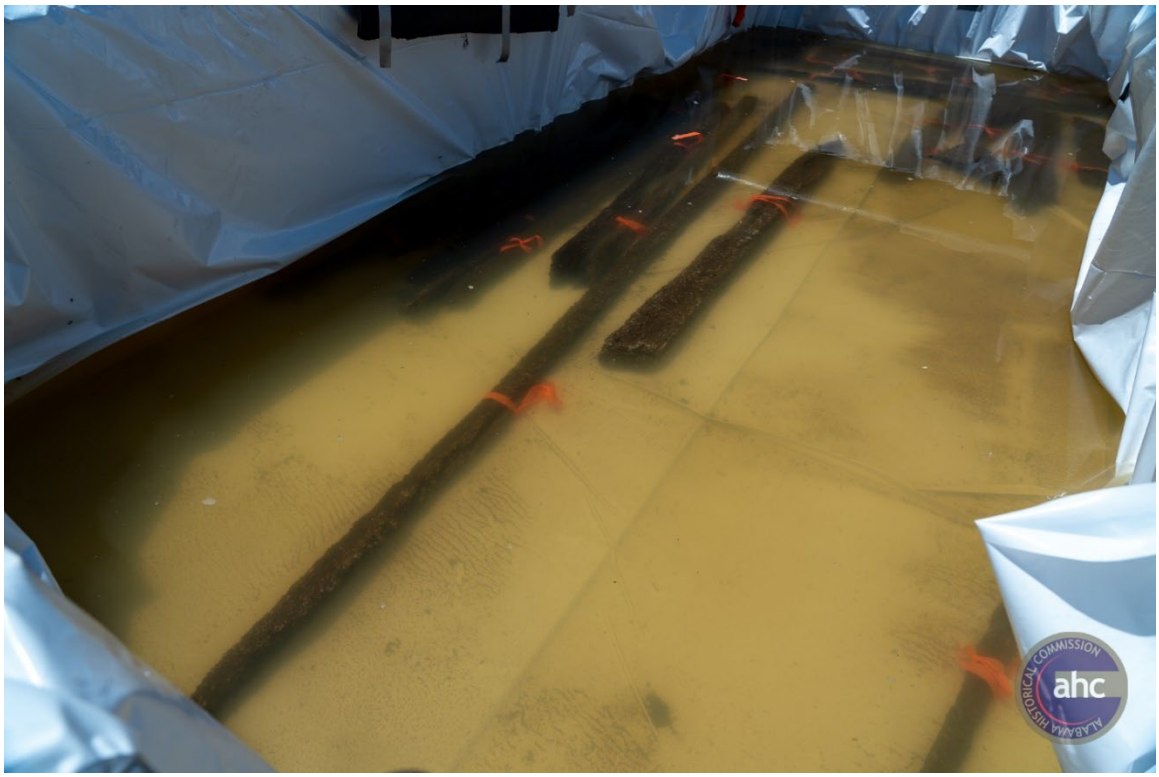
Dive supervisor Chris Mizener of Resolve monitoring a dive through helmet camera and direct communication with the diver (Daniel Fiore/Alabama Historical Commission).



Jay Haigler, Kyle Lent and Kamau Sadiki conducting initial documentation of timbers on the deck of the barge (Daniel Fiore/Alabama Historical Commission).



U.S. Army Corps of Engineers inspection visit to the project (Daniel Fiore/Alabama Historical Commission).



During the initial stage of temporary holding tank storage during the project, timbers were quickly placed in river water after initial assessment and documentation (Daniel Fiore/Alabama Historical Commission).



A recovered sediment core for biological sampling (Daniel Fiore/Alabama Historical Commission).



Conservator Paul Mardikian conducting an initial conservation assessment of a recovered timber on the barge (Daniel Fiore/Alabama Historical Commission).



Austin Burkhard deploying the side-scan sonar for one of the surveys of the wreck site (Daniel Fiore/Alabama Historical Commission).



One of the loose trees being lifted off the wreck site (Daniel Fiore/Alabama Historical Commission).

Artifact Photos



Loose timber, Waypoint 1.1 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 1.2 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 1.3 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 1.4 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 2.1 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 2.2 (SEARCH/Alabama Historical Commission).



Loose timber and fasteners, Waypoint 2.3 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 2.4 (SEARCH/Alabama Historical Commission).



Fasteners, Waypoint 3.1 (SEARCH/Alabama Historical Commission).



Loose timbers, Waypoint 3.2 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 3.3 (SEARCH/Alabama Historical Commission).



Iron, Waypoint 3.4 (SEARCH/Alabama Historical Commission).



Iron, Waypoint 3.5 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 4.1 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 4.2 (SEARCH/Alabama Historical Commission).



Loose timber and fastener, Waypoint 4.3 (SEARCH/Alabama Historical Commission).



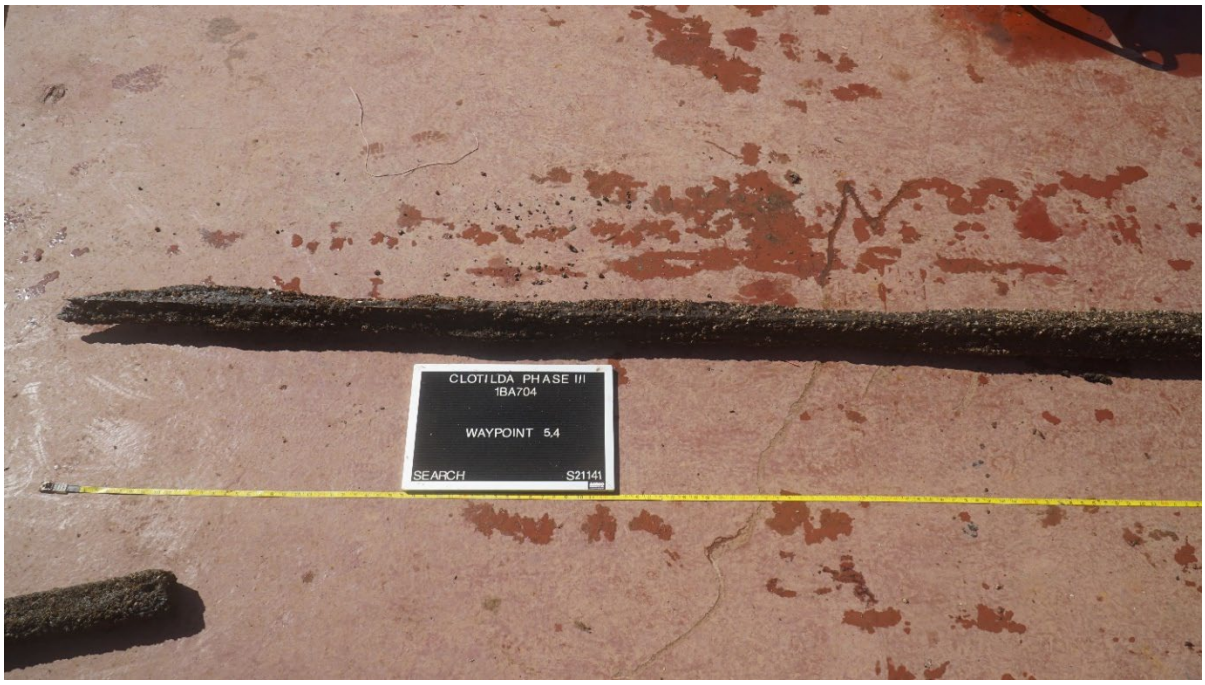
Loose timber, Waypoint 5.1 (SEARCH/Alabama Historical Commission).



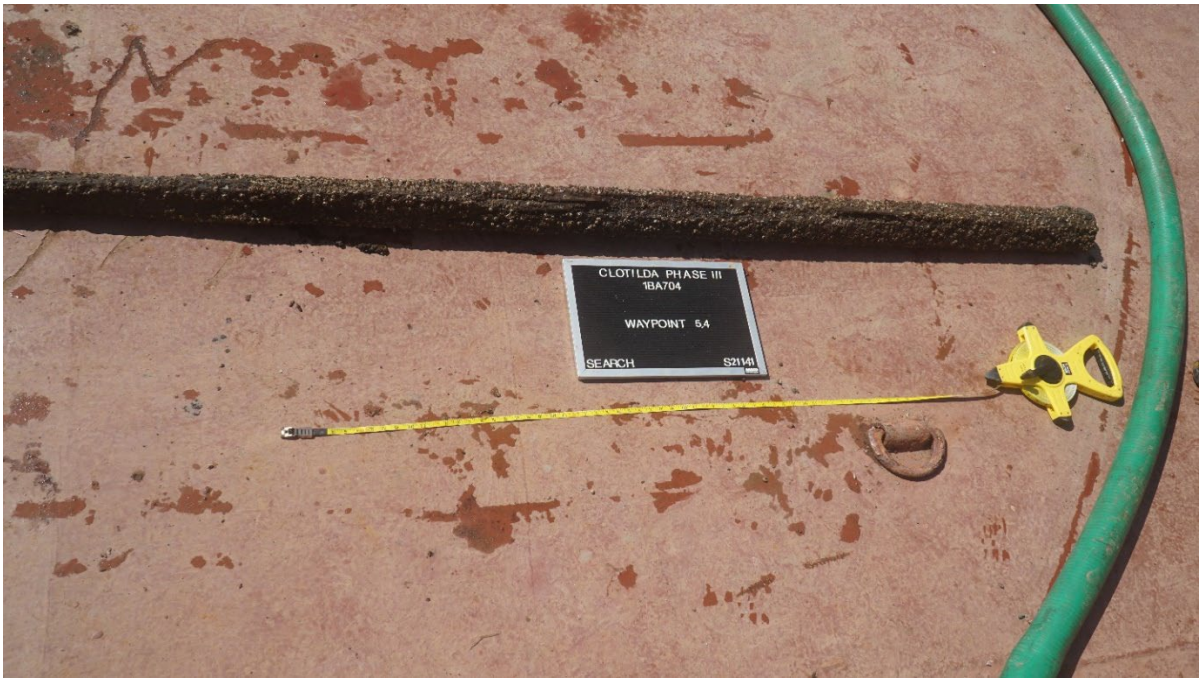
Loose timber, Waypoint 5.2 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 5.3 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 5.4 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 5.4 (SEARCH/Alabama Historical Commission).



Loose timbers, Waypoint 6.1 (SEARCH/Alabama Historical Commission).



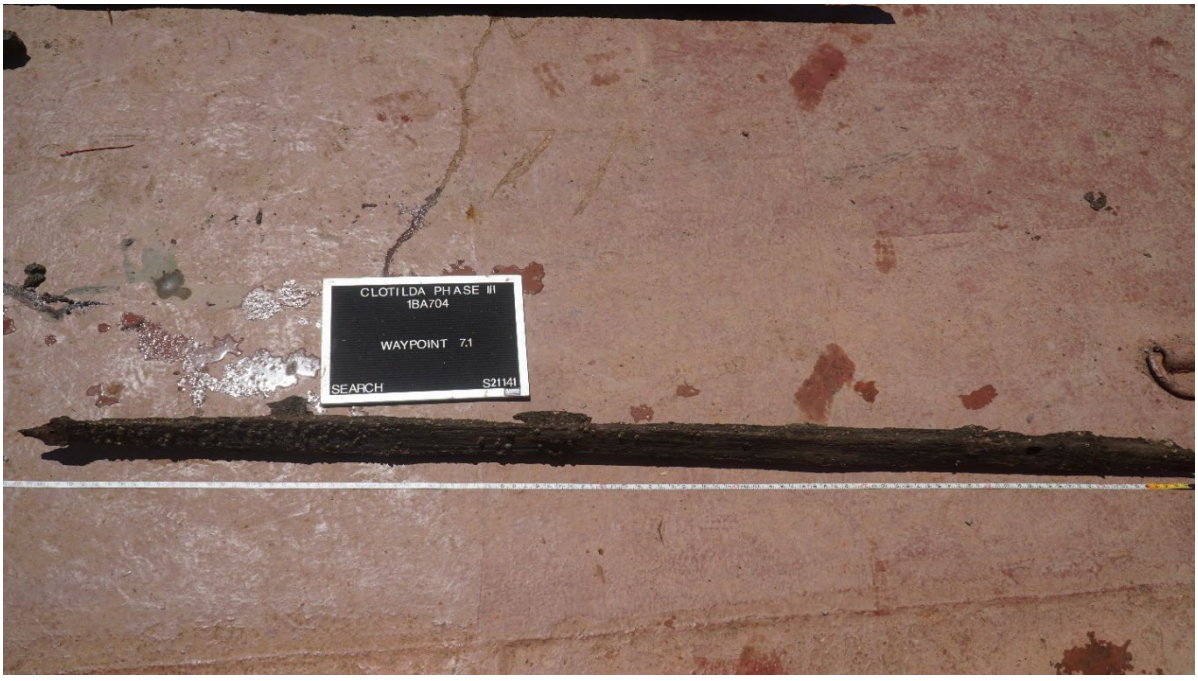
Loose timbers, Waypoint 6.2 (SEARCH/Alabama Historical Commission).



Iron, Waypoint 6.3 (SEARCH/Alabama Historical Commission).



Fastener, Waypoint 6.4 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 7.1 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 7.2 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 7.3 (SEARCH/Alabama Historical Commission).



Timber and steering gear, Waypoint 7.4 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 7.5 (SEARCH/Alabama Historical Commission).



Iron, Waypoint 7.6 (SEARCH/Alabama Historical Commission).



Iron, Waypoint 7.7 (SEARCH/Alabama Historical Commission).



Cap, Waypoint 7.8 (SEARCH/Alabama Historical Commission).



Loose timbers, Waypoint 8.1 (SEARCH/Alabama Historical Commission).



Loose timbers, Waypoint 9.1 (SEARCH/Alabama Historical Commission).



Bottle, Waypoint 9.2 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 10.1 (SEARCH/Alabama Historical Commission).



Loose timbers, Waypoint 11.1 (SEARCH/Alabama Historical Commission).



Loose timbers, Waypoint 11.1 (SEARCH/Alabama Historical Commission).



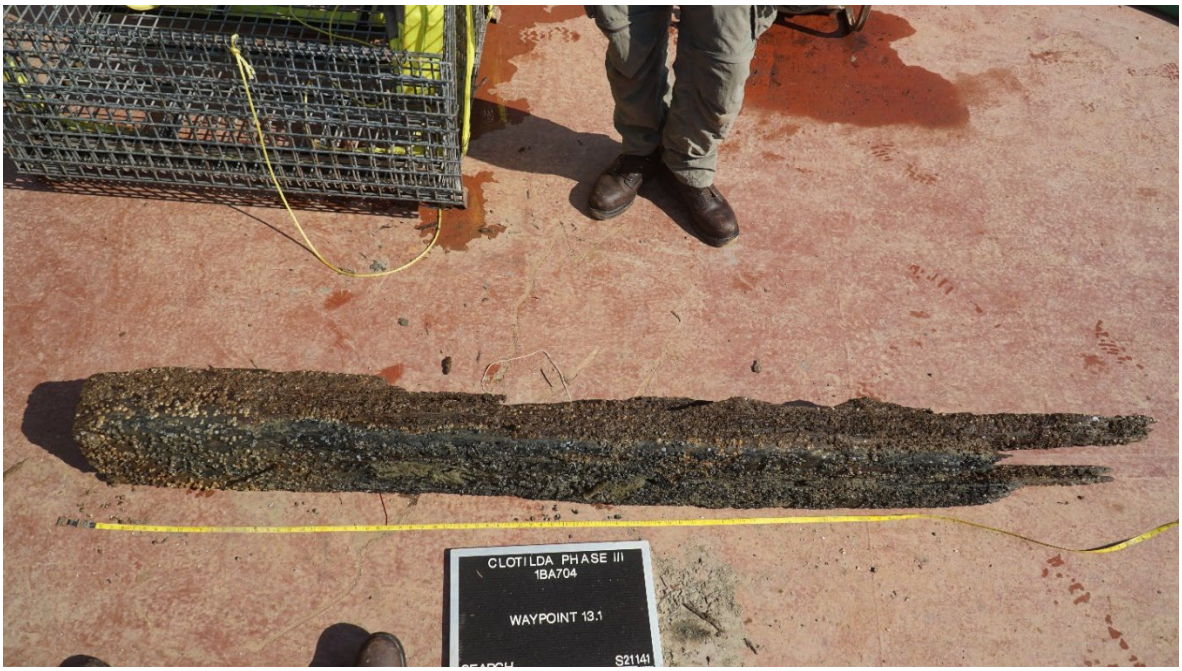
Loose timber with fasteners, Waypoint 11.2 (SEARCH/Alabama Historical Commission).



