

MITIGATING THE IMPACT OF HURRICANE HELENE ON SHELL MOUND (8LV42), LEVY COUNTY, FLORIDA



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Department of Anthropology
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Gainesville, FL 32611

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Cover illustration: mass wasting of the south ridge of Shell Mound (8LV42) from the storm surge of Hurricane Helene. Photo by senior author dated November 2, 2024.

MANAGEMENT SUMMARY

Personnel of the Laboratory of Southeastern Archaeology (LSA), Department of Anthropology, University of Florida conducted limited salvage investigations and stabilization to a portion of Shell Mound (8LV42) that was adversely impacted by the storm surge of Hurricane Helene in September 2024. Located on the Lower Suwannee National Wildlife Refuge on the northern Gulf Coast of Florida, Shell Mound has been the subject of LSA investigations under ARPA permits (LSUWNWR021612, LSCKNWR022113, LSCKNWR 060614, and LSCKNWR060315) with U.S. Fish and Wildlife Service (USFWS) since 2012 (Sassaman et al. 2013, 2015, 2019), the results of which have been parlayed into interpretative panels along a walking trail frequented by refuge visitors. Damage to Shell Mound in 2023 from Hurricane Idalia revealed that its greatest vulnerability to storm surge is along escarpments created by a road encircling the site, where near-vertical profiles were undercut and collapsed. Although the southwest margin of Shell Mound has been protected from vehicle traffic and further grading since the road was constructed decades ago, storm surge from Hurricane Helene undercut its tallest profile (~3 m tall) at a place where the walking trail crosses the apex of the south ridge, rendering vulnerable the profile to further collapse and introducing risk to the visiting public.

Mitigative salvage excavations by LSA in January 2025 under ARPA Permit LSNWR012025 consisted of profile facing of the escarpment of the south ridge coupled with stratigraphic excavation below the extant scree surface in an effort to document the tallest profile of Shell Mound to date. Although the base of the south ridge was not reached by excavation and augering, nearly 4 m of profile was exposed, documented, and sampled. Eight new AMS age estimates on charcoal from strata of the profile corroborate what the LSA learned from testing at other places along the south ridge: the ridge consists of extant midden that was mined and displaced from other locations at the site, presumably the north ridge, where evidence for summer solstice feasts abounds. However, salvage work also revealed that this portion of the south ridge encases a conical mound, possibly a house mound, that was later capped with extant midden. Comparisons of the artifacts, shell, and animal bone from salvage excavations of the south ridge with that recovered from testing of the north ridge provide tentative support for the hypothesis that the south ridge indeed started as a series of “midden-mounds” arranged in an arc to enclose a plaza that was occupied during the last half-century of the site’s occupational span, ca. AD 600–650.

Recommendations for additional salvage operations are informed by LiDAR surveys taken before and after Hurricane Helene to quantify both erosion and deposition and to develop a tool for ranking vulnerability to future storms. Applying this model to locations of Shell Mound with potential to expand knowledge of the site’s history and significance promises to provide the most effective tool for mitigating the inevitable damage of future hurricanes.

ACKNOWLEDGMENTS

Salvage excavations at Shell Mound (8LV42) in January 2025 were conducted under Archaeological Resources Protection Act Permit LSNWR012025 issued by Richard Kanaski, Regional Archaeologist and Regional Historic Preservation Officer, and Haley Messer, Archaeologist, U.S. Fish and Wildlife Service (USFWS), Southeast Region. Former Refuge Manager Andrew Gude and current Refuge Manager John Stark lent their support to all aspects of the project, for which we are grateful. The long-term partnership between USFWS and the Laboratory of Southeastern Archaeology (LSA), University of Florida, has been rewarding and productive.

Field crew for the January 2025 expedition consisted of Lukas Desjardins, Koda Lacey, Lennon Myers, Ginessa Mahar, Mike Halderson, Sawyer Jackson, Forrest Meyers, Rafael Peré, and Jack Pearce. John Stark and his Refuge staff arranged to stabilize the eroded escarpment upon completion of the excavation. The LSA crew appreciated their heavy equipment and skill in using it.

Kate Hughes conducted most of the lab work, notably cataloging the entire collection and taking a deep dive into the pottery assemblages. Ana Valdarrama Lemus sorted the bulk samples and did allometry on mullet verts reported in Chapter 4. Natalie Davis provided additional vertebrate analysis that is included in that same chapter.

Lukas Desjardins authored the entirety of Chapter 5, which showcases his original effort in quantifying the effects of storm surge on Shell Mound and from that developing a vulnerability model that holds promise for prioritizing proactive mitigation.

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CHAPTER 1

OVERVIEW AND PROJECT DESIGN

The northern Gulf coast of Florida has been and will continue to be impacted by tropical storms that alter the configuration of shorelines in a matter of hours. In recent years, hurricanes crossing the Lower Suwannee and Cedar Keys National Wildlife Refuges have overstepped land, eroded beaches, and accelerated mass wasting by toppling trees and undercutting escarpments. Many archaeological sites have been impacted, places occupied by Indigenous people over millennia of storms and sea-level changes that affected the inhabitability of coastal locations (Sassaman et al. 2017). If not obliterated by the erosion of rising sea and storm surge, sites of coastal settlement predating 5,000 years ago are now fully underwater (Newton 2025). Archaeological traces of more recent settlements are currently subject to erosion and inundation; many will disappear in coming decades as the severity and frequency of impactful storms intensify with rising sea (see Anderson et al. 2017 for a regional projection of site loss from rising sea alone).

One such place in the Lower Suwannee National Wildlife Refuge is Shell Mound (8LV42), a civic-ceremonial center dating to the first half of the first millennium CE. Recent storm surges have eroded its flanks, where a circumferential road built in the 1970s created escarpments prone to undercutting. In its current form, Shell Mound is a U-shaped ridge of mostly oyster shell measuring roughly 190 x 180 m in plan, and nearly 7 m tall (Figure 1-1). A 60 x 70-m central area largely devoid of shell is open to the southeast, where the remnant of a 2-m-tall sand-and-shell mound measuring 10 x 20 m in plan is located. The site lies at the southwest end of a 2-km-long peninsula that is the relict arm of a massive parabolic dune. Work by the Laboratory of Southeastern Archaeology (LSA) since 2012 has established that Shell Mound took shape between 400 and 650 CE, when regional communities gathered on summer solstices for ritual feasting (Sassaman et al. 2019, 2020). Earlier components of the site documented in limited testing include a Deptford period occupation dating to ~200 CE and a Late Archaic occupation dating to ca. 2400–2200 BCE. The archaeology of Shell Mound is featured in signage along a walking trail that is open to the public.

Shell Mound was impacted by Hurricane Idalia on August 30, 2023 and by Hurricane Helene on September 26, 2024. Idalia revealed that Shell Mound's greatest vulnerability to storm surge is along escarpments paralleling the encircling road and footpath (Figure 1-2), where near-vertical profiles are undercut and collapse (Sassaman 2023). Although the southwest margin of Shell Mound has been protected from vehicle traffic and further grading since the road was built decades ago, storm surge from Hurricane Helene undercut its tallest profile (~3 m tall) at a place where the walking trail crosses the apex of the mound, subjecting the profile to further collapse and introducing risk to the visiting public.

Reported here are the results of an effort to stabilize the eroded escarpment with aggregate and before that “face” it with a 2 x 2-m excavation unit that extended below the mound to basal sands, where evidence of Deptford and Late Archaic components has been observed. Although the latter goal was not fully achieved, the LSA crew was able to expose 3.8 m of profile at the center of mass wasting, the upper half on the escarpment proper, the

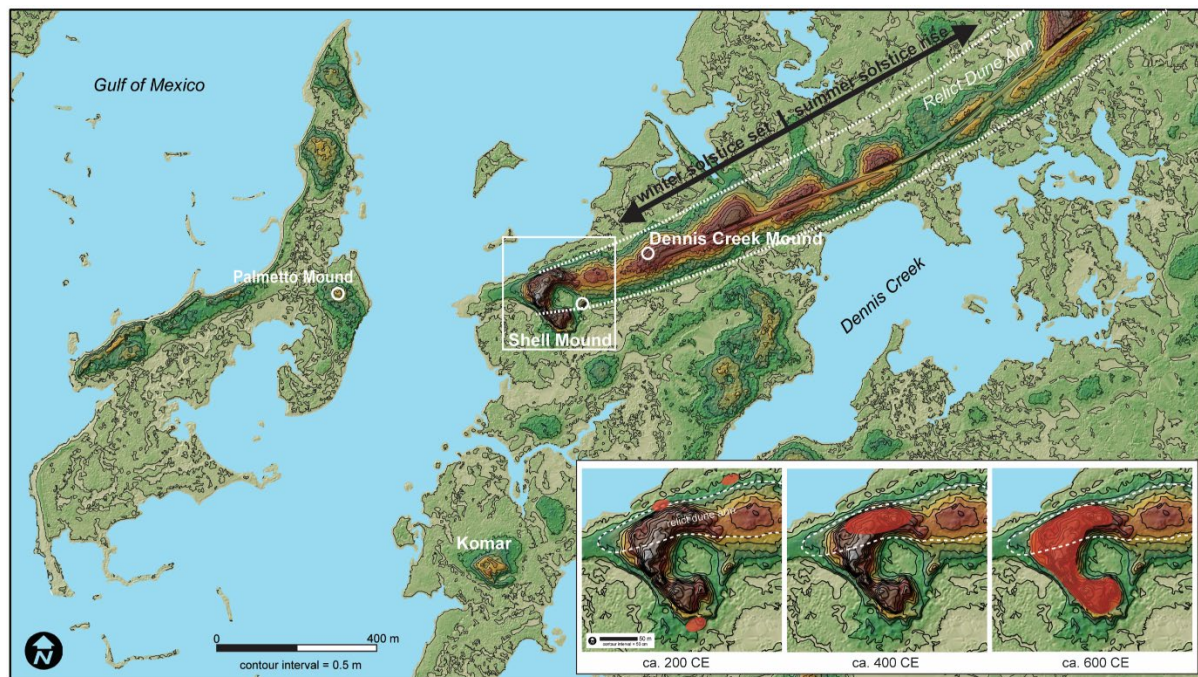


Figure 1-1. Topographic map of area surrounding Shell Mound (8LV42) and related sites, notably three mortuary mounds, each marked by open white circles. Note relief and solstice orientation of relict dune arm on which Shell Mound sits. Inset maps to the bottom right highlight in red a ~450-year sequence of occupation starting with ephemeral use of landform at low elevation at 200 CE, followed by occupation of the dune arm and pit digging after 400 CE, and terraforming of the south ridge by 600 CE. Shell Mound was abandoned as a place of gathering and terraforming ca. 650 CE.

lower half below the base of the escarpment. Revealed in augers beyond the depth of our excavation was another 2 m of shell deposits.