Loose timber with fastener, Waypoint 11.3 (SEARCH/Alabama Historical Commission).



Loose timber with fastener, Waypoint 12.1 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 13.1 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 14.1 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 14.1 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 14.1 (SEARCH/Alabama Historical Commission).



Metal ring, Waypoint 15.1 (SEARCH/Alabama Historical Commission).



Loose timbers, Waypoint 16.1 and 16.2 (SEARCH/Alabama Historical Commission).



Loose timber, Waypoint 17.1 (SEARCH/Alabama Historical Commission).



Loose timbers, Waypoint 17.2 (SEARCH/Alabama Historical Commission).



Loose timbers, Waypoint 18.1 (SEARCH/Alabama Historical Commission).



Loose timbers, Waypoint 18.1 (SEARCH/Alabama Historical Commission).



Electric light switches (SEARCH/Alabama Historical Commission).



Possible shoe leather, Waypoint 21.1 (SEARCH/Alabama Historical Commission).



Metal artifacts, Waypoint 22.1 (SEARCH/Alabama Historical Commission).



Loose timbers, Waypoint 23.1 (SEARCH/Alabama Historical Commission).



Loose timbers, Waypoint 23.1 (SEARCH/Alabama Historical Commission).



Loose timbers and fastener, Waypoint 23.2 (SEARCH/Alabama Historical Commission).



Waypoint 23.3 (SEARCH/Alabama Historical Commission).



Small finds, Waypoint 24.1 (SEARCH/Alabama Historical Commission).



Small finds, Waypoint 25.1 (SEARCH/Alabama Historical Commission).



Small finds, Waypoint 26.1 (SEARCH/Alabama Historical Commission).



Small finds, Waypoint 27.1 (SEARCH/Alabama Historical Commission).



Small finds, Waypoint 28.1 (SEARCH/Alabama Historical Commission).

ANNEX E:

Architecture and Structural Analysis of *Clotilda*

Annex E: Architecture and Structural Analysis of Clotilda

INTRODUCTION: The Architecture of *Clotilda*

James P. Delgado
SEARCH, Inc.

For non-maritime readers, the basic components of a schooner like *Clotilda* are explained here as an introduction to understanding the forensics of *Clotilda* as a shipwreck and the factors affecting efforts to stabilize or recover and then preserve and conserve the wreck. *Clotilda* was built in various parts that were fit together as a whole to form the structure of the schooner and provide the hull with the ability to remain water-tight, carry cargo, and operate under sail on the water in a variety of weather and sea conditions. Ships needed to withstand the strains of the hull pitching and rolling, and rising and dropping into the waves, and be water-resistant so that like a duck, it could shed water when a wave rolled over the decks. Wooden ships were built to withstand these strains, aided by the inherent flexibility of wood that gave a little but did not crack or break as an inflexible, brittle structure would. The overall structural integrity of *Clotilda* depended on each part of the hull working with the others; tightly fastened, but with some flexibility, and without fractures, cracks or dry rot weaking the timbers.

The principal structural member was a wooden keel, or backbone, that was the basis of *Clotilda*'s strength. It was the center line and made of oak; it may have been one or perhaps two pieces of timber fitted together and fastened with large iron bolts. Onto this backbone, the frames, or ribs, were fitted and fastened into the keel with large iron bolts driven through the frames and into the keel's top surface. These frames were shaped to fit into specific areas along the keel. The shapes of the ribs, as they curved up, defined the "lines" of the shape of the hull. The frames were "double-sawn," which meant that two overlapping sets of "futtocks" (the name for individual "rib" pieces) were halved together so that the "butt" ends of two timbers were joined together next to a solid piece.

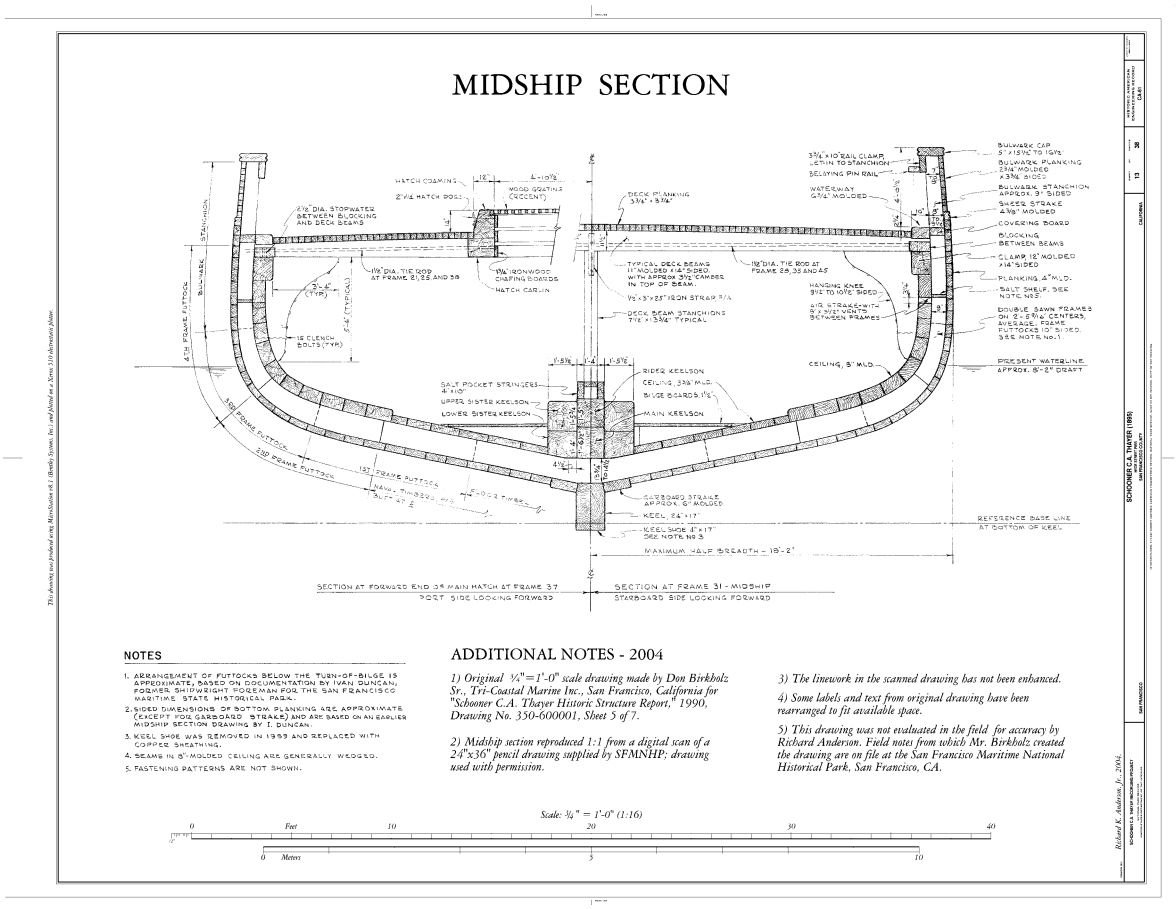


Figure 1. HAER Documentation of the midships structure of the 1895-built, three-masted wooden schooner C.A. Thayer at San Francisco Maritime National Historical Park. The upper portions of this structure are missing on *Clotilda* (Library of Congress).

These oak futtocks were bolted together to form a single frame. They were put on top of the keel and bolted into it. The frames in the midships (center) of the vessel were almost flat to form the cargo-carrying area of the hold (**Figure 1**). The frames closest to the bow and stern rise nearly straight up from the keel. Called "cant" frames, they formed the shape or lines of the hull where the schooner would "cut" through the water.

Once the frames were in place, a second structure, known as the keelson, was put in place on top of them and bolted into place to complete the schooner's backbone. Also made of oak, the keelson "sandwiched" the bottom or "floors" of the frames between it and the keel. The keel and keelson supported the oak timbers for the bow and stern at each end of the vessel. The stempost at the bow was made of timbers bolted together and braced into the keelson; the sternpost was fitted at the aft or back end. These were braced with large timbers known as breasthooks and sternhooks, and quarter-knees, that fit inside the hull to reinforce the bow and stern.

Clotilda was built to operate in a shallow water home port (Mobile), and was therefore built with a shallow draft to not get stuck in the harbor's mud. Most keels would project under a hull at least three feet, but *Clotilda*'s did not. It required a deeper keel to navigate offshore in deep water without fear of capsizing, so it was fitted with a centerboard, a large, probably thirteen-foot long, thick set of timbers bolted together; this fit inside a wooden "trunk" that was watertight. Located alongside the keel and keelson, it pivoted down and dropped into place (modern versions of centerboards are known in yachting as "drop keels") to allow *Clotilda* to navigate offshore in deep water. Because this essentially cut through the bottom of the schooner, the centerboard and its trunk had to be heavily built and fastened tightly (**Figure 2**).



Figure 2. View of the forward hold of the 1882-built, two-masted wooden schooner *Grace Bailey* during restoration in 1990-1991; the centerboard trunk is the wooden "wall" on the keel line. *Grace Bailey*'s length on deck is 80 feet, and the scale of the schooner is similar to that of *Clotilda*. *Clotilda*'s centerboard and trunk were apparently blasted and torn out after it sank, leaving a large hole in the hull and compromising the keel at this same location inside of the wreck (National Park Service Photograph by J. Candace Clifford).

The hull planking was made of varying lengths and thicknesses of steam-sawed yellow pine. These planks could be as long as thirty feet and several inches thick. The thickest planks were at the bottom of the hull and along the waterline. These were carefully fitted onto the frames by the shipwrights (carpenters) who shaped them with adzes to fit tight, and the edges of the planks were shaved with a plane to leave a small gap into which caulking made of rope fibers and tar would be pounded to create watertight seams. The large planks were steamed inside large wooden boxes in the shipyard so that they were pliable and bent to the shape of the hull; as they cooled and dried, the fact they conformed to the shape of the ribs was an important part of good wooden shipbuilding.

Every section of planking (known as strakes) was trimmed by the shipwrights to fit perfectly flush or flat with the ribs, and fastened into place with wooden pins known as "treenails" that fit into pre-bored holes that passed through the plank and into the rib. Multiple treenails and iron spikes fastened each strake to form a watertight and strong hull. For a vessel the size of *Clotilda*, thousands of treenails and iron spikes were used to fasten the hull. In addition to the outer hull planks, a second "skin" of planks was fastened inside the hull; these were known as "ceiling" planks. This double construction was also critical in ensuring the strength of the hull. *Clotilda*'s hull was subdivided into three areas; thick wooden watertight bulkheads made of heavy planks divided the main hold (for cargo) from a forward space and one near the stern that would be used to accommodate the crew (**Figures 3** and **4**). The planking was augmented by thick timbers known as "clamps" that formed the basic platform that supported the deck. These clamps were augmented every several feet by curved timber "knees" that were usually cut from the areas of trees where large branches or roots provided a natural strength to the curve of the knee. These, like the clamps, were also heavily fastened to each other and to the frames (ribs) with iron bolts. The deck planking was laid down over thick deck beams; the deck "planks" were usually as thick as they were wide (**Figures 5** and **6**). The deck planks were also caulked with oakum and tar to keep them watertight. The only gaps in the deck were where the masts, pumps and hatches were placed. Hatches were surrounded by heavy wooden beams that lined their perimeters that were known as carlings and coamings. Other heavy timbers included the mast partners, heavy beams that supported the wooden masts and were set into the keelson, and heavy beams that supported the windlass, which was used to raise and lower the anchors.

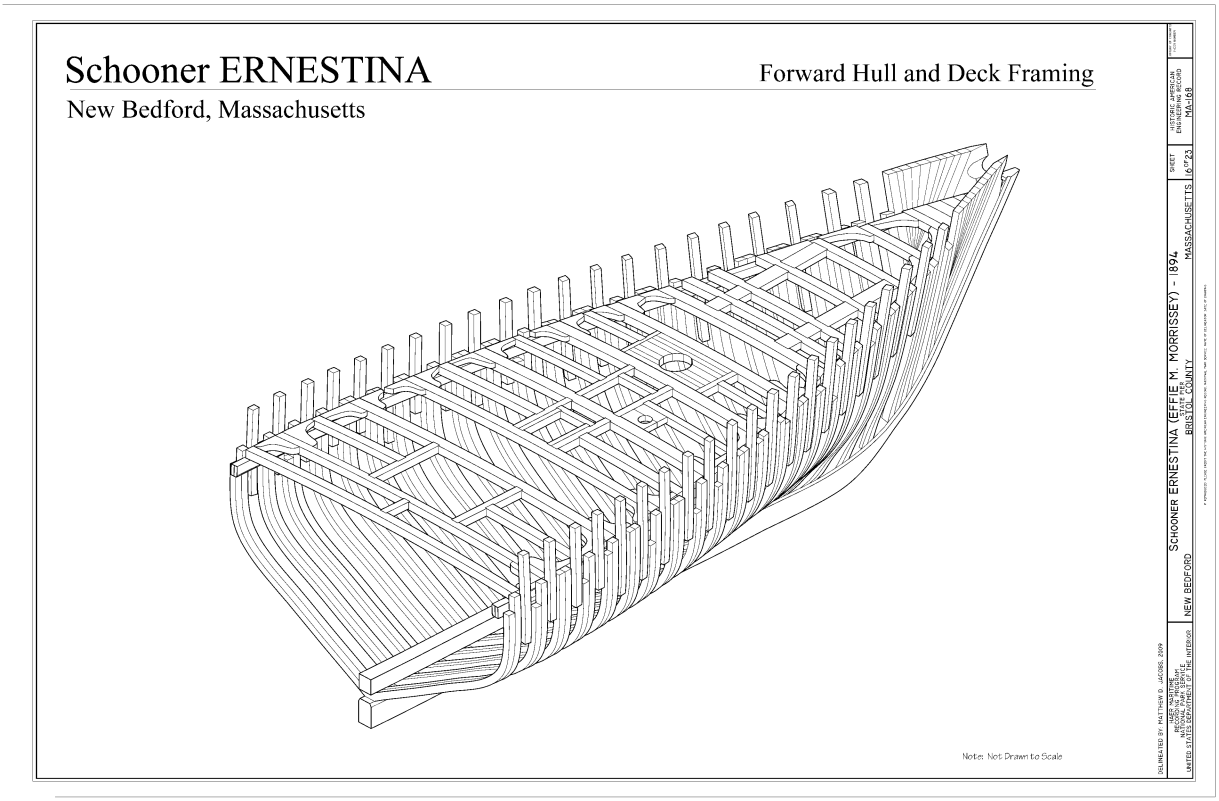


Figure 3. HAER documentation of the forward frames, stempost, keel, keelson, clamps and deck beams of the 1894-built two-masted schooner *Ernestina*. The deck structure, stanchions and outer edge of the stempost are missing on *Clotilda* (Library of Congress).