As a matter of circumstance, the escarpment undercut by the storm surge of Helene is in a location the LSA has never before tested. Excavations to date have been widely dispersed across the site in an effort to parse out its various components. Some locations have been avoided for obvious reasons, such as the apex of the ridge where visitors often pass and some linger. The damage wrought by Helene thus presented an opportunity to add to our inventory of stratified samples and deep profiles. The results confirm what we observed earlier: the south ridge of Shell Mound was constructed, at least in part, from extant shell deposits, presumably taken from the north ridge. Eight new AMS assays on charcoal add to an established record of reverse stratigraphy. But the results also lead us to the hypothesis that the south ridge started as a series of conical mounds, at least four, maybe five. Beyond repurposed fill from the north ridge, the matrix of conical mounds may include primary deposition. Ultimately, excavation ahead of stabilization enhanced our knowledge of the history of terraforming at Shell Mound and thereby validated the effort to collect data from deposits eroded by storm events. Shell Mound has many more lessons to share and is thus worth protecting for as long as possible.

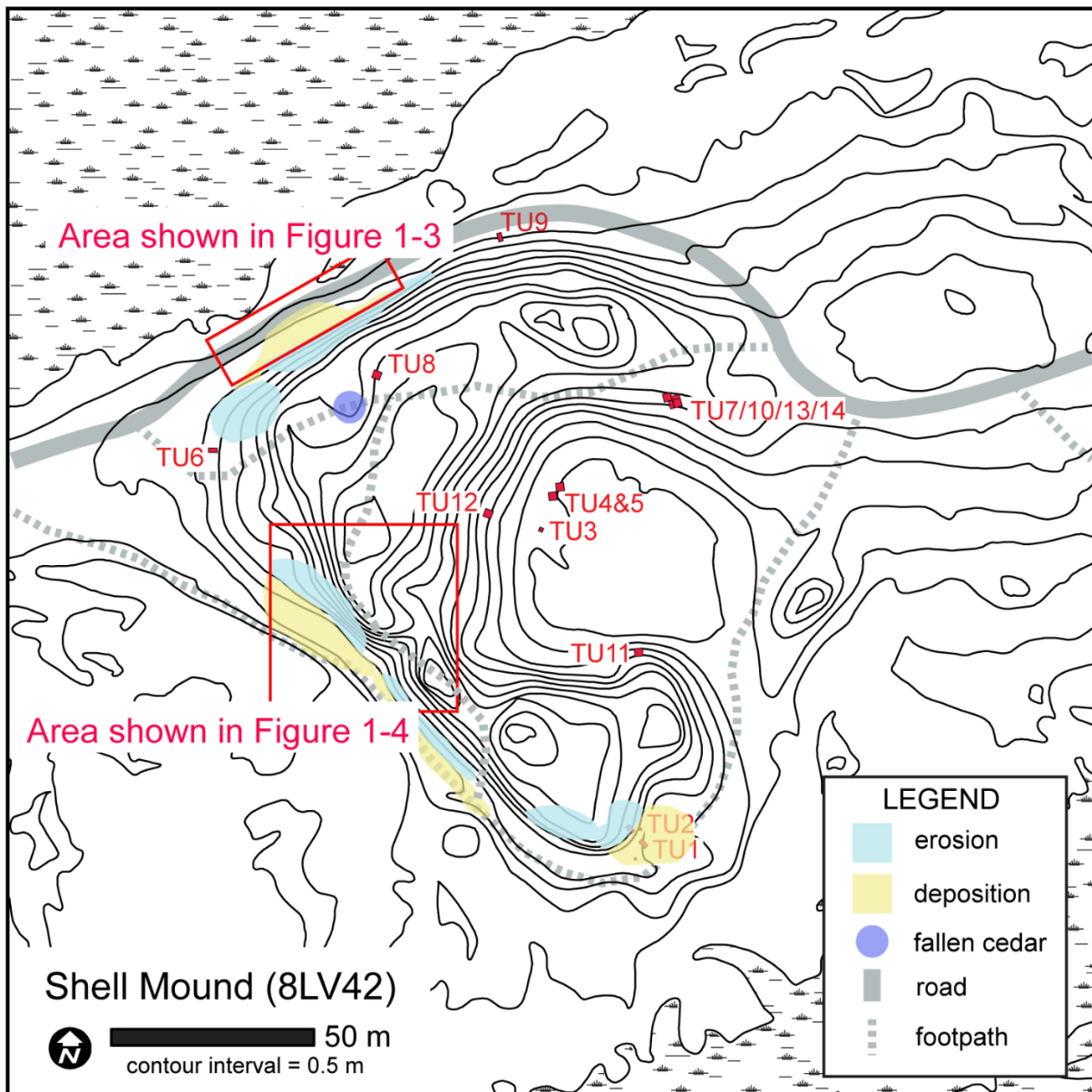


Figure 1-2. Topographic map of Shell Mound (8LV42) showing approximate areas of erosion and deposition from the storm surge of Hurricane Helene, September 26, 2024, and the locations of test units (TUs) excavated by Laboratory of Southeastern Archaeology, University of Florida, 2012–2015.

PROJECT DESIGN

The decision to focus mitigation efforts on the eroded escarpment of the south ridge was informed by pedestrian survey of storm-surge damage to Shell Mound by the senior author on November 2, 2024, a little over a month after Hurricane Helene made landfall. As we observed in the aftermath of Hurricane Idalia, the erosion of storm surge from Helene was concentrated in places where the relief of mounded shell was truncated by a road cut. This was evident on the drive into the site, where the access road skirts the north ridge of Shell Mound.

Although the escarpment of this road cut is less than a meter tall in most places, undercutting surge scoured the substrate and redeposited shell along a ~30-m length of the road (Figure 1-3). Much of the displaced shell formed an apron of scree-like deposition that extended a meter or more into the south margin of the road. In places where the escarpment was not covered by scree deposits, undercutting extended several meters into the escarpment. Holding together the overlying surface layer in many places of undercutting were the roots of trees, all vulnerable to toppling for lack of substrate.

Unlike the impact of its 2023 predecessor, Hurricane Helene was especially damaging to the south ridge of Shell Mound. Although vehicle and even walking access is restricted along the “footpath” paralleling the south ridge, the pre-refuge, unauthorized modification of Shell Mound by a private citizen in the 1970s involved road grading with a bulldozer. The resulting cut along the lower margins of the deposits contributed to its vulnerability to storm surge, and Hurricane Helene revealed just how vulnerable it is.



Figure 1-3. View facing southwest along access road showing redeposited shell apron (left) over a 30-m stretch of eroded escarpment. Photo by senior author, November 2, 2024.

Shown at the top of Figure 1-4 is a photograph facing northeast of severe erosion at Shell Mound, near the apex at the junction between the south and north ridges. It is hard to judge from this photograph how much of this profile was lost to Hurricane Helene, and how much was redeposited in the foreground of this photo. Fortunately, LiDAR data collected before and after the storm enable us to quantify both erosion and redeposition, as Lukas Desjardins reports in Chapter 5. These data also offer perspective on vulnerability going forward. Desjardins' analysis confirms that this part of the site sustained the most damage and remains prone to future damage due to the sharp relief and height of its escarpment.

Although Shell Mound will never be fully protected from storm surge and is not likely to survive a 50-cm rise in sea level, stabilizing the eroded escarpment of the south ridge is necessary if public access to the site remains a priority for USFWS. In addition, because this portion of the site has not yet been tested in the modern era, gathering information on the stratigraphy, chronology, and content of the apex of the south ridge is warranted in the process of stabilizing the escarpment. This portion of the south ridge potentially encases the most comprehensive stratigraphic sequence of Shell Mound to date, notwithstanding the sounding reported by Bullen and Dolen (1960), which never reached the base of the mound and was not sampled in a way that is conducive to modern analysis, including radiometric dating.

One means of salvaging stratigraphic data from any eroded escarpment is by "facing" the existing profile, a method that takes advantage of the exposure with limited new excavation. The LSA proposed to face a 2-m-wide section of the south ridge profile, the approximate location of which is shown in Figure 1-4. This process starts at the top of the profile to establish a vertical cut then proceeds down into intact matrix at the base of the escarpment, which is removed by level (10 to 20 cm, depending on thickness and consistency of strata) within strata, much like any stratigraphic excavation.

We failed to reach the base of the shell ridge through standard excavation. However, we were able to determine its depth by augering through another ~2 m of shell deposits in the excavation unit and in a shovel test 12 m downslope, at the edge of saltmarsh and the high-tide line. Adding the depth of substrate to the shell ridge elevation puts the total height of the ridge at ~ 6 m.

Besides the stratigraphic data provided by deep, intact profiles, the salvage effort produced assemblages of artifacts, vertebrate fauna, and charcoal that contribute to the ongoing effort to narrate the history of Shell Mound in increasingly finer detail.

The ultimate goal of this project was to stabilize the eroded escarpment of the south ridge. Thus, after salvage excavations were complete, USFWS staff delivered to the site a load of limerock in clayey matrix to shore up the profile. Together with displaced oyster shell of the scree slope fronting the escarpment, limerock was emplaced at the base of the profile with a front-end loader and allowed to establish its angle of repose. This stopgap measure will prevent further collapse of the profile and enable visitors to use the trail at the top with little risk. It will also blunt the energy of future storm surges, as Desjardins (2026) documents, by reducing the slope from ~90 degrees to ~35 degrees. It will not, however, eliminate the impact of hurricanes in the long term if sea level continues to rise, which it is expected to do for the

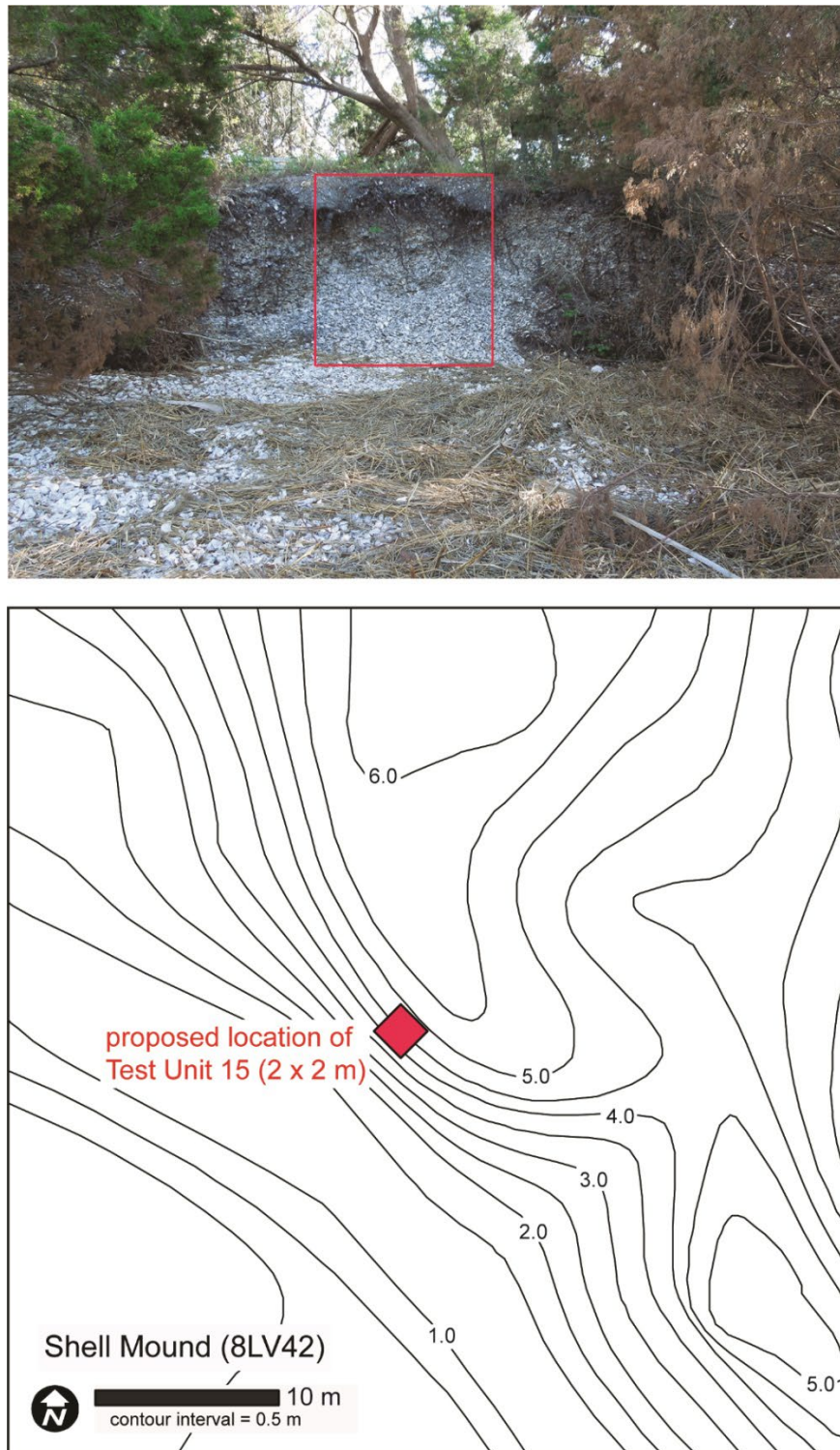


Figure 1-4. Photograph facing northeast (top) of the eroded profile of Shell Mound along the south ridge, and the location (bottom) of a proposed 2 x 2-m unit for profile facing and stratigraphic excavation of lower strata.

foreseeable future. Targeted salvage excavations like those reported here may be the only option to mitigate the inevitable damage of future storms.

The value of data collected from salvage excavations is expressed most directly through comparisons with data from prior testing of Shell Mound, which has been distributed widely across the site. Test units into the south ridge (TUs 1, 2, and 11) show that this portion of the mound to be fully anthropogenic and evidently constructed from shell midden mined from

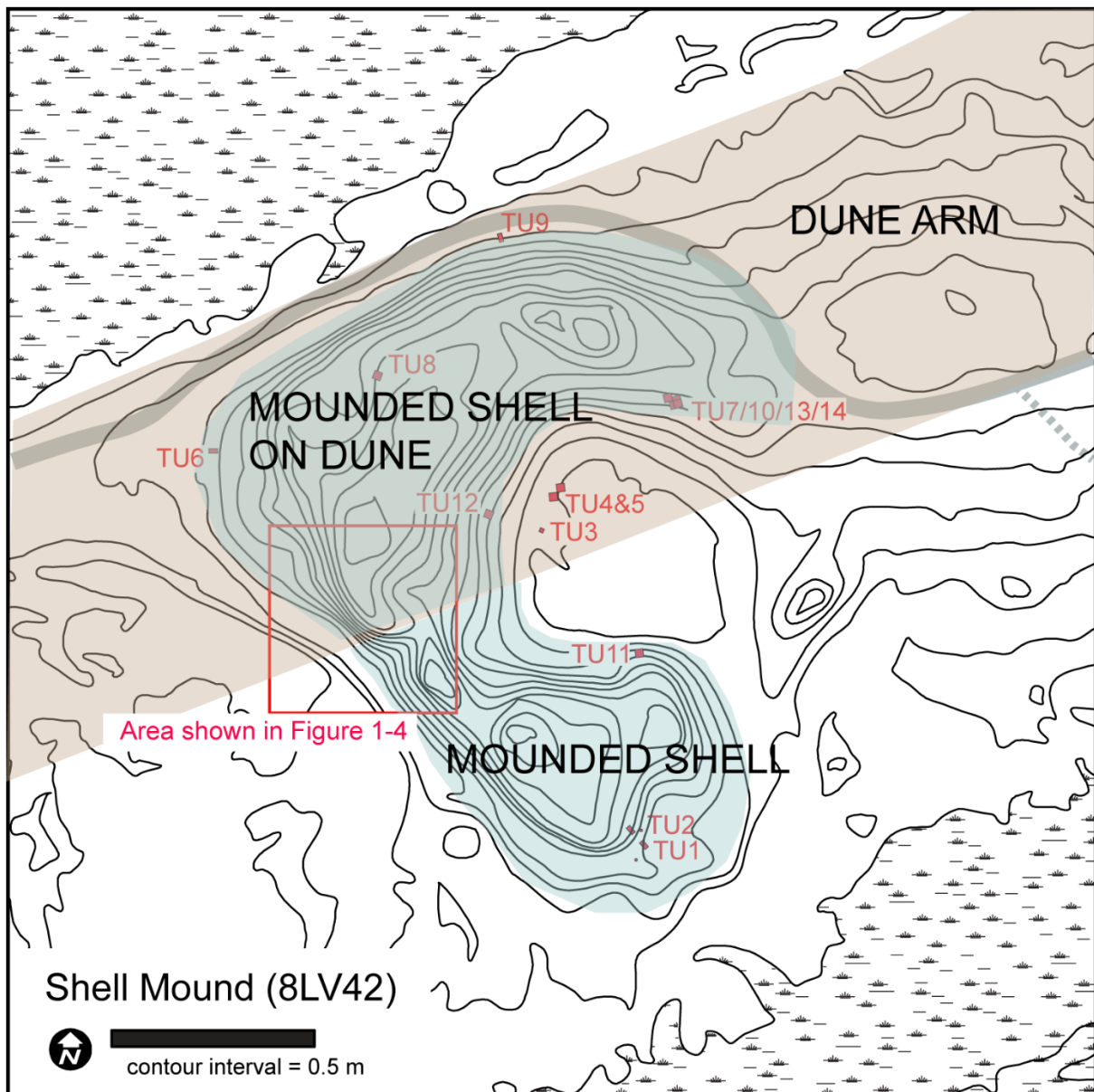


Figure 1-5. Schematic rendering of the major depositional units at Shell Mound, notably the contrast between shell emplaced on dune sands and shell of the south ridge, whose topographic relief is fully anthropogenic (i.e., mounded shell).

extant deposits (Figure 1-5). Test units in the north ridge show that shell was emplaced on the dune arm, which accounts for some of the topographic relief of this part of the mound. Notably, the portion of the south ridge badly eroded by Hurricane Helene and the target of salvage excavation lies at the interface between dune sands and terraforming. We might therefore expect to see some combination of primary and secondary deposition. To the extent that redeposited shell was taken from the part of the north ridge that was formerly dune slope and is now the north half of the plaza, we should expect it to contain artifacts and fauna consistent with the assemblage of primary deposition in large pits dug into dune sands, such as those of TUs 7, 10, 12, 13, and 14. To the extent that excavation in the area of the south ridge eroded by Helene exposes primary deposition on deeply buried dune sands, the artifacts and fauna are expected to compare favorably to basal strata of the north ridge, which include Deptford, Swift Creek, and related pottery of the first few centuries CE. Irrespective of the age and make-up of deposits that comprise the south ridge, the results of testing in an area straddling the dune and terraformed portions of the site are expected to provide new information on how the south ridge was constructed. Given the undulating surface topography of the south ridge, it would not be unreasonable to hypothesize that this part of the site started as a series of conical mounds arranged in arcuate fashion that was later in-filled with additional oyster-dominant deposits. How much, if any, of this terraforming involved primary deposits is unknown but worth investigating.