The hull, after being caulked, was painted, usually with three coats of thick black paint. On ocean-going vessels intended to go to sea for long periods, the bottom of the hull was coated in hot tar and then felt was tarred in place over that. Copper sheathing, made in long rectangular plates, was then nailed over that to protect the wood of the lower hull from wood-boring marine worms. *Clotilda* was not copper sheathed as it worked in coastal Gulf waters with frequent stops in ports that were fresh water (like Mobile) where the marine worms could not survive. For its final, slave-trading voyage across the Atlantic, with months spent in the ocean, where the marine worms would thrive, *Clotilda* required the copper sheathing that was added to the lower hull for that voyage.

Clotilda's two wooden masts were among the last things set into the hull after it was completed; they were placed once the schooner had been launched into the water from the "ways" or platform it had been built on at the shipyard. The ribs where they rose above the deck were tapered and smaller in size than the lower futtocks and frames; above deck they were known as the stanchions and formed the "railings" of the deck. The rigging (setting up the lines that

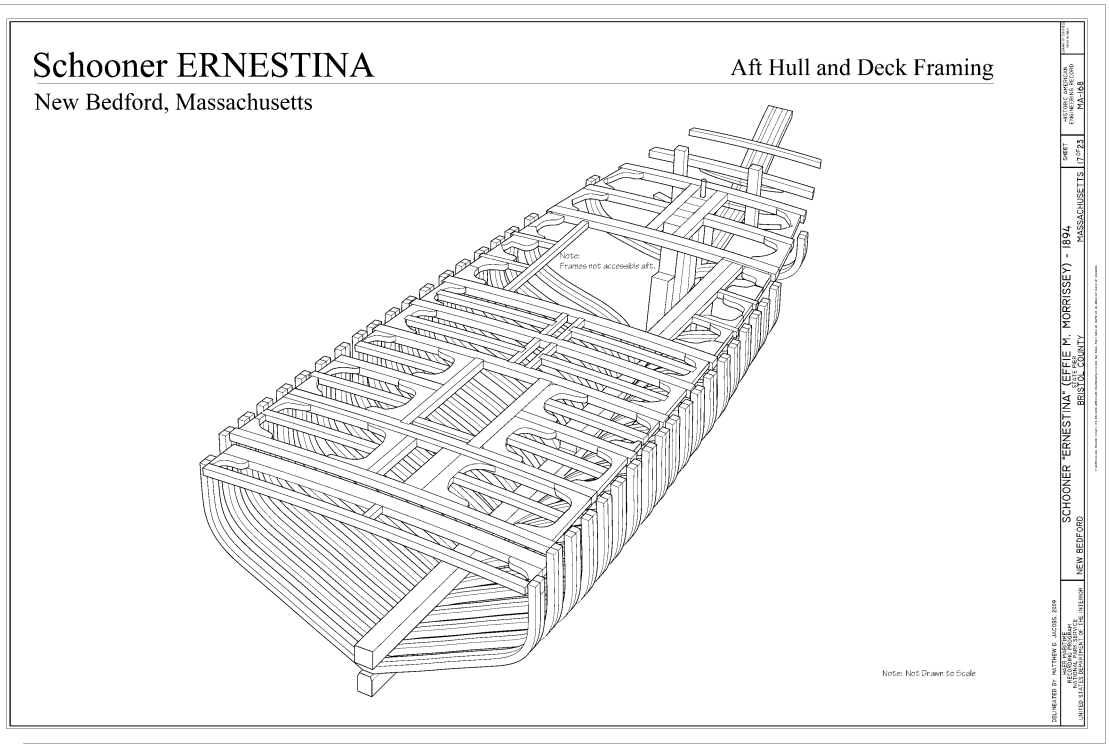


Figure 4. HAER documentation of the aft structure, keel, keelson, deck beams and stern post of the 1894-built, two-masted schooner *Ernestina*. The majority of this structure is missing from *Clotilda* (Library of Congress).

supported the masts and controlled the sails) was among the last items of work done to ready *Clotilda* for work on the water. The thick bulkheads inside the hull provided areas to fit a cabin for the captain and officers near the stern, and accommodations for the crew forward at the bow in a space known as the forecastle, both of them fitted into place with planking, bunks and "mess" tables for meals. The pump, an iron and wood apparatus used to free the hold of water due to leaking or "shipping" water that could pour into the hold in a storm and heavy seas, was installed near the main mast (in the middle of the hull) and in the aft cabin; the captain and the officers had a small iron toilet that was hand-pumped to empty it through a valve into the sea after each use. The last known alterations to *Clotilda* came in 1860 on the final voyage with the addition of a non-structural bulkhead to create the space in the main hold to confine the captives,

and the installation of wooden platforms on which the captives were forced to make the voyage. At the end of that voyage, *Clotilda* was set on fire and scuttled, sinking with damage to its hull and decks and resting in a muddy river where it began to deteriorate as marine organisms colonized it and bacteria and immersion in the water attacked and weakened the wood of the hull as well as beginning to corrode its iron fasteners.

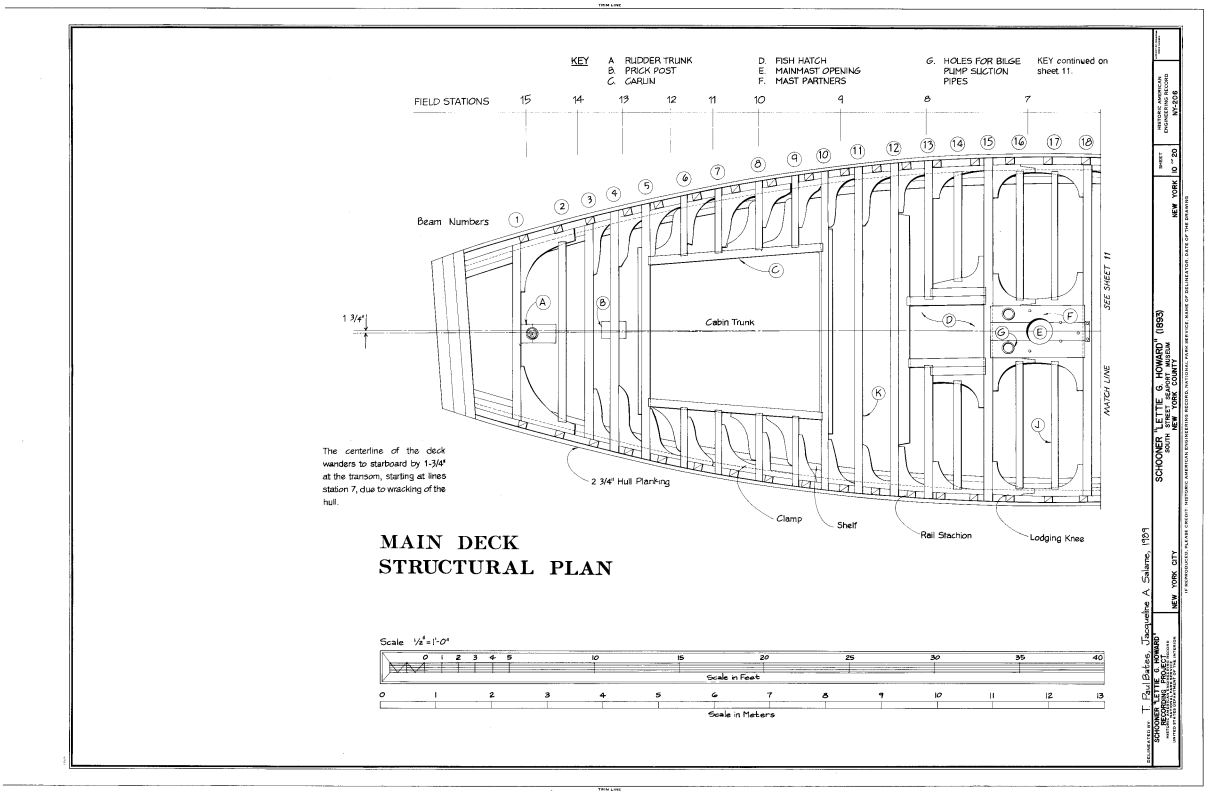


Figure 5. HAER documentation of the aft main deck structural plan with the deck beams and structure for the trunk cabin of the 1894-built, two-masted wooden schooner Ernestina. All of this structure is missing on *Clotilda* (Library of Congress).

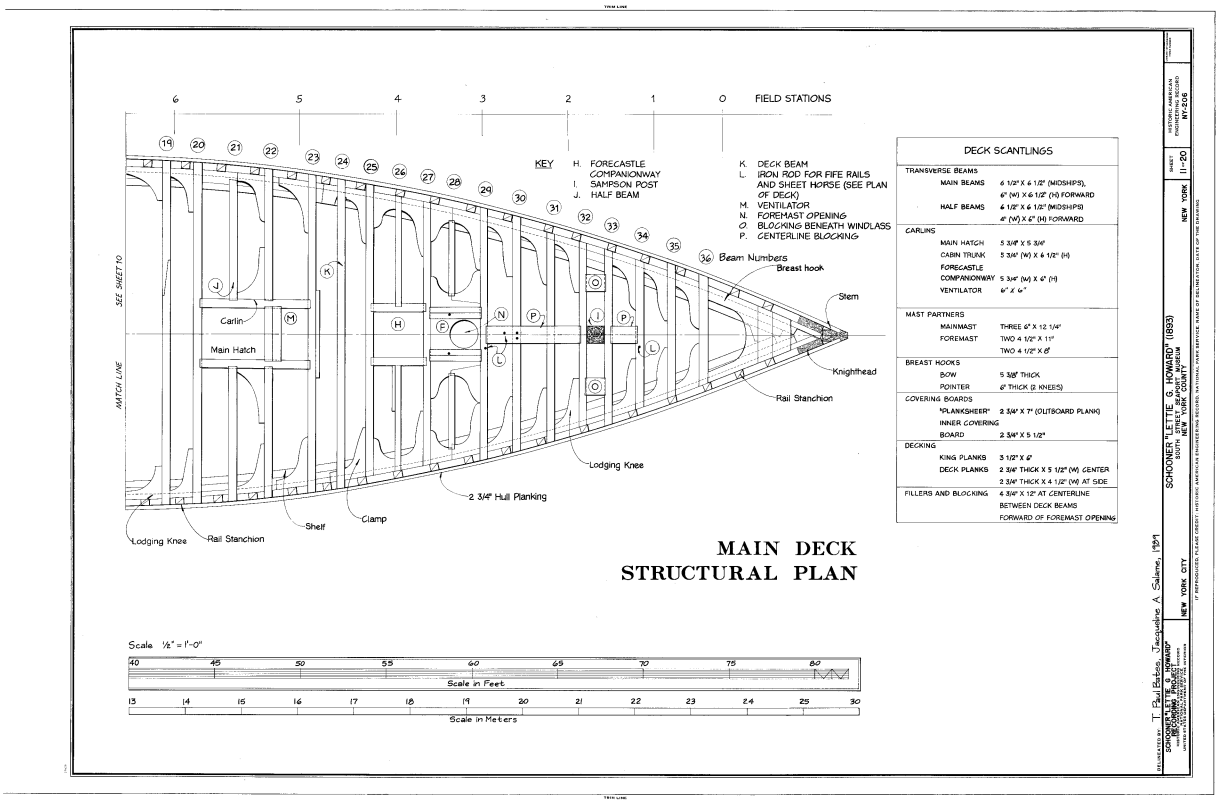


Figure 6. HAER documentation of the forward deck structure of the 1894-built, two-masted wooden schooner *Ernestina*. All of this structure other than the sheer clamps on the sides of the hull are missing on *Clotilda* (Library of Congress).

Raising *Clotilda:* A Qualitative Structural Risk Analysis

Dr. Larrie D. Ferreiro
George Mason University, Fairfax, VA

1. Aspects of wooden ship structural strength

The hull of a wooden ship is a complex puzzle of planks and frames, joined together with scarphs and fastened with treenails, bolts and nails. Another way of looking at it is that the hull is a succession of discontinuities between the wooden pieces, butting up against each other at the edges, and loosely pinned together at scattered points. Unlike iron, plastic or steel hull assemblies, which carry loads between plating and frames through relatively rigid connections, wooden ship structures transmit loads (bending and shear) primarily through pinned connections (fasteners such as iron spikes and treenails) between planks and frames. Pinned connections mean that planks move and rotate independently of one another, so that they slide past each other as they bend. Plank-to-plank sliding movement is restricted by caulking, but when that caulking deteriorates, the gaps between planks can widen considerably under bending deformation, also allowing freer movement between planks. Because pinned connections carry most of the load, the localized structure immediately around them is subject to the highest forces, in compression, crushing and torsion (Figure 1).

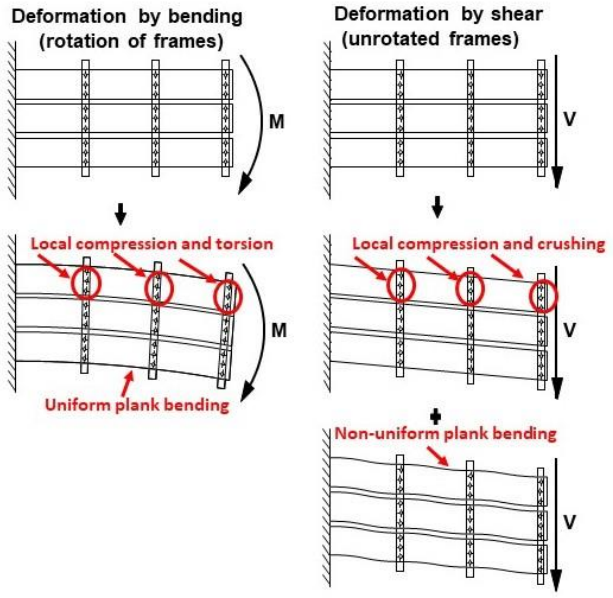


Figure 1

Wooden hull structures – deformations and stress.

2. Current state of *Clotilda* wreck

What remains of *Clotilda* is embedded several feet in the bank of the Mobile River, encased in sediment and silt that varies in density from loose to compact. The wreck site is not flat, but instead slopes away from the bank. The ship itself is not upright – it is heeled to port several degrees off vertical. Although the lower hull of the ship, below the turn of the bilge, has not been observed, the archeological evidence (notably the fact that parts of the centerboard trunk was found several feet away from the wreck) indicates that a substantial section of the keel and keelson is missing around amidships. The upper hull, above the turn of the bilge, rises several feet above the mudline. Framing and planks are still in place. Close examination of disarticulated timbers shows evidence of marine wood-borers, which in the upper hull would seriously compromise its strength. The iron fasteners are universally corroded, ranging from mild to severe. The main deck is entirely missing. On the starboard side, the upper hull runs aft about three-quarters of the way aft to the third bulkhead, after which the planking and frames are broken off and fragmented. On the port side, the upper hull runs aft about halfway, and then effectively disappears after the second bulkhead. The open hull space inside these upperworks is filled with silt that extends above the mudline.