ORGANIZATION OF REPORT

The method and results of excavation are the subjects of Chapter 2 of this report. Among the more noteworthy results are stratigraphic evidence for redeposition like that observed elsewhere in the south ridge, as well as tentative evidence that this part of the south ridge started as a conical mound. Considering the artifacts and fauna recovered from strata of this possible conical mound, it was possibly constructed from extant matrix, but some differences allude to different sources, arguably those of primary deposition associated with daily living.

Chapter 3 provides data on all material culture recovered from our 2025 work. Dominating the assemblage are sherds of limestone-tempered pottery that is the hallmark of Shell Mound. The inferred size and shape of limestone-tempered vessels is consistent with assemblages elsewhere from the region, which are generally smaller than the large cooking vessels of infilled pits of the north ridge. Traces of sand-tempered and spiculate-tempered wares accompany the dominant pottery at frequencies below site-wide averages. Other types of artifacts from our salvage excavation are few and include shell tools and a single whole hafted biface.

Vertebrate and invertebrate fauna are the subject of Chapter 4. Oyster shell is even more dominant among invertebrate remains from 2025 salvage excavations than it is among shells from other contexts of Shell Mound, but it lacks strong evidence for mariculture that Jessica Jenkins (2016, 2017) infers from shell collected from stratified deposits of the north ridge. Although animal bone was collected from all matrix of 2025 excavations that was passed through ¼-inch screens, vertebrate faunal analysis reported here focuses on select bulk samples from intact strata of profiles. Particular attention is given to the remains of mullet. The size of

mullet as determined by allometry of atlases compares favorably to those from the feasting pits of the north ridge, seemingly bolstering the claim that the south ridge consists of redeposited fill from the north ridge. However, given the lack of supporting evidence for repurposing extant midden for the presumed conical “midden-mound,” this similarity in size is likely to reflect use of similar capture technology, notably the fish trap at Richards Island (Sassaman et al. 2026), rather than repurposed fill.

Efforts to quantify the displacement of shell from the surging waters of Helene are summarized in Chapter 5 by Lukas Desjardins (see also Desjardins 2026). The sense that most of the damage to Shell Mound occurred at places where mound slopes were truncated by road cuts is quantified by Desjardins by comparing drone-mounted LiDAR data collected before and after the storm. Using these same data, he is also able to model the vulnerability of Shell Mound to future storms, thereby providing an objective means to prioritize efforts should opportunities for preemptive mitigation arise.

The results of salvage excavations are summarized in Chapter 6 and then compared to prior results to parse out novel insights on the occupational history of Shell Mound. We also provide in this closing chapter recommendations for additional testing and analyses to address unanswered questions, bearing in mind that some parts of the site are more vulnerable to erosion than others and thus priorities for proactive mitigation.

CONCLUSION

Hurricane Helene brought considerable damage to Shell Mound, particularly at the location of the tallest profile near the apex of the mound. Stabilizing this profile by backfilling it with unconsolidated shell and aggregate is a stopgap measure that will not hold up to storms comparable to or greater than Helene, but it should blunt any further erosion from lesser storms and routine human activities. Stabilization of this profile reduces the risk to visitors of the site walking along a trail that passes close to the profile. Without stabilizing the profile, another storm like Helene may well undercut the trail.

The results of salvage excavations in advance of stabilization clearly demonstrate the value of mitigation in the aftermath of storms. Much new information was garnered from a relatively modest amount of excavation, a testimony to the richness of Shell Mound as an archive of ancient human experiences, some of which arguably was intended to intervene in the course of weather events and rising sea that disrupted coastal settlement. We should appreciate that people with generations of experience dealing with coastal change left behind a record of alternative strategies for sustaining settlement, some technical, others social and ritual. Before any more of this archive is lost to increasingly frequent and severe storms, USFWS and its partners in preservation may want to consider additional testing to ensure none of the chapters of this history are erased before they are written.

CHAPTER 2

METHOD AND RESULTS OF SALVAGE EXCAVATIONS

The main objective of salvage excavations at Shell Mound in response to damage from Hurricane Helene was to “face” the profile of the tallest eroded escarpment of the south ridge (Figure 2-1) and extend a test unit below the base of the escarpment to reach the premound surface. The first part of this objective was achieved as planned; the second part was not fully completed due to the depth of mounded shell below the eroded escarpment, estimated at ~2 m below the floor of our deepest excavation or ~4 m total below the base of the escarpment. Abandoning the test unit before reaching the bottom was in part a matter of safety. Despite reducing the 2 x 2-m unit to a 1 x 2-m subunit back from the escarpment, after removing another 2 m of mounded shell, the risk of collapse was considerable.



Figure 2-1. Photograph of erosional escarpment of the south ridge of Shell Mound (8LV42) facing northeast, on November 2, 2024, about five weeks after Hurricane Helene made landfall. The escarpment in this location is roughly 2 m tall.

METHODS OF SALVAGE EXCAVATION

A primary goal of salvage excavations of the south ridge of Shell Mound was to expose a deep stratigraphic profile of mounded deposits for the purpose of inferring the sequence and mode of ridge construction. The storm surge of Hurricane Helene did much to expose a ~2-m profile, but not abiding by the rules of cartesian geometry, it created an irregular and unstable wall, and it undercut the surface root mat so that it slumped over the top of the profile. Our approach to facing the escarpment was to minimize the amount of matrix that had to be removed to achieve a vertical profile. The deepest undercut into the escarpment was estimated at about 50 cm, so we placed our baseline for excavation at the top of the escarpment 50 cm back (northeast) from the edge. Designated Test Unit 15 (TU15), this 2 x 2-m unit extended southeast across the scree slope with a ~2.5-m drop in elevation. To locate the downslope corners of the 2 x 2-m unit, a wooden frame of the same size was anchored to the upper corners and extended across the open space using line levels to keep it level. A plumb bob dropped from each of the two corners to the scree slope marked the downslope corners. Given the position of TU15 relative to the escarpment, its orientation is intercardinal, in this case roughly 53 degrees E/N. For the sake of simplicity, the wall of TU15 conformant to the escarpment was designated the “grid east” wall. Subsequent designations in the field sometimes deviate from this convention, as we note elsewhere in this report.

The facing of TU15 commenced from the top of the escarpment (Figure 2-2) and continued downward in 20-cm arbitrary levels to a maximum depth of 177 cm below datum (cmbd), which was set as zero at the (grid) northeast corner of the unit. Fill from level excavation was passed through ¼-inch hardware cloth. All artifacts, vertebrate fauna, and gastropods were collected, bagged, and returned to the lab for analysis. In addition, bulk samples were collected from each level, starting with Level B, to provide volumetric samples of oyster shell and other matter not collected from ¼-inch screens, as well as the opportunity to collect through flotation matter less than ¼-inch in size. All charcoal samples submitted for AMS age estimates came from bulk samples.

The volume of matrix from each level of TU15 varied due to the irregular nature of the eroded escarpment. In general, the volume of matrix decreased with depth as the upper part of the escarpment with root-dense, overhanging matrix gave way to the undercut profile that at ~150 cmbd consisted of only a 20-cm-wide portion of intact matrix. Again, bulk samples taken from each level provide a reliable basis for comparisons standardized by volume, as reported in Chapter 4.

The resulting grid-east profile of TU15 provides a clear view of the upper ~175 cm of the south ridge in this location (Figure 2-3). Because it is dominated by unconsolidated oyster shell, this profile could not be continued deeper without imposing considerable risk of collapse. Instead, excavation of TU15 into substrate below the scree slope continued only in the grid-west half of the unit, what was designated as TU15S (Figure 2-4). The first level of this subunit consisted of a wedge-shaped unit to remove scree deposits and define the intact, pre-Helene surface, itself a product of earlier erosion. Continuing with ~20-cm levels downward into intact deposits (Figure 2-5), TU15S was terminated at ~390 cmbd, well above the base of mounded shell but as far as one could excavate with tolerable risk of collapse.



Figure 2-2. Commencing profile facing in Test Unit 15 with 20-cm level along grid-east baseline ~50 cm back from edge of escarpment.



Figure 2-3. The escarpment of the south ridge of Shell Mound (8LV42) before (left) and after (right) the facing of Test Unit 15.



Figure 2-4. View facing north of the excavation of the grid-west half of Test Unit 15 (TU15S) into the scree slope and underlying intact strata of the south ridge of Shell Mound (8LV42).