The structural integrity of the hull does not appear to be sound. The most obvious problems are (1) the lack of a structural main deck tying together the port and starboard sides, and (2) the likely absence of large parts of the keel/keelson, which would have held the hull sides together as well as provided continuity of longitudinal strength amidships, which is the most heavily stressed part of the hull. Although the timbers do not appear to be significantly waterlogged, after more than 160 years of immersion (including damage from marine wood-borers), they have lost considerable strength and resilience. Some of the structure was burned in the original fire, which also contributes to deterioration. As noted, the iron fasteners (drift pins, nails, bolts) are corroding (Figure 2). The combination of wood deterioration and iron corrosion means that the pinned connections between planks and frames have been greatly weakened, and can no longer resist localized compression, crushing and torsion forces that would result from outside loads imposed on the wreck – such as those forces that would be inflicted in attempts to raise *Clotilda*.



Figure 2

Sample of deteriorated structural timber and iron fasteners from *Clotilda*

(SEARCH, Inc./Alabama Historical Commission).

3. Probable scenario for raising *Clotilda* wreck

Given the shallow depth of the *Clotilda* wreck and nature of the Mobile River bottom, the most probable recovery method would be to first build and drain a cofferdam, similar to what was done successfully with the *La Belle* wreck in Matagorda Bay, Texas from 1995-1996 (Figure 3). After that, the next steps would be to take apart the wreck piece by piece (as with *La Belle*), or raise it whole with lifting cranes. However, the location and condition of the wreck argue not only against lifting it intact with cranes, but also against the process of draining and exposing it in a dry or semi-dry cofferdam. There are differences between the *Clotilda* wreck and that of *La Belle* that significantly elevate the risk of damage during that process. The first is the location of the *Clotilda* wreck – a sloped riverbank with loose sediment, calling into question whether a dry or even semi-dry cofferdam is even feasible to construct and maintain (*La Belle*'s site was relatively flat with clay soil that mostly kept out the water when pumped dry). The second difference is that *Clotilda* has extensive hull structure extending vertically above the mudline with almost no lateral support, which would likely be damaged by vertical and lateral loads during the draining process, as outlined below. By contrast, the *La Belle* wreck was primarily horizontal ship's bottom, not subject to the same loading, so it was recovered relatively intact.

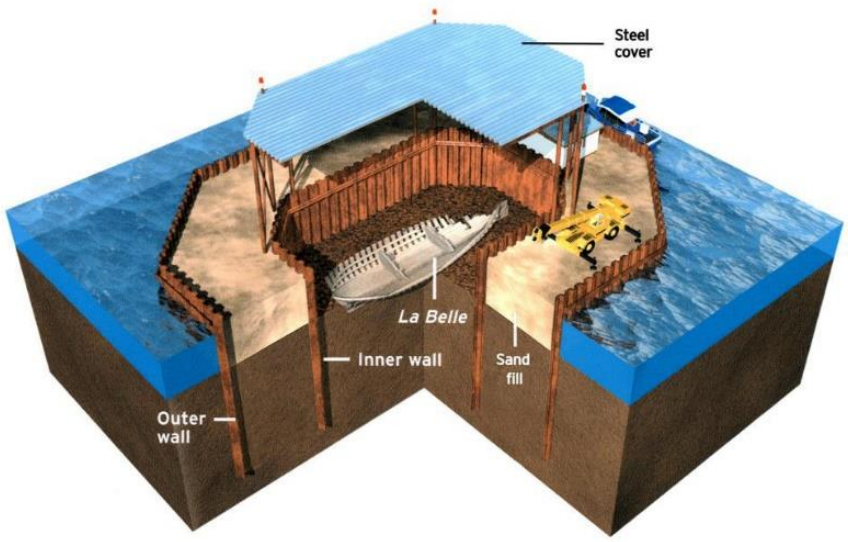


Figure 3

***La Belle* wreck in cofferdam (Bullock Museum).**

4. Qualitative analysis of structural risks involved in raising *Clotilda* wreck

The *Clotilda* wreck has numerous structural problems that present serious risks for any attempt to raise the vessel. The first, as mentioned, is the wood deterioration and iron corrosion that have greatly weakened the pinned connections between planks and frames. Second, the lack of a main deck structure tying the hull sides together, as well as the likely absence of keel structure below the mudline, means that the frames are cantilevered without any structural resistance to side loading. Third, the stern section aft of the second and third bulkheads is not enclosed, but rather open and broken apart, so the entire hull acts like an open cardboard tube, without resistance to external torsional and vertical loads.

The excavation operation presumed above begins with creating a dry or semi-dry cofferdam, then pumping out the water to reveal *Clotilda*. This operation in itself presents the risk of damage to the ship; the hammering of sheet piles in proximity to the hull in the sediment, some of which is sand held in dynamic suspension, would transmit the shock waves of hammering to the hull and further weaken it. Moreover, given its somewhat precarious position – heeled over on a sloped river bank – there is a question as to whether this operation would trigger any shifting or sliding of the wreck.

The next set of risks occur during the draining process itself, during which the hull would need to be kept constantly wet to inhibit further deterioration. The two modes of failure that present the highest risk are:

- Collapse of vertical hull structure due to lateral water flow and sediment spill;
- Compression and crushing of frames and planks around fasteners, due to redistribution of longitudinal loads.

The first failure mode is shown in Figure 4. The left-hand illustration is a conjectural wreck having an intact main deck and keel/keelson; the deck and intact keel would act as a structural beam, providing supporting forces (light arrows) to counter transverse loads from water flow and sediment spill (dark arrows). These would prevent the side frames and planks from collapsing. The right-hand illustration is the presumed condition of the *Clotilda* wreck. With no structural keel, and no main deck beam to counteract transverse loads, the side frames and planks would be subject to racking loads, resulting in their collapsing outward. The wreck would require extensive bracing athwartships to prevent this collapse, but the deteriorated state of the hull structure calls into question how such bracing would be attached without causing further damage. Additionally, with the passage of water and sediment through the hull, outer hull planks may disengage from the frames and fall off. The structural integrity of the frames is unknown, but as doubled and through-drifted elements, they may have variances in their remaining strength.



Figure 4

Collapse of vertical hull structure due to lateral water flow and sediment spill

Left: conjectural intact ship; Right: Presumed current state of *Clotilda*.

The second failure mode is shown in the Figure 5 illustration. As noted above, a wooden ship hull cannot be thought of as a solid reinforced beam under load. Instead, the planks can be considered as a series of beams, each connected to a frame, which can slide past each other under bending or shear loads. Those loads are transmitted through pinned connections between planks and frames. As the *Clotilda* wreck is drained, the shift in buoyancy and sediment distribution would cause the longitudinal distribution of loads to change. This would change the forces on the pinned connections between planks and frames; and since deterioration and corrosion have greatly weakened those connections, the wood structure would not be able to resist localized compression, crushing and torsion forces. Additionally, the apparent absence of the keel/keelson amidships means that there is little residual strength in the hull structure to resist additional loads due to the draining process. Add to that the forces imposed by any bracing, and the increased loading on the already-weakened hull of *Clotilda* may result in permanent damage.

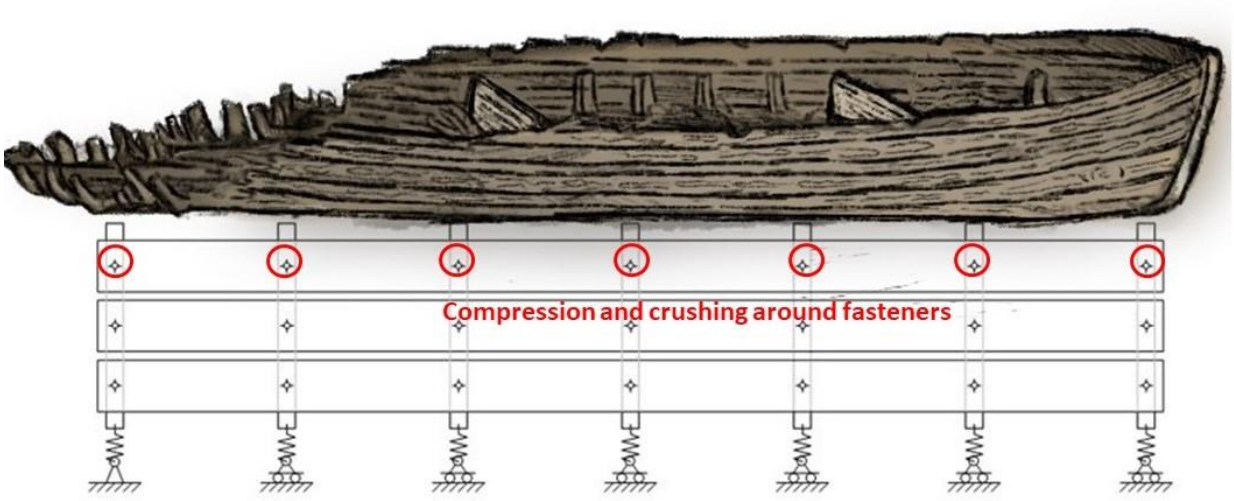


Figure 5

Compression and crushing of frames and planks around fasteners, due to redistribution of longitudinal loads.

Finally, there are several risks beyond structural ones. Fragile materials may collapse and the damage may be irreversible. Likewise, silt and sediment will compact as water drains out, making it extremely difficult to work on, and water permeation would be constant, requiring mud pumps. Creating a stable worksite will prove challenging; it is important to note that the *La Belle* excavation site was essentially on a flat seabed, and once exposed, offered access with catwalks to completely excavate it (also, there was no upper hull, only the floors and outer and inner planks covered with archaeological material, which was completely excavated, leaving only the cleared lower hull to be raised). The *Clotilda* site is quite different; not only is it markedly sloped, but also, large portions of the wreck extend considerably above the sediment. The level of effort in creating a complex arrangement of scaffolding and catwalks would be considerably greater than for *La Belle*. Workplace personnel hazards would also prove more challenging to deal with; timbers and iron fasteners have been altered in the exposed areas to often razor-sharp projections, and some would be at angles easy to slip and fall on if the hull were exposed in a cofferdam. And lastly, the process of disassembling the hull would likely cause irreversible damage. While corrosion of iron components may facilitate the disassembly, the process of taking it apart would be very destructive.

5. Conclusions

The process of raising *Clotilda* using the most probable method (described above) poses significant risks of irreparably damaging the wreck, even before any archaeological excavation begins. These risks include:

- Shock damage due to hammering of sheet piles;
- Shifting or sliding of wreck on sloped river bank;
- Collapse of vertical hull structure due to lateral water flow and sediment spill during cofferdam draining;
- Compression and crushing of frames and planks around fasteners, due to redistribution of longitudinal loads as wreck settles during drainage operations.

Other risks include hazards to personnel and loss of fragile material.

Given the nature and severity of these risks, due consideration should be given to retaining *Clotilda* in-situ while protecting it from further damage, in order to allow further study.

6. References

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ANNEX F:

Smithsonian Museum Conservation Institute
Analytical Report

Smithsonian
Museum Conservation Institute

Analytical Report

MCI request number: 7020.1

Title / Object: material identification of recovered sample from shipwreck

Catalog number: WP-26 (P7020_1_1)

Manufacturer: n/a

Geographic region: Mobile River, Baldwin County, Alabama, U.S.A.

Materials/Techniques: fragment of possible organic dark brown in color, sample kept in water until analysis

Dimensions: ~ 7 x 9 cm

Date: 19th Century

Owner: Alabama Historical Commission

Requested by: Paul Gardullo, NMAAHC

Telephone: 202-633-7337

E-mail: gardullop@si.edu

Unit: Alabama Historical Commission/NMAAHC (through the Slave Wrecks Project)

Analyst(s): E. Keats Webb, Imaging Scientist (webbekeats@si.edu), Thomas Lam, Physical Scientist (lamt@si.edu), G. Asher Newsome, Physical Scientist (newsomeg@si.edu), Gwénaëlle Kavich, Head of Technical Studies/Conservation Scientist (kavichgm@si.edu).

Executive summary

The Slave Wrecks Project collaboration, hosted at NMAAHC, has been working alongside and in support of the Alabama Historical Commission, key community and archaeology and heritage organizations in Africatown for several years. Archaeological investigation activities on the nineteenth century *Clotilda* shipwreck site in Mobile River, Baldwin County, Alabama (U.S.A.) recovered a fragment that was sent to MCI for materials identification (fiber and possible organic matter).

The *Clotilda* is the last known slave ship to (illegally) bring captives to the US in 1860. During excavation inside the hold, the team encountered a set of articulated 4x4 inch posts on each side of the hold that are not associated with a bulkhead (as far as could be seen), but that conform to the location and spacing of the platforms utilized on slave ships for the stowing of captives. One aspect of that excavation in one corner of the hold was a mass of material that may be fabric or organic material. The fragment, waterlogged, felt like 'wet cardboard' to the divers, that had only a few inches of visibility, and appears to be at least partially organic, possibly linoleum, according to Claudia Chemello, senior conservator working onsite. There is a definite weave structure on one side and a dark brownish color on the other.

Prior to analysis, a few words of recognition to honor the slaves who are associated with the sample were said and a moment of silence taken, as requested by NMAAHC. The sample had then to be air dried in order to pursue the analysis. Finally, MCI analyses could not confirm the presence of any organic materials.

Both the requestor and the MCI report authors must review any manuscripts or presentations reporting results of this request prior to its submission, presentation or publication. When referring to data in this report, co-authorship and/or credit must be given to the MCI report authors.

Imaging techniques emphasized what could be a textile-like pattern on one of the sides of the fragment, without providing more specific characterization. Elemental analyses by pXRF highlighted a surface rich in iron that could explain the brown color of the fragment. FTIR analysis allowed identification of chrysotile (a form of asbestos and hazardous material) fibers, confirmed afterwards by SEM-EDS analysis and the presence of fibrous magnesium silicate mineral.

Following these findings, recommendations are made to work with OSHEM (Office of Safety, Health, and Environmental Management) and OSHA (Occupational Safety and Health Administration) on protocols for safe handling of objects containing asbestos.

Methods: A- Multimodal Imaging (Visible light imaging (VIS), Ultraviolet (UV)-induced visible luminescence imaging (UVL), Reflected UV imaging (RUV), Reflected Infrared (IR) imaging), B- Reflectance Transformation Imaging (RTI), C- Digital x-radioagraphy, D- pXRF (portable X-ray Fluorescence Spectroscopy), E- Scanning Electron Microscopy-Energy Dispersive X-ray Spectroscopy (SEM-EDS), F- Direct Analysis in Real Time (DART)-Mass Spectrometry (MS), G- Non-proximate desorption photoionization (NPDPI)-Mass Spectrometry (MS), and H- Attenuated Total Reflectance-Fourier transform Infrared Spectroscopy (ATR-FTIR).

A- Multimodal Imaging (VIS, UVL, RUV, and IR)

Visible light imaging (VIS) records an object under normal illumination and creates an image similar to one the human eye would see. The technique is used to record the condition of an object and to act as a reference for other imaging techniques. The visible light image is particularly useful if the object is not available when analyzing and interpreting the image data. Visible light images were acquired to correspond with the other imaging modalities as well as document the condition of the object.

Ultraviolet (UV)-induced visible luminescence imaging (UVL) records low-energy radiation that materials reemit in the visible range, called luminescence, during exposure to UV radiation. UVL has been widely used in conservation as a non-destructive examination technique for characterizing and differentiating materials, assessing the condition, and showing alterations and past conservation treatments. It is particularly useful in the cases of organic materials such as coatings and adhesives and can be used to characterize varnish coatings on paintings. UVL was used to investigate whether any materials or features might luminesce to inform additional analysis and locations of sampling.