Figure 2-5. View facing south from the top of the escarpment overlooking the excavation of Test Unit 15S on the south ridge of Shell Mound (8LV42).

The profiles of TU15S revealed greater complexity to oyster-dominated strata than in the overlying strata of TU15 (Figures 2-6 and 2-7), notably what appear to be buried surfaces following a ~30 degree angle of repose. Further description of the profile is reserved for the section on stratigraphy below. To continue with our methods to reach the (natural) surface beneath mounded shell and midden, we employed a 4-inch bucket auger at the base of TU15S (Figure 2-8) to examine matrix another ~160 cm below the base of the unit (or ~570 cm total depth from top of escarpment). Although gleyed oyster shell was observed in matrix ~130 cm below the base of TU15S (or ~540 cmbd), and exhibited brackish moisture, we did not encounter groundwater before a weld on the bucket auger broke, rendering the tool inoperable.



Figure 2-6. Grid-east profile of Test Unit 15S, showing sloped buried surfaces and overlying shell strata at an angle of ~30 degrees from a horizontal plane, roughly the angle of repose.



Figure 2-7. Grid-south profile of Test Unit 15S, showing sloped buried surfaces and overlying shell strata at an angle of ~ 30 degrees from a horizontal plane, roughly the angle of repose.



Figure 2-8. Lennon Myers augering the substrate at the base of TU15S just before a weld on the auger broke.

To get a better sense of the basal deposits in this area of the south ridge, a shovel test 50 x 50 cm in plan was excavated downslope of TU15 and TU15S (Figure 2-9), a few meters back from the edge of the tidal marsh, itself bordered by a shallow (~50 cm tall) escarpment, in this case the results of normal tidal erosion. Excavated in 20-cm levels, Test Unit 16 (TU16) penetrated 115 cm of oyster-shell-dominated matrix with occasional shells of other mollusk taxa, crown conch hammers, vertebrate bone, and sherds of limestone-tempered pottery. The upper 20 cm of matrix consisted of crushed shell in dark sand. Below that surface stratum, whole oyster in dark sand continued to about 85 cmbs, where it gave way to whole oyster in orange sand that became wetter with depth.

Level excavation of TU16 ceased at 115 cmbs before hitting the water table or base of shell deposits. Before it broke, the four-inch bucker auger was used to extend the sounding of TU16 through shell and standing water, both roughly at 155 cmbs. Saturated black mucky sands (~15 cm thick) overlying gray sands to a depth of 223 cmbs attest to the premound ground surface at the edge of the marsh. Although TU16 and the auger results provided inadequate observation about the stratigraphic structure of shell deposits at the edge of the marsh, other lines of evidence, discussed later in this chapter, suggest that they were redeposited from the erosion of mounded shell of the south ridge.



Figure 2-9. Ginessa Mahar and Lukas Desjardins excavating a shovel test pit (TU16) ~12 m downslope from TU15 and TU15S, seen in the background of this photo, taken March 19, 2025.

RESULTS OF SALVAGE EXCAVATION

A composite profile of TUs 15 and 15S is provided in Figure 2-10 and details of its stratigraphic units are given in Table 2-1. Also shown in the composite are the locations of 18 bulk samples taken from level excavation and the profile. Although the composite profile and supporting photographs (Figures 2-3, 2-6, 2-7) show considerable stratigraphic complexity, the density of oyster shell across all samples, by weight, varies little (468.4 ± 20.5 g/liter of bulk sample). What stands out in the profile are strata with organically enriched clastic matrix (Strata III and VII), generally loamy sands that tend to slope downward to grid north in thin bands, reminiscent of buried surfaces. The orientation of oyster shell in some strata lacking much sand (Strata VA and IX) is likewise sloping down to grid north. Other strata of mostly unconsolidated oyster shell (Strata VA and IX) lack nonrandom shell orientation.

Two strata also stand out for containing not only more clastic matter than most, but also relatively abundant vertebrate remains and most of the pottery recovered from TUs 15 and 15S. The shallower of the two, Stratum VIII, lies immediately below an inferred buried surface (Stratum VII). This stratum was obscured for some time by residual scree deposits at the base of TU15. After excavating TU15S, this residuum was removed to reveal Stratum VII, which was further revealed by partial collapse of the lower portion of TU15. Because this presumed

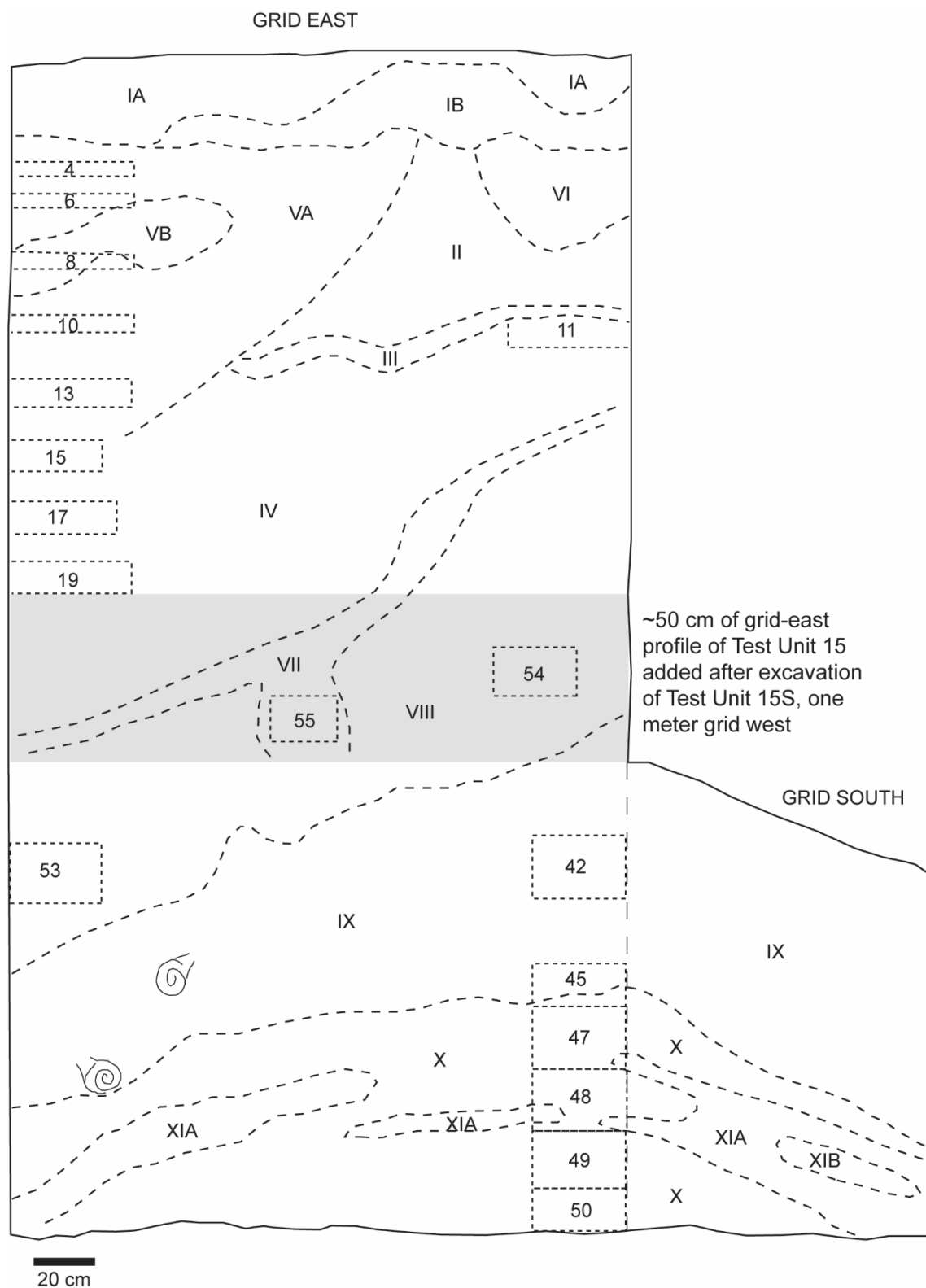


Figure 2-10. Composite grid-east profile of Test Units 15 and 15S and grid-south profile of Test Unit 15S. Descriptions of the stratigraphic units of these profiles can be found in Table 2-1. Bulk samples collected from strata labeled numerically in dashed boxes.

Table 2-1. Stratigraphic Units of Test Units 15 and 15S, Shell Mound (8LV42). AMS Assays Listed in the Descriptions are uncalibrated.

Stratum	Max. Depth (cmbs)	Munsell Color	Description
IA	30	10YR2/1	humic layer of loamy fine sand with moderate to light density of oyster shell
IB	30	10YR4/1	loamy fine sand with crushed shell and ash
II	99	-	unconsolidated oyster shell with minimal clastic material; mostly whole shell; no preferred orientation but many horizontal
III	105	10YR3/1	loamy fine sand with charcoal; probable burned buried surface, truncated by Stratum VA
IV	221	-	unconsolidated oyster shell with minimal clastic material; mostly whole shell; no preferred orientation; three assays of 1530±30 B.P.
VA	125+	-	unconsolidated oyster shell with minimal clastic material; mostly whole shell; preferred diagonal orientation; 1440±30 B.P.
VB	78	10YR2/1	loamy fine sand and minor charcoal but not ashy; greasy texture; 1330±30 B.P.
VI	63	10YR3/1	loamy fine sand, ashy texture with charcoal flecks, oyster shell
VII	225+	10YR2/1	loamy sand with charcoal, oyster shell, and some vertebrate fauna (mostly jack); probable burned buried surface
VIII	301	10YR2/1	loam with abundant large oyster shell and vertebrate fauna; 1430±30 B.P.
IX	345	-	unconsolidated oyster shell with vertebrate fauna and occasional lightning whelk; bedded with dip of underlying strata; 1390±30 B.P.
X	390+	10YR2/1	loam with charcoal throughout and stringers of oyster shell (Str. XIA) with less matrix; 1460±30 B.P.
XIA	388	-	stringers of oyster shell with crushed bone and abundant mullet vertebrae
XIB	375	10YR2/1	stringer of loam with charcoal

buried surface was not evident in the profile of TU15 before the partial collapse, it may actually be limited in horizontal extent, perhaps more like a surface stringer that was quickly buried rather than a buried surface that was exposed for an extended period of time.

In contrast, Stratum X at the base of the excavation is a thick unit of loamy sand with oyster shell, vertebrate fauna, and pottery sherds. This stratum is arguably the only autochthonous unit in the profile, consistent with the attributes of either primary or secondary midden. Of particular note in this stratum is its dip to both grid north, like several overlying strata, and its dip to grid west, conformant with the current slope of the scree. It is reasonable to infer from the orientation of this stratum that it was part of a conical mound whose edge was intercepted diagonally by TU15S. Further details in support of this inference are reserved for the closing discussion of this chapter.

Age estimates for the strata of TUs 15 and 15S come from eight samples of charcoal taken from bulk samples across six units. The uncalibrated assays are reported in Table 2-1; two-sigma calibrated date ranges are provided in Figure 2-11. A quick scan of the date ranges from the bottom to top of the profile reveals reversals that challenge the law of superposition. As we have observed repeatedly in mounded shell across Shell Mound, reverse stratigraphy is common and it attests to the mining and repurposing of extant midden/pit fill in mound building. The composite profile of TUs 15 and 15S is no exception but it does deviate from other profiles of the south ridge in having a potential autochthonous unit (Stratum X) below mounded shell. Charcoal from the unit immediately above it (Stratum IX) is actually coeval or slightly younger than charcoal from Stratum X, but moving up the sequence the age estimates get older, particularly in Stratum IV, mostly unconsolidated shell. All three samples of charcoal from this stratum returned the same age estimate. Unfortunately, the calibration of these assays intercepts the curve in two places, reducing their precision at two sigma to ~170 years. Still, the estimates support the inference of reverse stratigraphy for capping what arguably is a conical mound or midden-mound dating late in the 250-year span of terraforming and ritual gatherings.

Drawing on the stratigraphy and AMS assays of TUs 15 and 15S, it is possible to offer a provision sequence of deposition starting with occupation that led to the formation of a conical mound through primary or secondary deposition of shell, vertebrate fauna, ash, charcoal, pottery, and other matter. Relatively clean oyster shell (Stratum IX) was emplaced over the conical mound and charcoal from that unit suggests this act slightly postdated the conical mound and thus was not likely to be mined from extant deposits, as the senior author has long asserted as the source of all shell of the south ridge. On top of this younger stratum of shell is either a buried surface or a stringer of organically enriched matrix (Stratum VII). If the former, the conical mound with shell cap was left exposed for considerable time. If the latter, the deposit portends what was to come in the overlying Stratum IV, which is redeposited shell from older deposits. Either way, the intent of depositing large quantities of oyster shell seems to have been to level the slopes of the conical mound and achieve a more-or-less continuous ridge to enclose a central plaza. We have enough evidence to infer that infilling took place near the end of the occupational sequence, after about AD 650. We are uncertain about the basal components of this part of the south ridge. The inferred conical mound may extend to the original ground surface and that would be close to 2 m of additional depth below

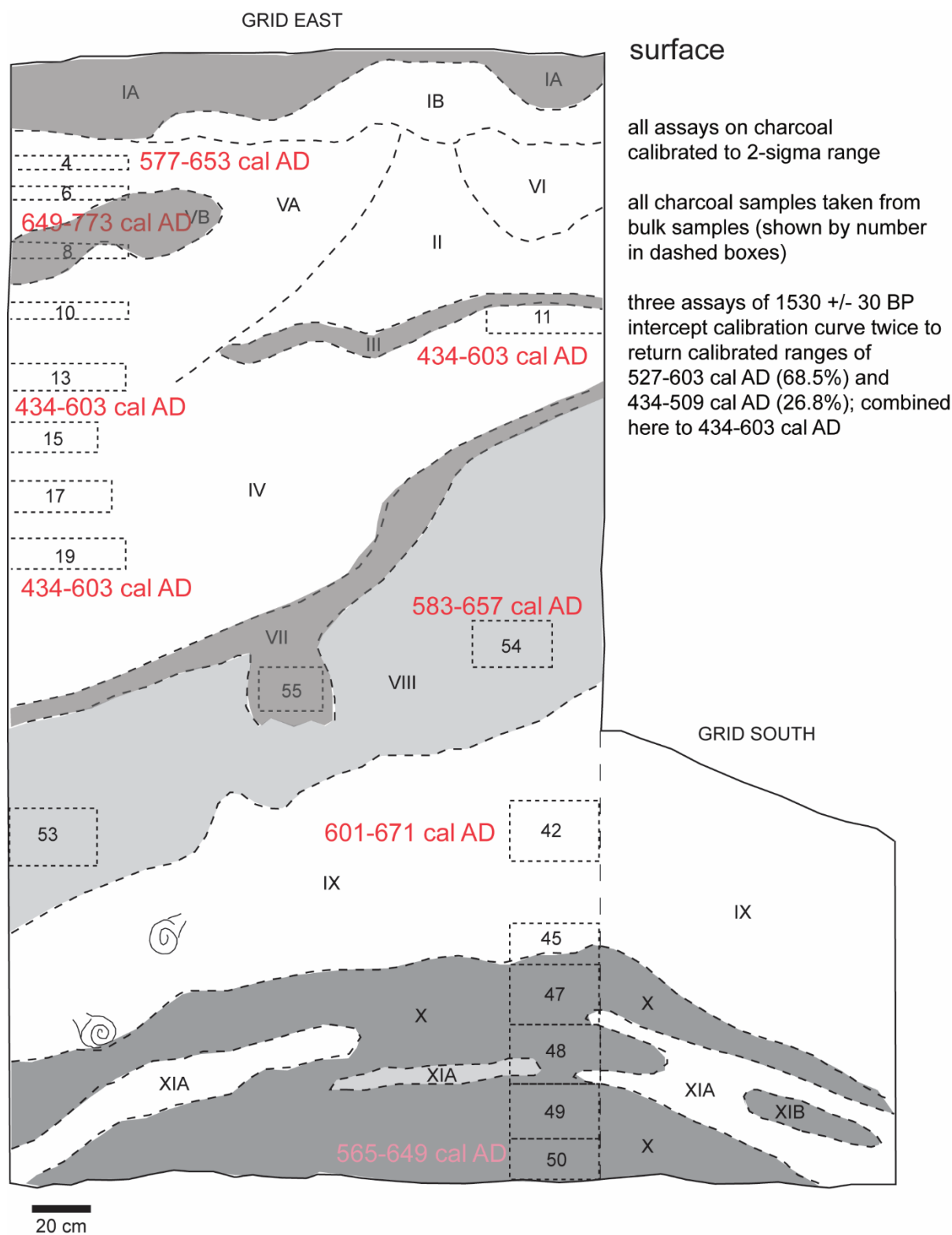


Figure 2-11. Composite grid-east profile of Test Units 15 and 15S and grid-south profile of Test Unit 15S with AMS assays of eight samples of charcoal from bulk samples of major strata.

the maximum depth of TU15S. Elsewhere on the south ridge (TU1, Sassaman et al. 2013) basal components dating to the Deptford and Late Archaic periods underlie mounded shell that was mined and repurposed. No such components were observed in the salvage work of 2025.

One final observation about the sequence of depositional events accounting for the profile of TUs 15 and 15S is that some of the upper strata (Strata VA and VB) reflect either late-period intrusive pits or shell fill emplaced on a sloping surface (Strata VA and VB). Oyster shell in Stratum VA has a decidedly diagonal orientation, but this attribute alone cannot distinguish between pit fill and surface dumps on a slope. Support for an intrusive pit is found in the truncation of Stratum III, one of the inferred buried surfaces. It is also noteworthy that Stratum VA produced some of the only appreciable counts of pottery sherds and vertebrate fauna apart from Stratum X, which had the most of all strata. It is also worth noting that the substratum labeled VB in the profile produced charcoal that was assayed by AMS to immediately postdate the 250-year period of summer solstice feasting at Shell Mound (AD 400-650). Under the usual constraints of superposition, the youngest stratum is expected to be at the top of the sequence, but the second youngest assays on charcoal are from strata two meters deeper. Charcoal from strata in between is older than that from either the top or bottom of the profile.

Artifacts, shell, and vertebrate fauna from the salvage excavations of 2025 support the observation that the upper and lower strata of TUs 15 and 15S have more in common than either does with intervening strata. Table 2-2 provides an inventory of recovered materials greater than ¼-inch in size and Table 2-3 does the same for the >1/8-inch fractions of 18 bulk samples. Full details on diagnostic artifacts in the assemblage are provided in Chapter 3. In short, most of the pottery from 2025 excavations consist of sherds of plain, limestone-tempered ware consistent with the Pasco Plain type. This is the most common type at Shell Mound in general, accompanied in most contexts by minor amounts of St. Johns Plain, Dunns Creek Red, and nondiagnostic sand-tempered plain sherds. As noted earlier, sherds diagnostic of the two centuries (AD 200-400) of occupation prior to solstice gatherings at Shell Mound—specifically Deptford and early Swift Creek—were not observed in the 2025 salvage excavations.