Reflected UV imaging (RUV) records the variable absorption, transmission, and reflection of UV radiation by an object. Materials that luminesce with UVL will appear dark with RUV, which could enhance the visibility of some materials. RUV is used to characterize and differentiate materials and to identify retouches. It is not as widely used as UVL as the technique requires the use of a camera sensitive to UV radiation, and in this case a modified digital camera with filters was used. RUV was used to investigate whether any materials or features might respond differently to UV wavelengths from visible light to provide insight into materials and to inform additional analysis and locations of sampling.

Reflected Infrared (IR) imaging records the variable absorption, transmission, and reflection of IR radiation by an object. The IR wavelengths may penetrate materials below the surface, unlike visible light, revealing preparatory drawings and information about the artist process when documenting materials like paper objects and paintings. Materials may absorb and reflect IR radiation differently from visible light, which can help with material characterization and enhancing the visibility of obscured or faded details. In the case

of paint and charcoal or carbon-based inks on paper, the contrast can be dramatic. IR imaging was also used to investigate whether any materials or features might respond differently to IR wavelengths to provide insight into materials and to inform additional analysis and locations of sampling.

The imaging modalities (VIS, UVL, RUV, and IR) used a combination of cameras, radiation sources, and filters. The cameras used for the recording of the sample are listed in Table 1, the radiation sources are listed in Table 2, a summary of the imaging modalities are listed in Table 3 with the corresponding cameras, radiation sources, and filters, and the imaging targets are listed in Table 4. The imaging setup with the camera and radiation sources is illustrated in Figure 1.

Images were acquired as RAW (*.CR2 for Canon and *.NEF for Nikon) and converted to 16-bit TIFF using Adobe Camera RAW (ACR) and Digital Negatives (DNGs) for the resulting images and archiving. For RTI and photogrammetry, images were converted to JPEGs to process the RTI file and 3D reconstructions. Adobe Bridge was used for naming the files and extending the metadata with information about the technique, equipment, and setup.

Table 1. Reference list for camera and lens information

	Name	*Make and Model*	*Specifications*	*Imaging modalities*
Cameras	*Nikon*	Nikon D850	Full-frame CMOS sensor (36 x 24 mm), maximum resolution of 45.7 MP (8,256 x 5,504 pixels) and 4.35 μm pixel pitch	VIS, UVL
	mCanon	Canon 5D Mark II + monochrome conversion by MaxMax LDP LLC	Full-frame CMOS sensor (36 x 24 mm), maximum resolution of 21.1 MP (5,616 x 3,744 pixels) and 6.4 μm pixel pitch	RUV, IR
Lens	*60 mm*	Coastal Optics 60 mm f/4	UV-VIS-IR Apochromatic (APO) macro lens	VIS, UVL, RUV, IR

Table 2. Radiation sources used for imaging and the corresponding modalities.

Make and Model	*Specifications*	*Imaging Modalities*
Lowel ViP Pro-lights (Tiffen, Hauppauge, New York, USA)	Impact FSH halogen 125w/120v 3200K lamps (Gradus Group LLC New York, NY, USA)	VIS, IR
Wildfire VioStorm VS-60 60W 365nm LED UV Light Wildfire Lighting, Torrance, CA, USA		UVL, RUV

Table 3. Imaging modalities and corresponding camera, lens, lighting, and filtration.

Imaging Modality	*Camera + Lens*	*Lighting*	*Filters*
VIS	Nikon D850 + Coastal Optics 60 mm Camera Settings: • f/11 1/2 ISO 100	Two Lowel ViP Pro-lights	None

UVL	Nikon D850 + Coastal Optics 60 mm Camera Settings: • f/11 ISO 100 • shutter speeds: 1", 2" (overexposed), and longer exposures	Two VioStorm UV lamps	Kodak Wratten 2E and Peca 916
RUV	Modified Canon 5D Mark II + Coastal Optics 60 mm Camera Settings: • f/11 1/15 ISO 100	Two VioStorm UV lamps	Baader U-Filter (60nmHBW/320-380nm)
IR	Modified Canon 5D Mark II + Coastal Optics 60 mm Camera Settings: • f/11 0.4" ISO 100	Two Lowel ViP Pro-lights	Peca 910 (87C)

Table 4. Imaging targets

Target	*Image*	*Description*
UVInnovations UVTarget (Imaging Science Associates, Rochester, NY, USA)		UV target presented by McGlinchey Sexton, Messier, and Chen[1] and specifically made for conservation documentation. The workflow for the UV Innovations UV Target can be found on the UV Innovations website http://uvinnovations.com/resources.html. Size: 12.75 x 3 cm
AIC PhD Target (Robin Meyers Imaging, Pleasanton, CA, USA)		AIC Photodocumentation Target (AIC PHD target) was designed by conservators and included as recommended target in Warda et al[2]. The target includes color and grey patches, an illumination guide, a size scale, and an area to include information about the object. Size: 50 x 4 cm

[1] McGlinchey Sexton, J., Messier, P., and Chen, J.J., 2014. Development and Testing of a Fluorescence Standard for Documenting Ultraviolet Induced Visible Fluorescence. In *42nd Annual American Institute for Conservation Meeting*, 1–42. San Francisco: American Institute for Conservation.

[2] Warda, J., Frey, F., Heller, D., Kushel, D., Vitale, T., Weaver, G., 2017. The AIC Guide to Digital Photography and Conservation Documentation, 3rd ed. American Institute for Conservation of Historic and Artistic Works, Washington, DC.

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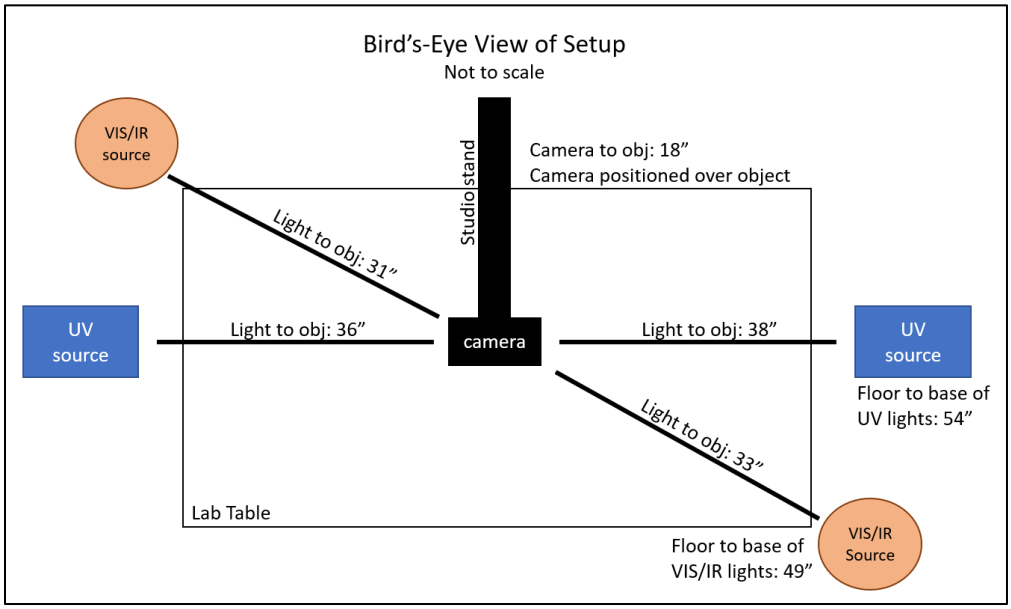


Figure 1. Figure of the imaging setup for the multimodal imaging as seen from above (bird's-eye view).

B- Reflectance Transformation Imaging (RTI) records varying light positions illuminating an object and provides information about an object's surface geometry. The technique involves the capture of multiple images with the subject and camera position fixed and the light source varying. The series of images are lit from a point source of light that is at a constant radius from the subject but relocated through a virtual hemisphere of positions. The software processes the multiple images into a single file that derives all possible light positions within the virtual hemisphere of light. The final image looks like a 2D photograph but is actually the documentation of the subject's surface interaction with the light positions, at the individual pixel level. RTI was used to record both sides of the fragment to try to better understand its materials and whether the fragment includes any fabric.

RTI was performed using the Nikon D850 with the Coastal Optics 60mm macro lens (camera settings: ISO 100 f/11 1/100). The camera was mounted on a studio stand above the object (camera-object distance = ~ 40 cm) (Figure 2). An AIC PhD Target was included in the images for a color reference, and a ruler was included for a measurement scale (Figure 3). Two black reflective spheres (marbles with ~1.5 cm diameter) were included in each image. These spheres are used as a reference for the processing software and enable the software to calculate the light direction for each image.

The technique involves the capture of multiple images with the subject and camera position fixed and the light source varying. The object to light distance is the same for the full image set, and this distance is at least four times the longest dimension of the object. This distance is maintained by using a string which is connected to the flash. Before each image is acquired, the end of the string is held over them middle of the object and the flash is positioned at the other end of the string. The end of the string held above the object is then moved out of the field of view and an image acquired. This is repeated to acquire the virtual hemisphere of light around the object. Approximately four dozen images are acquired to create this virtual hemisphere of light. (A total of 56 images were acquired of side 1 and 47 images of side 2.) This could be thought of or visualized as an umbrella with the light positions following ideally 12 ribs with 3-4 angles between 15˚ and 65˚ along those ribs. The studio stand column prevents acquiring light positions along 12 ribs and this gap can be seen in a composite image of the light positions from the RTI processing software (Figure 4). A Nikon Speedlite SB-5000 flash was used to illuminate the object with an object-to-flash distance of ~90 cm and set to a power of M½ .

Exported JPEGs were used for the data processing using the RTI processing software, ReLight, which creates a single RTI file from the four-dozen input images. This software was used to process the multiple images into a single file that derives all possible light positions within the virtual hemisphere of light. The final image looks like a 2D photograph but is actually the documentation of the subject's surface interaction with the light positions, at the individual pixel level. The final RTI file has to be viewed in specific viewer, RTIViewer (Figure). By moving a mouse (or other pointing device), the viewer can control the light direction, zoom in and out, and select data enhancement options that increase sharpness and contrast and even change surface properties.

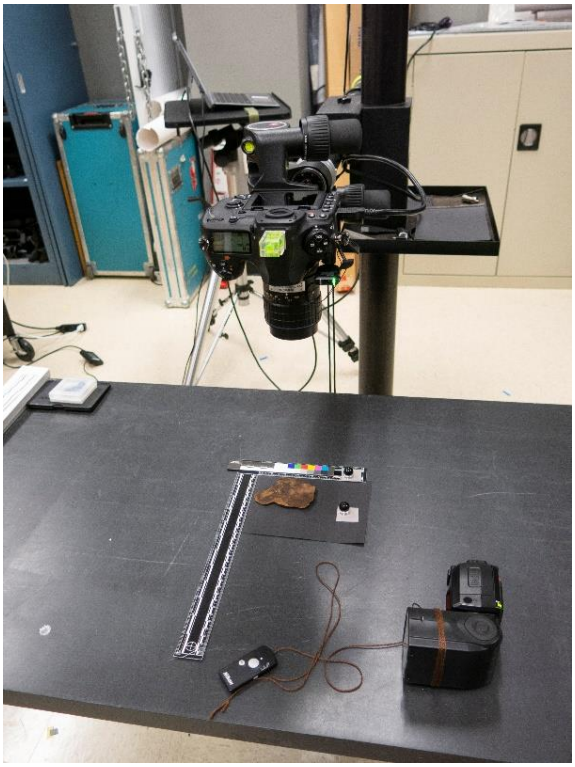


Figure 2. RTI setup with the camera mounted above the object and the flash with string for measuring object-light distance.

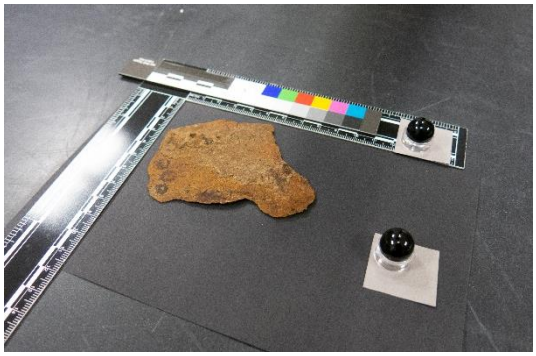


Figure 3. RTI setup for the fragment from the Clotilda with the spheres placed to the side and the AIC PhD target at the top of the object.



Figure 4. Composite image of a reflective sphere with all the light positions from side 1 of the fragment (total of 56 images). This was processed using ReLight software.

In RTIViewer, there are different rendering modes, or enhancement tools, for viewing the resulting RTI file. These rendering modes are mathematical enhancements that use information from surface shape and color and can provide more information about the surface than a standard color image. A very general overview will be provided below on the main rendering modes, but a more complete description can be found in the Cultural Heritage Imaging (CHI) *Guide to RTIViewer*.[3]

- Default: This presents the RTI image without any mathematical enhancements.

[3] Cultural Heritage Imaging. 2013. *Guide to RTIViewer v 1.1*. Accessed 19 December 2022. https://culturalheritageimaging.org/What_We_Offer/Downloads/rtiviewer/RTIViewer_Guide_v1_1.pdf

- Specular Enhancement: This mode can help to enhance the perception of the shape of the object's surface by increasing the specularity of the object and by removing the color. This mode can render shape-based reflections and color information either separately or in combination resulting from the algorithm having separated the diffuse color information, the specular reflection derived from the shape of the object, and the size of the specular highlight.[1] In this mode, the viewer can adjust the percentage of diffuse RGB color information, the percentage of specular reflection, and the size of the specular highlight.
- Normals Visualization: This mode provides a false-color rendering that represents the subject's surface orientation which can help looking at surface contours. (More information about surface normals can be found on the CHI website: https://culturalheritageimaging.org/Technologies/RTI/#how_RTI.)

The RTI files were processed using ReLight v.1.2.3[4] (Visual Computing Lab, Institute of Information Science and Technologies, Italian National Research Council, Pisa, Italy). RTIBuilder (Cultural Heritage Imaging, San Francisco, CA, USA) was previously the software used for processing RTI, but the 2010 software has not been updated and presents challenges for installation and processing on current operating systems. ReLight is the incoming solution, but there is still not a lot of documentation available about the software. CHI and the Visual Computing Lab will be working together to create and share that documentation.

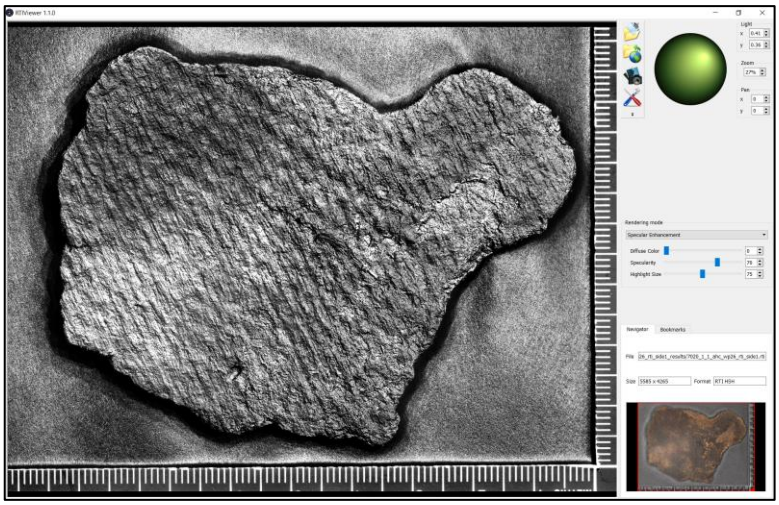


Figure 5. A screenshot of the RTIViewer used to view the final RTI files. The green sphere in the top right represents the angle of light and can be moved by the viewer. There are various settings that can be changed in the viewer to change the effect on the surface properties.