Comparing the relative density of artifacts, shell, and bone across strata of TUs 15 and 15S is difficult because levels dug into the escarpment (i.e., the levels of “profile facing”) varied in volume and contained mixed matrix along its crenulated, erosional face. The volumetric controls of bulk samples, however, eliminate this bias by standardizing the density of matter per liter of intact matrix. To summarize the most salient results of these comparisons, pottery and vertebrate fauna are densest in the bulk samples of Stratum X (Table 2-4), the presumed autochthonous unit (midden mound). Vertebrate fauna is especially dense in Stratum X compared to the density of bone in all of other strata, nearly five times more than the second-highest value, from Stratum V, the potentially intrusive pit or in-filled slope at the top of the sequence. Two other strata, VII and VIII, produced vertebrate fauna densities slightly less than Stratum V. The remaining two strata are those with unconsolidated shell and little clastic matrix, IV and IX, which produced only trace vertebrate fauna and pottery.

Table 2-2. Inventory of Artifacts, Shell, Vertebrate Fauna, and Miscellaneous Rock from Levels of Other Proveniences of Test Units 15, 15S, and 16, Shell Mound (8LV42). All items >1/4-inch. All weights (wt) in grams.

Prov.	Level	Pottery		Flaked Stone		Modified Shell		Misc. Shell		Vertebrate Fauna		Misc. Rock		Historic Artifacts	
		ct	wt	ct	wt	ct	wt	ct	wt	wt	wt	wt	wt	ct	wt
Surface		2	28.5			1	63.1								
TU15	A	4	24.5			1	27.5			8.6		51.6		70	48.5
	B	6	8.4			2	64.5			15.9		69.1		12	14.4
	C	6	7.7					2	292.9	51.8		19.6		3	1.9
	D	3	11.2							49.4		13.6			
	E	9	50.9							46.1					
	F	1	36.3							37.1					
	G	8	43.0							34.0					
	H	4	21.8							69.8					
	I	2	7.9			2	100.5			57.1		10.4			
	Profile Clean-up	7	105.0												
Subtotal		50	316.7			6	255.6	2	292.9	369.8		164.3		85	64.8
TU15S	A	11	61.3							153.7		22.5		2	1.7
	B	21	172.6			3	120.6	1	18.3	331.8		57.6		2	2.2
	C	10	144.5			3	97.1	1	30.9	423.7		140.7			
	D	18	207.4							338.0		99.9			
	E	16	164.4			1	38.8			176.1		163.9			
	F	39	303.0			5	242.0			196.7		37.0			
	G - Zone A	19	151.7			1	78.6			96.9					
	G - Zone B	20	91.1			1	30.4			121.3		7.4			
	H	46	324.0			1	49.0			512.4		10.2			
	STR I	1	8.8												
	STR IX 240-260 cmbd	3	12.8									13.4			
	STR IX 260-280 cmbd	6	45.6			1	22.9					2.9			
	Top of STR X 300-315 cmbd	1	3.4							7.1					
	STR X 330-334 cmbd	1	6.6												
	STR X 350-354 cmbd	1	5.7												
	Bucket Auger 574 cmbd	1	10.1												
	Profile Clean-up	37	351.0												
Subtotal		251	2,064.0			16	719.2	2	49.2	2357.7		555.5		4	3.9
TU16	A	1	1.5												
	B									1.6					
	C					3	111.6			0.4					
	D	2	3.7							0.2		46.8			
	E	1	9.9			2	42.1			3.0					
	Bucket Auger 115-223 cmbs	6	4.2							9.4					
Subtotal		10	19.3			5	153.7			10.4					
Total		313	2,428.5	1	22.9	28	1,191.6	4	342.1	2,752.5		766.6		89	68.7

Table 2-3. Inventory of Artifacts, Shell, Vertebrate Fauna, and Miscellaneous Rock from 18 Bulk Samples of Test Units 15 and 15S, Shell Mound (8LV42). All items >1/8-inch. All weights (wt) in grams.

Bag#	Stratum	vol (l)	Pottery		Flaked Stone		Modified Shell		Oyster Shell		Other Bivalve Shell		Gastro-pod Shell		Misc. Shell		Vertebrate Fauna		Botanical		Misc. Rock		Notes
			ct	wt	ct	wt	ct	wt	wt	wt	wt	wt	wt	wt	wt	wt	wt	wt	wt	wt	wt	wt	
4	STR V	10.5	5	2.6					5,290.7	1.6	1.6	1.1	1.1	39.9	24.5	0.1	109.8						
6	STR V	12.0	1	1.9					5,503.9	1.1	1.1	17.7		10.0	22.1		2.0						
8	STR V	12.0					1	25.2	5,695.1	13.9				0.7	15.8		92.7						
10	STR V	15.5	13	21.3			2	63.8	7,319.6	3.2			63.0	19.0	14.6	0.5	7.0						
13	STR V	12.5							6,074.2					14.1	9.5	0.1							
11	STR IV	10.0	1	2.6					4,420.0	16.2			12.3	18.1	11.5		71.0						
15	STR IV	12.0							5,744.1	3.5			5.0	20.9	4.5								
17	STR IV	12.5							6,050.1	4.5			3.0	72.8	2.2		155.7						
19	STR IV	12.5							5,956.9	7.1			31.0	24.1	3.6								
55	STR VII	4.5	1	2.3					2,165.7	56.2			0.1	14.7	4.7								
53	STR VIII	12.5	1	4.7					5,867.7	21.0			36.2	48.0	17.7		0.6						
54	STR VIII	11.5	2	9.5					5,637.6	1.0			1.4	23.7	11.4		0.3						
42	STR IX	14.5					2	105.6	6,379.6	19.8			96.2	34.3	4.5		71.6						
45	STR IX	7.0	1	2.1					3,201.0	5.8			1.7	34.4	5.2	0.6	2.9						mica
47	STR X	15.5							6,950.8	2.4			18.9	65.1	100.2		23.1						
48	STR X	15.0	5	19.7					7,330.9	55.5			68.3	36.7	32.5	1.0	5.3						
49	STR X	11.0	7	13.0	1	19.0	1	77.8	4,959.8	7.7			107.4	57.6	52.5	0.5	0.8						Bradford
50	STR X	12.5	6	10.2					5,352.3	31.1			3.1	19.7	151.8	0.1							
Total		213.5	43	89.9	1	19.0	6	272.4	99,900.0	251.6			466.4	553.8	488.8	2.9	542.8						

Table 2-4. Density Values by Weight (g) for Pottery Sherds and Vertebrate Faunal Remains among the Bulk Samples of Six Strata in Test Units 15 and 15S, Shell Mound (8LV42).

	Vol (l)	Pottery sherds			Vertebrate Fauna	
		ct	wt	g/l	>1/8-in wt	g/l
Stratum V	62.5	19	25.8	0.41	86.5	1.38
Stratum IV	47.0	1	2.6	0.06	21.8	0.46
Stratum VII	4.5	1	2.3	0.51	4.7	1.04
Stratum VIII	24.0	3	14.2	0.59	29.1	1.21
Stratum IX	21.5	1	2.1	0.10	9.7	0.45
Stratum X	54.0	18	42.9	0.79	337.0	6.24
Total	213.5	43	89.9	0.42	488.8	2.29

In sum, salvage excavation of the eroding escarpment of the south ridge of Shell Mound provided the first glimpse into stratigraphy to support the inference that this part of the site encases a conical mound that was infilled with older shell deposits. We have long known that terraforming to create the south ridge was late in the sequence of occupation at Shell Mound (i.e., post AD 550), and this is corroborated by AMS assays from our salvage work. We have also long known that stratigraphy of mounded deposits of the south ridge is typically reversed, with older matrix overlying younger matrix, as is expected of repurposing existing deposits for mound fill, in this case those that formed before the south ridge was constructed. AMS age estimates on charcoal from Stratum IV of TU15 add to the record of reverse stratigraphy from the south ridge.

New to our perspective on terraforming at Shell Mound is that the south ridge may have been preceded by at least one conical mound that was occupied and took form during the last century of the sequence. Stratum X of TU15S is the first evidence we have seen in the profiles of the south ridge for an autochthonous unit this late in the occupational sequence. Traces of Deptford and Late Archaic components were observed at the base of mounded shell of Test Unit 1 of the south ridge, but these have nothing to do with terraforming at the site. In contrast, what we recorded as Stratum X lies about 2 m above the ground surface housing these early, premound components. We do not have a good sense of what the underlying 2 m of matrix represents, but like all other mounded matrix at Shell Mound, it is dominated by oyster shell.

Whether the inferred conical mound lies directly on the original ground surface or some elevated platform of shell, the resulting ridge would have sloped down towards the marsh and open water at an angle of repose that makes it possible to project the location of its buried remnant (Figure 2-12). Assuming that the upper elevation of the escarpment, where the foot path crosses, is close to the original elevation of mounding, an angle of repose of 30 degrees puts the outer edge of the ridge about 9 m grid-west of TU15S. Much of the redeposited shell overlying the lower slope of the ridge is the product of Hurricane Helene. Other hurricanes and road grading in the 1970s contributed to the present topography by displacing and redistributing shell from the ridge. Test Unit 16 fully penetrated redeposited fill and reached the subsurface sand at about 170 cm below the surface.