For additional RTI Resources, see additional user guide and related information.[5]

[4] Software is available on GitHub: https://github.com/cnr-isti-vclab/relight/releases/tag/ReLight-1.2.3

[5] a) Additional information about RTI: https://culturalheritageimaging.org/Technologies/RTI/. b) RTIViewer Free Download and User Guide (https://culturalheritageimaging.org/What_We_Offer/Downloads/View/index.html). c) ReLight software: https://github.com/cnr-isti-vclab/relight/releases/tag/ReLight-1.2.3.

C- Digital x-radiography records information through the entire depth of an object, which the other imaging techniques cannot achieve. X-radiography has been a standard non-invasive and non-destructive technique for cultural heritage professionals to document and assess the condition and construction of an object. The technique has been used on a range of cultural heritage materials, including textiles, papers, metals, ceramics, bones, fossils, and paintings, in the areas of artistic, anthropological, biological and historic objects and artefacts. X-radiography was used to investigate the fragment to try to better understand its materials and whether the fragment includes any fabric.

Digital X-radiography was performed using was the Waygate MXR-320HP/11 x-ray tube run with a Titan|neo x-ray generator (Figure 6) and a computed radiography (CR) scanner, the Pegasus CR50P scanner (Figure 7). The final exposure was made at 45kV and 9mA for 10 seconds with 0.4 mm focal spot at approximately 40" distance between the X-ray source and the imaging plate. A 0.010" lead sheet was placed behind the plate during exposure. X-radiograph images were acquired using a IPU2 phosphor plate from Waygate Technologies (Lewistown, PA, USA). The IPU2 plates have the highest image quality and sharpness of the Waygate imaging plate series, and they were specialized for power generation and aerospace applications. These are more expensive plates and do not incorporate the same scratch-resistant coating of the IPS plates (more routinely used at MCI). [6]

The plates were scanned using the GE Rhythm Acquire software at 50 μm and a low gain setting. The x-ray exposures were processed using the GE Rhythm Review software and the GE Rhythm Flash! filters. This processing optimizes each pixel with complex algorithms increasing the clarity of details and features. X-ray images were acquired using a 32-bit Digital Imaging Communications in Medicine (DICOM) file format, which allows for a wide dynamic range and the ability to process without degrading the image quality. The results were exported as TIFFs and JPEGs.

[6] Information about phosphor imaging plates from Waygate Technologies website: https://www.bakerhughes.com/waygate-technologies/industrial-radiography-and-ct/computed-digital-radiography-crdr/phosphor-imaging-plates

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Figure 6. MCI's Waygate MXR-320HP/11 x-ray tube with the Titan|neo x-ray generator in the background.



Figure 7. The Pegasus CR50P scanner used for scanning the imaging plates.



Figure 8. Sample placed on kim wipe on the imaging plate cassette for exposure to x-rays.

D- XRF Method (X-ray fluorescence spectroscopy)

X-ray fluorescence is a simple three-step process occurring at the atomic level. 1) An incoming x-ray knocks out an electron from one of the orbitals surrounding the nucleus within an atom of the material. 2) A hole is produced in the orbital, resulting in a high energy, unstable configuration for the atom. 3) In order to restore equilibrium, an electron from a higher energy, outer orbital falls into the hole. Since this is a lower energy position, the excess energy is emitted in the form of a fluorescent x-ray. The energy difference between the expelled and replacement electrons is characteristic of the element atom in which the fluorescence process is occurring. Thus, the energy of the emitted fluorescent x-ray is directly linked to a specific element being analyzed and is in general independent of the chemistry of the material. For example, this means that a calcium peak obtained from $CaCO_3$, CaO and $CaCl_2$ will be in exactly the same spectral position for all three materials.

Instrument:	Bruker Elio portable spectrometer
Tube:	Rhodium tube
Vacuum/Helium flush:	None
Excitation voltage:	40 kV
Current:	60 µA
Set up:	The spectrometer was equipped with a mapping head. Both sides of the sample were mapped and analyzed. The element identification, deconvolution, and quantification were performed using the Bruker Esprit software.

E- Scanning Electron Microscopy-Energy Dispersive X-ray Spectroscopy (SEM-EDS)

A sample of fibrous material was extracted and mounted on an aluminum stub with carbon double stick adhesive. The sample was carbon coated and scanning electron microscopy (SEM) was performed in high vacuum mode with a Hitachi S3700-N SEM. Electron Dispersive Spectroscopy (EDS) was performed using a Bruker XFlash 6|60 detector and equipped with the Esprit software. Samples were analyzed at approximately 10 mm working distance at 15 kV accelerating voltage. An EDS map was collected and a region of interest were extracted for normalized semi-quantification by phi-rho-z method. For lighter element and non-conducting oxides, such as ceramics, phi-rho-z method has been reported to calculate better quantification.[7]

F- Direct Analysis in Real Time-Mass Spectrometry (DART-MS)

DART[8] ionization is a method for ambient mass spectrometry in which materials are rapidly sampled at atmospheric conditions with little to no preparation. DART systems flow helium through a cell where an electrical discharge between a needle and disk electrodes produces a plasma of ions, electrons, and metastable ions (Figure 9). The plasma further flows through a heated cell and a grid at a set voltage to remove all charged species except for helium metastable ions. The reactive metastables exit the DART through a port in a ceramic cap and interact with both the sample itself and water in the ambient atmosphere. Analyte molecules are thermally desorbed off a sample surface, and the analyte (whether desorbed by the plasma plume or already in the gas phase) is ionized. The vacuum of the mass spectrometer itself or a supplemental vacuum pulls the ionized analyte into a ceramic transfer tube to the mass spectrometer ion optics for analysis.

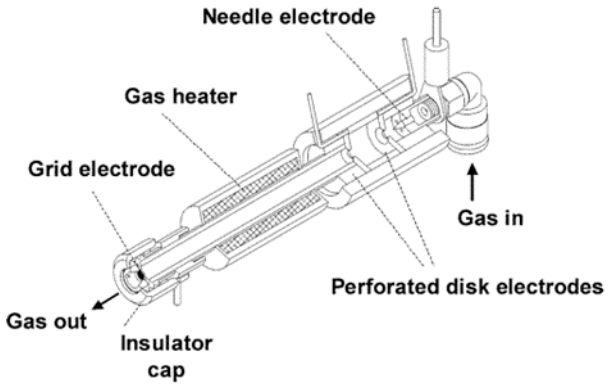


Figure 9. Diagram of DART optics. (Cody, R. B.; et. al. Anal. Chem. 2005, 77 (8), 2297-2302).

A DART-100 probe operated by an SVP controller (IonSense, Saugus, MA) was operated in transmission mode in front of an Orbitrap Elite mass spectrometer (Thermo Fisher Scientific, Waltham, MA) fitted with a differentially-pumped Vapur interface. The DART was custom-mounted from above with multi-dimensional translation stages attached to uprights at the base of the mass spectrometer. Sampling was performed by dipping a sealed glass capillary into the water in which the fragment was shipped, then mounting it between the DART and transfer tube inlet (Figure 10). The edges of the fragment were also

[7] Friel, J.J., Terborg, R., Langner, S., Salge, T., Rohde, M. and Berlin, J. (2017) X-Ray and Image Analysis in Electron Microscopy. 3rd ed.

[8] Cody, R. B.; Laramee, J. A.; Durst, H. D. Versatile new ion source for the analysis of materials in open air under ambient conditions. Analytical Chemistry 2005, 77 (8), 2297-2302. DOI: 10.1021/ac050152j.

exposed to the DART stream by hand-manipulating the piece (Figure 11). All DART analysis was performed at 300 °C helium temperature setting. MS data was acquired at 120,000 nominal resolving power in the Orbitrap. Accurate mass measurements were calibrated against positive mode tune mix (Ultramark and caffeine) as well as common, known background phthalate masses.

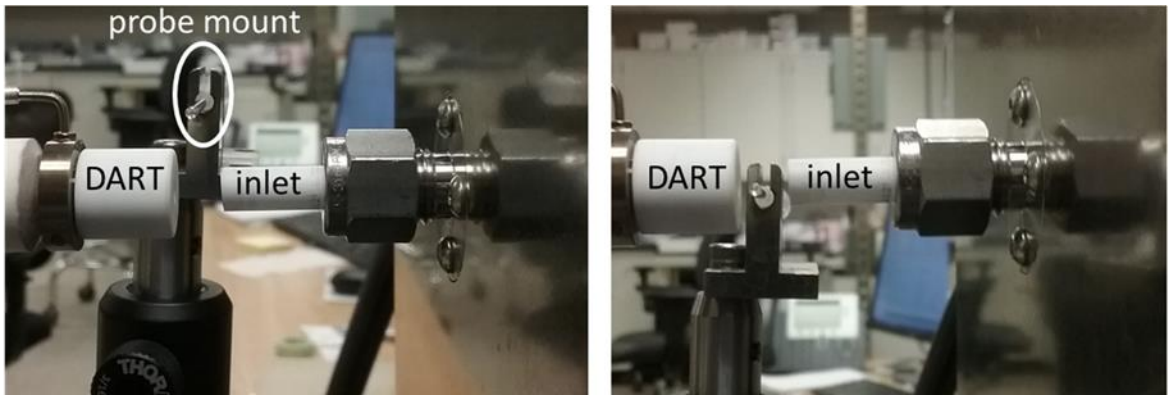


Figure 10. Capillary probe mounted before (left) and during DART analysis (right).

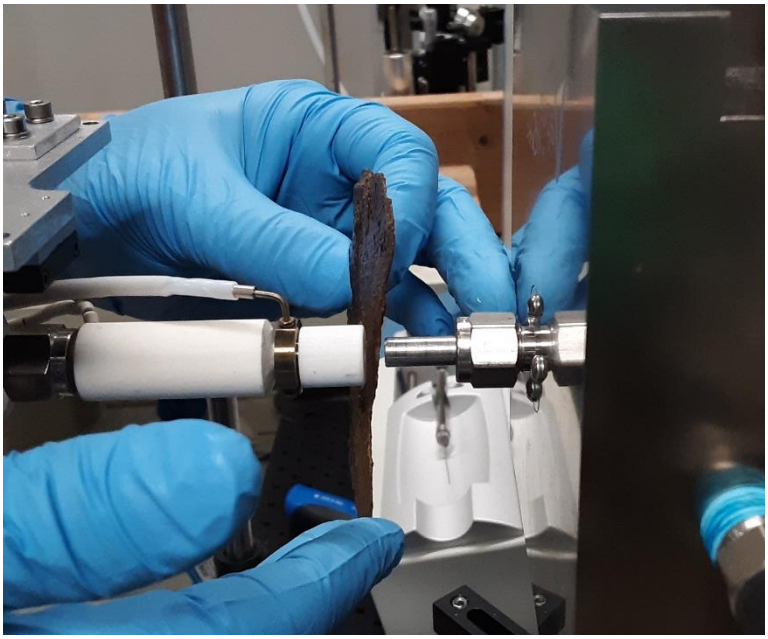


Figure 11. Clotilda fragment manipulated for DART.

<u>G- Non-proximate desorption photoionization (NPDPI) mass spectrometry (MS)</u>

NPDPI is a recently developed method[9] that allows the central surfaces of intact objects to be analyzed. Instead of desorbing sample with a continuous stream of heated ionizing gas, NPDPI allows an

[9] Newsome, G. A.; Martin, K. M. Non-proximate Sampling and Photoionization for Damage-Free Mass Spectrometric Analysis of Intact Native American Baskets. Analytical Chemistry 2023, 95 (28), 10695-10702. DOI: 10.1021/acs.analchem.3c01468.

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object to be positioned at rest before exposure to a brief pulse of heated neutral gas. Desorbed material is then moved through a meter-plus long transfer line to a photoionization lamp in from on the mass spectrometer. To analyze different surfaces on the *Clotilda* fragment, the dried piece was positioned on a clean surface below a free-standing nitrogen jet probe (Figure 12). Sampling was done with the gas at 175 °C for three seconds. Desorbed material entered a 180 °C, SilcoNert-coated, 2 m long stainless steel transport line. Anisole dopant was added to the analyte/air mixture in transit by an in-line permeation tube to aid the ionization. Analyte was conducted past a krypton vacuum ultraviolet lamp for photoionization at the entrance to the differentially-pumped inlet to the Orbitrap Elite mass spectrometer.

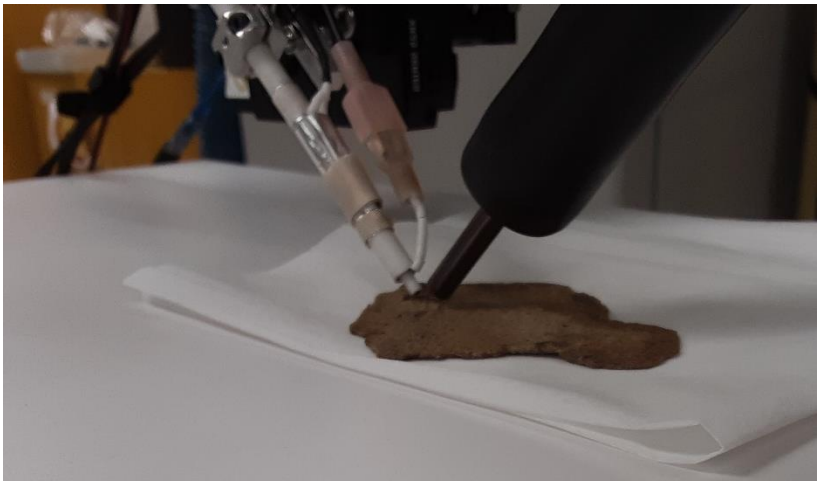


Figure 12. Clotilda fragment positioned for NPDPI.

H- Attenuated Total Reflectance-Fourrier Transform Infrared (ATR-FTIR) Spectroscopy

The bonds between the elements in a molecule absorb energy as they vibrate and rotate. Organic and organometallic molecules absorb energy in the form of infrared light in the mid-infrared region (wavelengths from 2.5-20 µm, frequencies between 4000-650 cm^{-1}). Each bond will often have many infrared peaks, giving a complex infrared spectrum. Often the infrared spectrum of an unknown sample can be matched to known reference materials. If the sample spectrum is not a good match for a reference spectrum, some of the peaks in the infrared spectrum may be assigned to a general class of material. Peaks can be described by their position (cm^{-1} or wavenumber), shape (broad or sharp) and relative intensity (weak, medium or strong) in the spectrum.

Two measurement methods are generally used at MCI for infrared analysis, attenuated total reflection (ATR-FTIR) or transmission through an infrared microscope (µ-FTIR). For this study, only the ATR-FTIR method was used. For more background on infrared spectroscopy please see Infrared Spectroscopy in Conservation Science.[10]

ATR-FTIR Method (Attenuated Total Reflectance)

Instrument: Thermo Nicolet iS-50 Fourier transform infrared (FTIR) spectrometer
Sampling accessory: Golden Gate ATR with diamond crystal, single bounce, 45º
Detector: DTGS

[10] Michele R. Derrick, Dusan Stulik, and James M. Landry, Infrared Spectroscopy in Conservation Science (Los Angeles: Getty Conservation Institute, 1999).

Correction: ATR corrected
Resolution: 4 cm^{-1}
Number of scans: 64

A fibrous sample from the *Clotilda* fragment was placed directly on the diamond crystal of the ATR accessory. A piece of aluminum foil was used to back the sapphire anvil to eliminate any sapphire absorption in the IR spectrum. FTIR spectra were identified using the IRUG (Infrared and Raman Users Group) libraries, the HR Hummel Polymer and Additives library as well as the ASTER mineral library.

Results and Discussion

The fragment was kept in water as long as possible and then air-dryed to allow analysis to pursue. Imaging (multimodal imaging, radiography, and RTI) was carried out first and results are as follows.

From the RTI, the specular enhancement and normal visualization views emphasize a textile-like pattern of what we will refer as side 1 (Figure 13). Moving the light source in the RTI viewer may highlight different aspects of the pattern.[11]

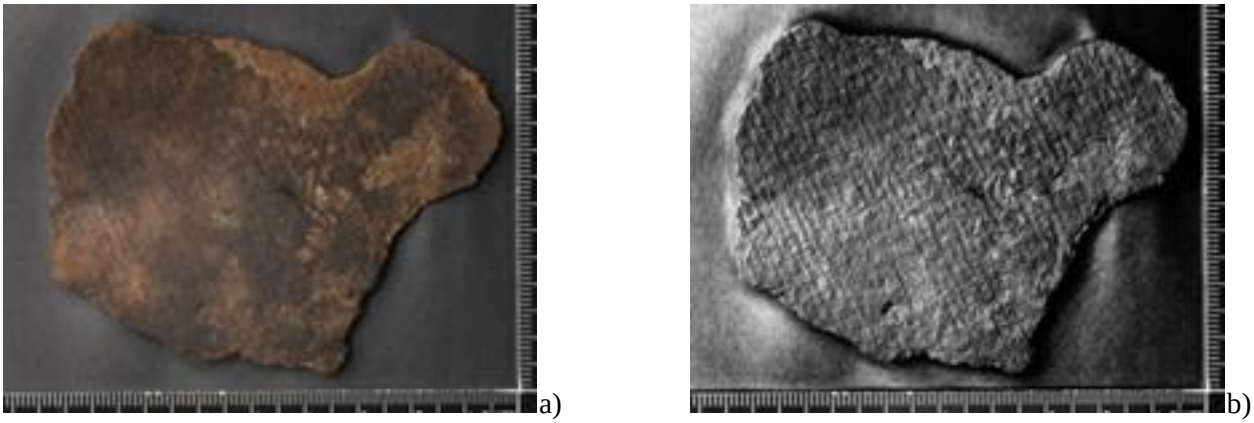

a) b)

Figure 13. Default view (a) and Specular Enhancement View (b) from RTI of side 1 from Clotilda fragment.

Further investigation zoomed into specific areas using the specular enhancement view (where, for example, there may be indication of material or fiber) is not particularly helpful because of the amount of surface detail that is getting emphasized. Similarly, looking at an area that may show layering, the specular enhancement view is emphasizing a lot of surface information making it more challenging to interpret and draw any further conclusion from it. On the other hand, RTI of side 2 does not show the repetitive pattern of side 1 and highlights a surface with more landscape but no pattern.

Multimodal imaging was also applied to the *Clotilda* fragment. The different imaging modalities (visible light, reflected infrared, UV-induced luminescence or UVL, and reflected UV or RUV) applied to both sides of the fragment offer slightly different views though it is not clear that any of the modalities offer any additional constructive insight about the material-(s), though it may help inform sampling or location of additional analysis. For example, on side 1, there is very weak yellow-orange luminescence in the UVL image that are circular areas (showing slightly lighter gray in the RUV image) that may be potential areas of interest for further analysis.

[11] See full imaging results in attachment.

Radiography was conducted as well but did not provide any additional information.

Following imaging, another non-invasive technique was applied, portable x-ray fluorescence spectroscopy, to identify the elemental signature of the fragment focusing on the side 1 as identified during the imaging. Figure 14 shows the region from side 1 of the fragment mapped by pXRF, where iron appears to dominate on the surface which could explain its color. The overall elements detected are Al, Si, P, S, K, Ca, Ti, Cr, Mn, Fe, Ni, Cu, Zn and As.

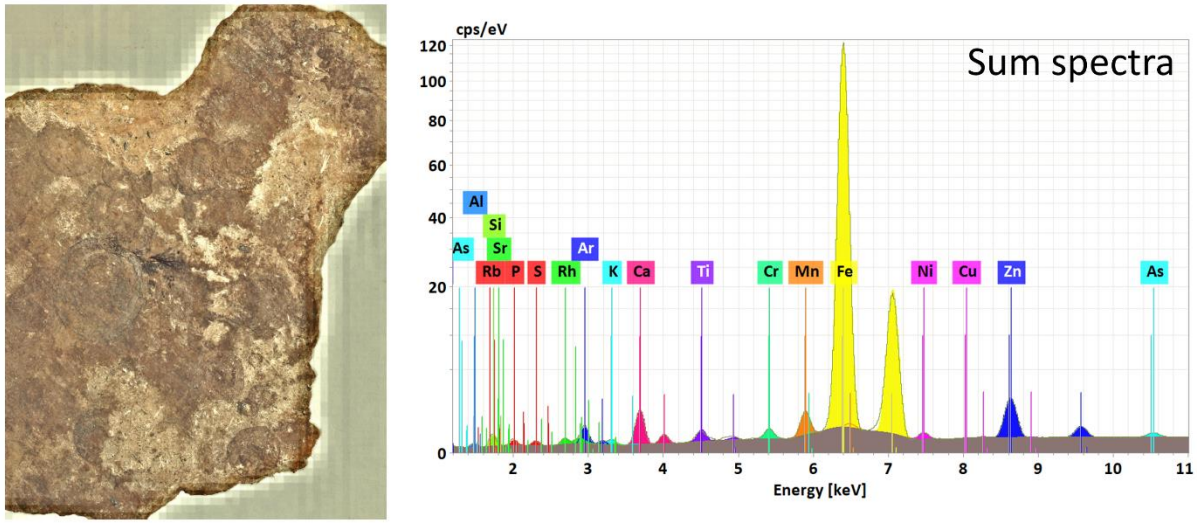


Figure 14. Optical stitched image of the pXRF mapped region (dimensions of 5.2 cm by 7.0 cm at 1 mm pixel resolution) (left). EDS sum spectra from the pXRF map (right).

Figure 15 represents an example of a composite pXRF map from the same region of the fragment: S (in red), Si (in green), and Mn (in blue) are highlighted. The spectra from the high S areas in red, high Mn areas in blue, and high Si areas in green were all extracted and plotted for comparison. For the high Mn region, P, Ca, Fe were also in higher concentrations.

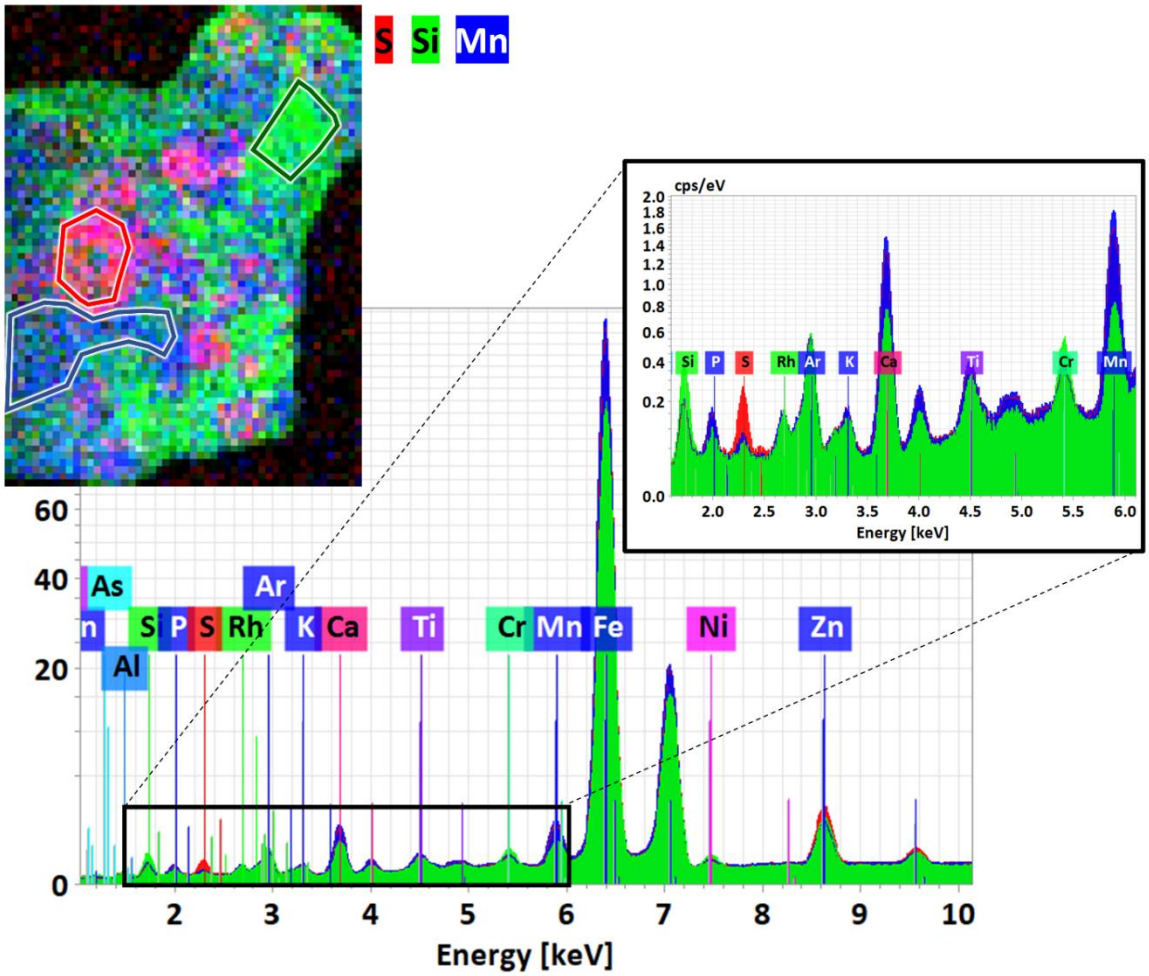


Figure 15. pXRF composite map (dimensions of 5.2 cm by 7.0 cm at 1 mm pixel resolution) with the corresponding regions with the extracted spectra.

The spectroscopic technique was applied to the luminescence regions identified using the UVL modality in imaging. Figure 16 represents these luminescent regions and associated heat maps that appears to correlate with an increase in S and Zn. The iron concentration throughout the sample is relatively constant. Higher Si regions appear to correlate with the lighter brown regions and may be part of the matrix or core of the fragment while Mn correlates with the darker brown regions of side 1 on the surface.

Figure 17 shows additional pXRF elemental heat maps of different elements (K, P, Ti, Cr, and As) emphasizing their distribution on the fragment.

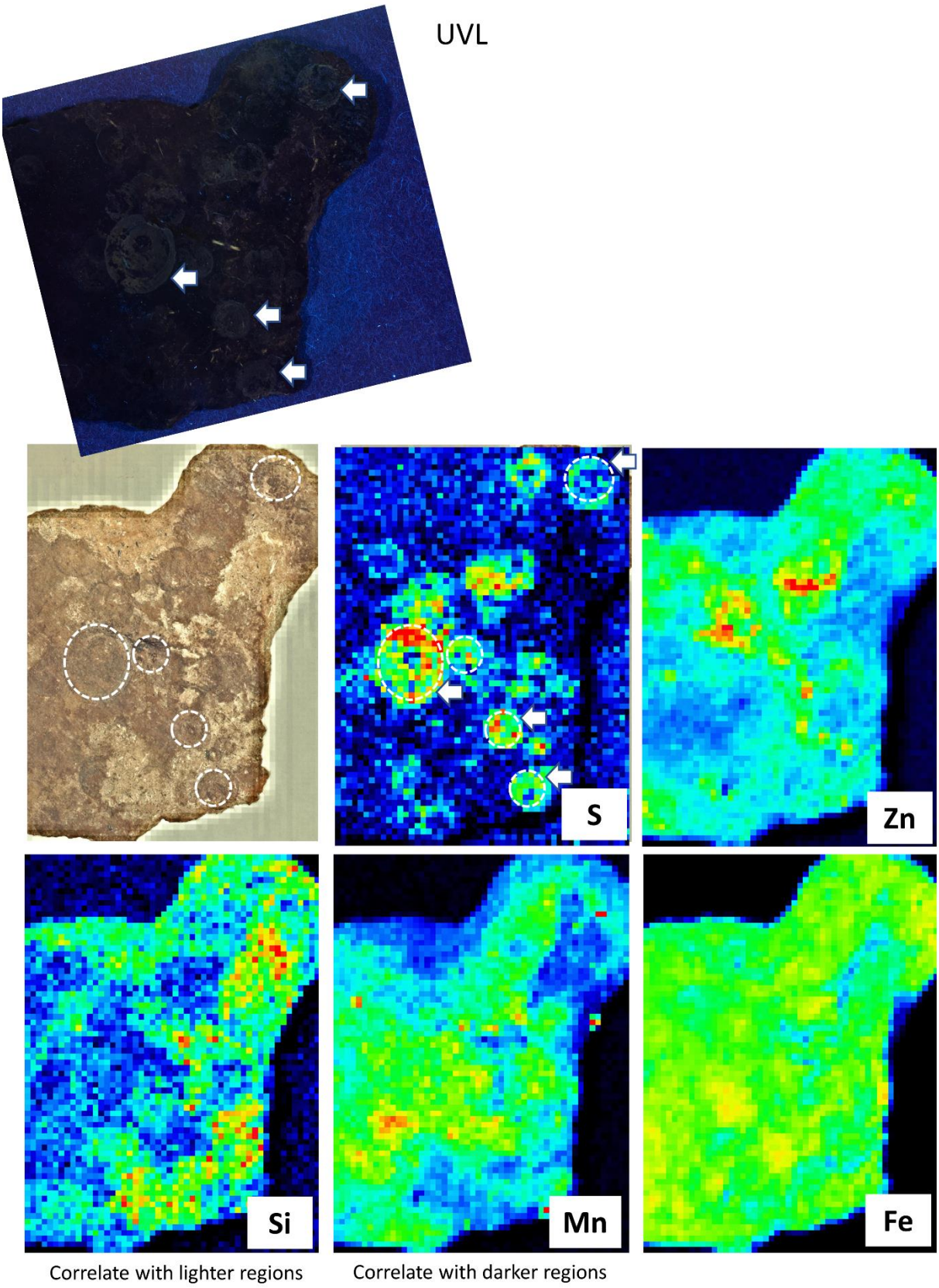


Figure 16. Correlation of UVL signal with pXRF element heat maps (blue, lowest- red, highest) and other higher signal pXRF.

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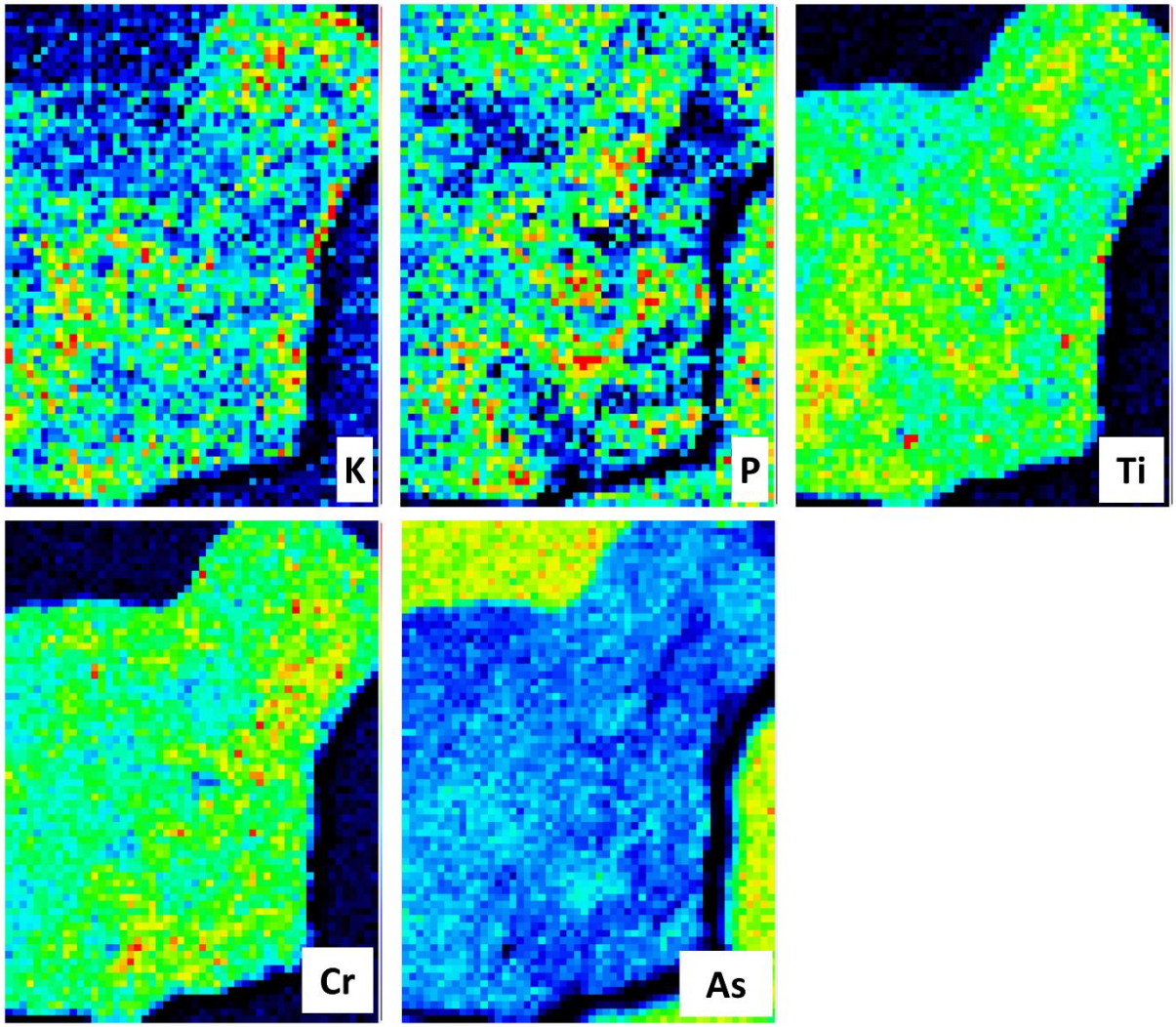


Figure 17. Additional pXRF element heat maps (blue, lowest- red, highest) with weaker signal.

A fiber sample from the Clotilda fragment (side 1) was analyzed by FTIR spectroscopy. The spectrum obtained (Figure 18) highlights spectroscopic features, i.e. OH stretching (3681 and 3640 cm^{-1}) and Si-O stretching (1069 and 943 cm^{-1}) vibrations as well as the Mg-OH band at 605 cm^{-1}, that may be associated with the presence of chrysotile, a fibrous variety of serpentine with the chemical formula $Mg_3Si_2O_5(OH)_4$ also known as asbestos (an hazardous chemical). The elements identified above by pXRF could be due to minerals that are frequently associated with chrysotile such as magnetite ($Fe^{2+}Fe_2^{3+}O_4$), chromite ($FeCr_2O_4$), brucite ($Mg(OH)_2$), calcite ($CaCO_3$), dolomite ($CaMg(CO_3)_2$), and awaruite (Ni_2Fe to Ni_3Fe). [12]

[12] M. Ristić, I. Czakó-Nagy, S. Musić, A. Vértes, Spectroscopic characterization of chrysotile asbestos from different regions, Journal of Molecular Structure, Volume 993, Issues 1–3, 2011, 120-126. https://doi.org/10.1016/j.molstruc.2010.10.005

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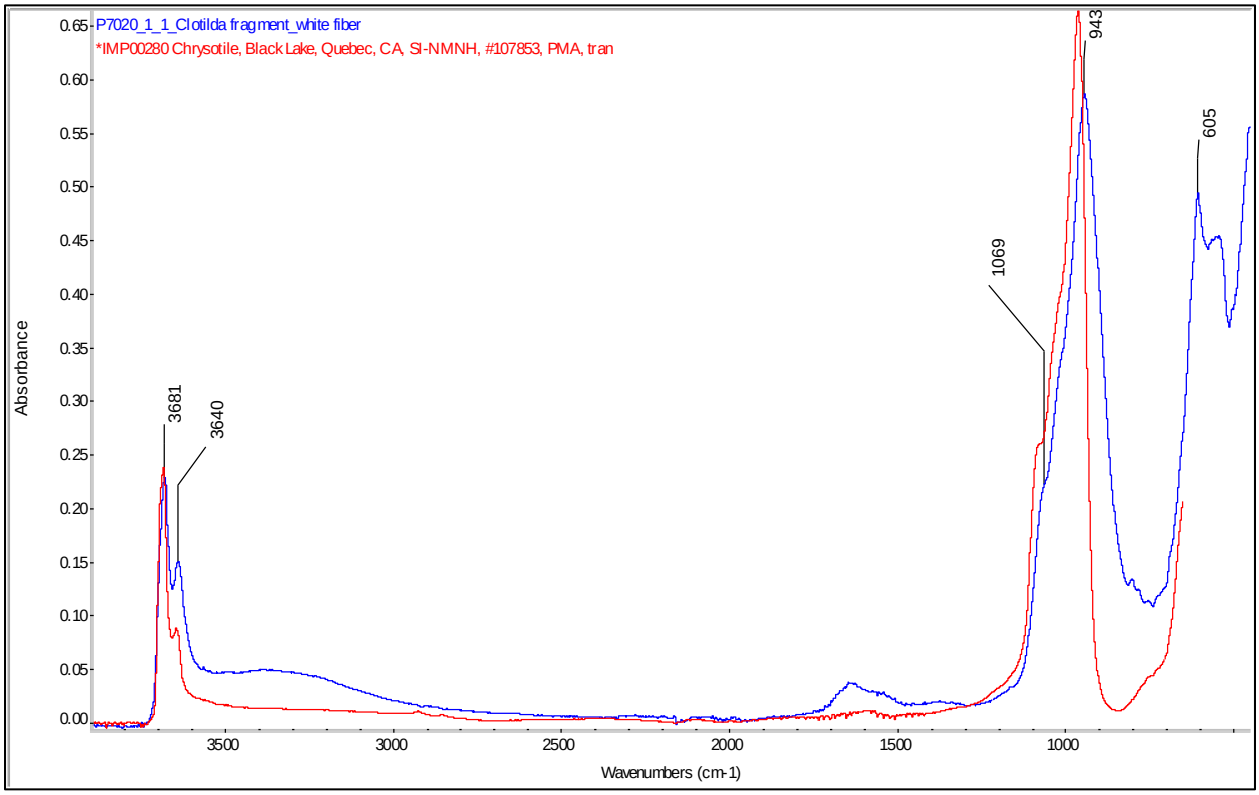


Figure 18. Overlay of the FTIR spectra of a fiber from the Clotilda fragment (blue) with the reference sample of chrysotile (red).

In order to confirm the fiber identification from the FTIR analysis, additional elemental analysis were carried out. Figure 19 illustrates the corresponding SEM-EDS data. Backscattered electron (BSE) image shows numerous fibers and fiber-like bundles, with fibers measuring down to 222 nm (with mainly fibers likely < 222 nm). When the fibrous material are bundled, Mg, Si, and O are all observed in the same locations from the EDS maps. An extracted EDS spectrum from selected region in the BSE image, confirms the major elements as Mg, Si, and O with minor elements of Al, P, and Fe. The semi-quantitative analysis in atomic % shows slightly higher Mg than Si and the O/Si ratio was calculated to be 4.59, which would be consistent with the 9 O to 2 Si ratio reported for the chrysotile mineral with the chemical formula $Mg_3Si_2O_5(OH)_4$.

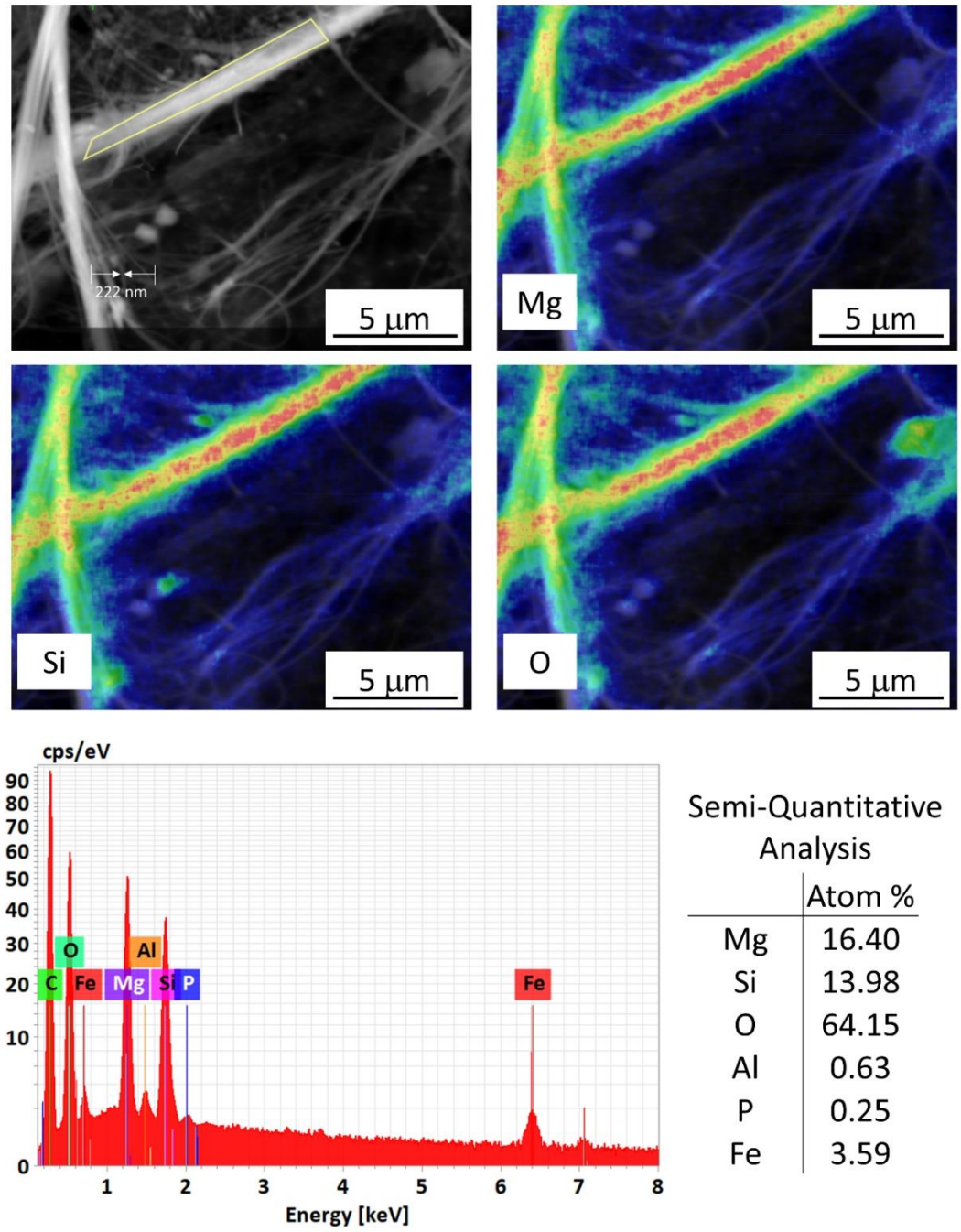


Figure 19. BSE image (top left). SEM-EDS Mg heat map blue (lowest- red, highest) (top right). SEM-EDS Si heat map blue (lowest- red, highest) (center left). SEM-EDS O heat map blue (lowest- red, highest) (center right). Extracted EDS spectrum from BSE image (bottom left). Semi-quantitative EDS calculation (bottom right).

Finally ambient mass spectrometric techniques were applied to identify any organic material present on the fragment. Both DART and NPDPI-MS analyses produced protonated molecule signal. Neither the edges of the *Clotilda* fragment, or any of the several central surfaces or rings on the fragment produced a signal above background levels that could be related to analytically useful information pertaining to the presence of an organic material. Similar results were obtained from the packing water (sampled by probe) that was

also tested in case any organic material would have leached out from the fragment. The only large spectral signal in any of the experiments came from an isomer of oleamide at *m/z* 282, $C_{18}H_{35}NO$ (Figure 20). The signal came from one of the fragment perimeter analyses collected as the object was rotated by hand, but the chemical formula is so common as to have no analytical meaning.

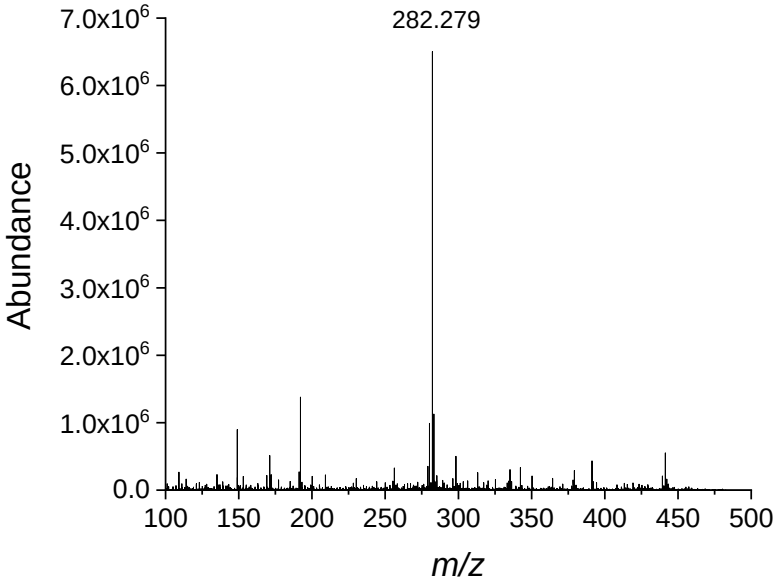


Figure 20. Selected DART MS spectrum of Clotilda fragment.

Conclusion

Archaeological investigation activities on the nineteenth century Clotilda shipwreck site in Mobile River, Alabama (U.S.A.) recovered a fragment that was sent to MCI for materials identification (more specifically fiber and possible organic matter).

Analysis revealed that what felt like 'wet cardboard' to the divers during recovery is indeed a fragment made of phyllosilicate fibers, in particular chrysotile (a form of asbestos and hazardous material) as identified by FTIR analysis and confirmed by SEM-EDS analysis and the presence of fibrous magnesium silicate mineral. Imaging techniques emphasized what could be a textile-like pattern on one of the sides of the fragment, without providing more specific characterization. Elemental analyses by pXRF highlighted a surface rich in iron that could explain the brown color of the fragment. More luminescent areas as identified by UV imaging contain higher amounts of zinc and sulfur. No organic material could be detected neither on the fragment or in the water in which the sample was received. The latter was also tested in case any potential organic material present would have leached out.

Following these findings, recommendations are made to work with OSHEM (Office of Safety, Health, and Environmental Management) and OSHA (Occupational Safety and Health Administration) on protocols for safe handling of objects containing asbestos.

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