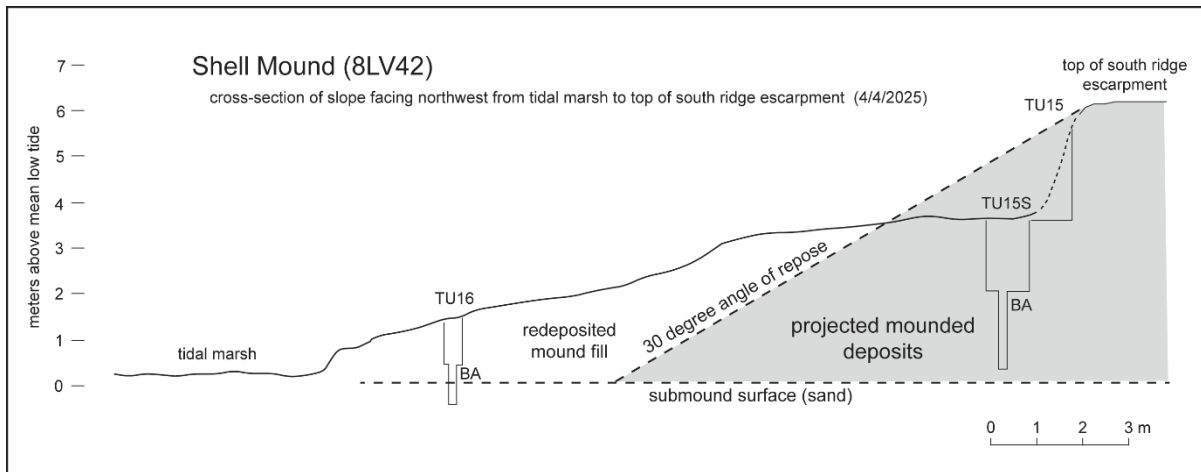


Figure 2-12. Schematic cross-section of slope facing northwest from the tidal marsh (left) to the top of the south ridge escarpment (right), a drop of about six meters. Bucket augers (BA) at the base of TU15S and TU16 revealed oyster shell-rich matrix continuing well below the depth of excavation in respective units, roughly 20 cm above the mean low tide line (0 m) in TU16. Projected mounded deposits based on an angle of repose of 30 degrees extend about eight meters southwest of TU15S.

STABILIZING THE ERODED ESCARPMENT OF THE SOUTH RIDGE

The south ridge of Shell Mound sustained considerable damage from the storm surge of Hurricane Helene. The limited salvage operation reported here targeted a location of particularly bad damage, one that rendered vulnerable the pathway crossing the apex of the ridge to further erosion or collapse, a potential public safety hazard, as well as additional loss of intact archaeological deposits. As outlined in the closing chapter of this report, stabilization of the south ridge is ill advised if it entails hardening the shoreline. We instead recommend systematic testing of other portions of the south ridge where storm surge has undercut escarpments, followed by judicious use of redeposited matrix to backfill vertical profiles to forestall, if not prevent further collapse.

At the close of salvage excavations in 2025, USFWS staff availed their heavy equipment and labor to back fill the escarpment we faced (Figure 2-13). To bolster the resistance of fill to further erosion, an aggregate of clayey sand and crushed limestone was emplaced first in the area of excavation. Dumped from the top of the escarpment with a Cat 2990 Compact Track Loader, this aggregate formed its own scree slope. From the downslope side of the escarpment, aggregate was pushed by the loader up the scree slope towards the top of the profile. This was followed by careful scraping of redeposited shell downslope, likewise pushed upslope towards the top of the escarpment. The resulting slope of back fill did not reach the ground surface at the top, but it was plenty high enough to prevent further collapse, at least until the next hurricane as or more powerful at Helene.



Figure 2-13. Photographs of the process of backfilling the escarpment of the south ridge at Shell Mound (8LV42): dumping aggregate from the top (upper left); pushing aggregate up escarpment (upper right); scraping up displaced shell (middle left); emplacing shell on escarpment (middle right); final scree slope of emplaced fill (bottom).

CONCLUSION

Targeting the tallest escarpment of the south ridge, salvage excavations in 2025 at Shell Mound (8LV42) by the Laboratory of Southeastern Archaeology, University of Florida added new insight to our understanding of the formation and occupational history of this important civic-ceremonial center. Corroborating earlier observations about the timing and sequence of construction of the south ridge of Shell Mound, salvage excavations also exposed evidence for a possible conical mound under ~2 m of fill, some of which was evidently mined from extant deposits, presumably from the north ridge. Construction and occupation of the conical mound took place late in the occupational sequence of the site, after about AD 550, or roughly 150 years into a 250-year-sequence.

Artifacts retrieved during salvage excavations, the subject of Chapter 3, are consistent with those found elsewhere at Shell Mound in contexts ranging from AD 400 to 650. The same can be said about the faunal remains recovered, the subject of Chapter 4. Whereas vertebrate fauna from the salvage work compares favorably to that found elsewhere at the site, these are the first to be recovered from the south ridge that are not necessarily mined from extant deposits for mound fill.

On balance, the salvage effort of 2025, in the wake of erosion from the storm surge of Hurricane Helene, was productive in providing novel insights on one of the region's most important archaeological sites. The profile-facing method used in this operation is both economical and it has low impact. Opportunities await for further salvage of the site's south ridge using this method.

CHAPTER 3

MATERIAL CULTURE

Collected from level excavations and bulk samples of test units of the 2025 salvage operation were 392 pieces of material culture. These include items of human manufacture (pottery, stone tools), as well as “natural” items like the shells of marine gastropods that were technologically modified (e.g., drilled) and/or altered through use (e.g., blunted by impact). Distributed across most levels and bulk samples was 1,309.4 g of miscellaneous rock, mostly limestone but also mudstone. Because none of this rock bears evidence of modification or use, we do not consider it “material culture” per se, although it seems likely to have been drafted into some use because most, perhaps all of it was transported to the site by people.

Totaling 356 pieces >1/4 inch, sherds of pottery dominate the artifact assemblage. Modified gastropod shell consists of 34 hammers, two made from lightning whelk, the rest from crown conch. One nearly complete hafted biface and a core fragment, both made from chert, round out the assemblage. Details on the each of these classes of material culture follow below, starting with pottery sherds.

POTTERY SHERDS

A total of 356 pottery sherds weighing 2,518.3 g were retrieved from subsurface contexts during 2025 salvage excavations at Shell Mound, each >1/4-inch in size. The assemblage is dominated by limestone-tempered pottery, including crumb sherds (i.e., sherds <1/2 inch), at 96.3 percent by count and 98.2 percent by weight. Second in frequency are spicule-tempered sherds (2.0 percent by count, 1.2 percent by weight), and finally sand-tempered sherds (1.7 percent by count, 0.6 percent by weight), both found in trace amounts. Provided in Table 3-1 are sherd counts and weights by temper, surface treatment, and portion represented (rim, body, crumb). About a quarter (91, or 25.6 percent) of the sherds by count are crumb sherds, which are included in the column for “eroded/UID” sherds given their limited surface area. These sherds are, however, classified by temper and most likely are dominated by plain surface treatments, as are larger sherds.

Limestone-Tempered Sherds

Florida archaeologists currently recognize two series of limestone-tempered pottery: the Pasco series defined from work in central Florida by Goggin (1948), and the Perico series defined from work by Willey (1949:361–366) just south of Tampa Bay. Limestone-tempered pottery extends beyond these regions to include the northern Gulf coast of Florida, at least as far north as Horseshoe Beach. Perico and Pasco pottery differ little with regard to paste and form, with the only notable difference being surface treatment. Perico is typically incised and sometimes punctated, whereas Pasco is typically plain. An occasional incised limestone-tempered sherd has been observed at sites in the greater Lower Suwannee area (e.g., McFadden and Palmiotto 2012:60), but these are eclipsed manifold by plain limestone-tempered sherds. Although justified in classifying the plain limestone-tempered sherds from Shell Mound as

Table 3-1. Absolute Frequency and Weight (g) of Pottery Sherds from 2025 Investigations of Shell Mound (8LV42), by Temper and Surface Treatment.

Temper	Plain		Other		Eroded/UID		Total	
	ct	wt	ct	wt	ct	wt	ct	wt
Limestone								
Body	225	1,943.9					225	1,943.9
Rim	31	435.9					31	435.9
Crumb					87	94.0	87	94.0
Subtotal	256	2,379.8			87	94.0	343	2,473.8
Spicule								
Body	3	9.4	2 ^a	10.0			5	19.4
Rim	1	9.4					1	9.4
Crumb					1	0.3	1	0.3
Subtotal	4	18.8	2	10.0	1	0.3	7	29.1
Sand								
Body	2	11.7					2	11.7
Rim	1	2.3					1	2.3
Crumb					3	1.4	3	1.4
Subtotal	3	14.0			3	1.4	6	15.4
Total	263	2,412.6	2	10.0	91	93.8	356	2,518.3

^a Dunns Creek Red

“Pasco,” we choose to refer to these sherds by their definitive temper in the discussion that follows.

Limestone-Tempered Sherds

Florida archaeologists currently recognize two series of limestone-tempered pottery: the Pasco series defined from work in central Florida by Goggin (1948), and the Perico series defined from work by Willey (1949:361–366) just south of Tampa Bay. Limestone-tempered pottery extends beyond these regions to include the northern Gulf coast of Florida, at least as far north as Horseshoe Beach. Perico and Pasco pottery differ little with regard to paste and form, with the only notable difference being surface treatment. Perico is typically incised and sometimes punctated, whereas Pasco is typically plain. An occasional incised limestone-tempered sherd has been observed at sites in the greater Lower Suwannee area (e.g., McFadden and Palmiotto 2012:60), but these are eclipsed manifold by plain limestone-tempered sherds. Although justified in classifying the plain limestone-tempered sherds from Shell Mound as “Pasco,” we choose to refer to these sherds by their definitive temper in the discussion that follows.

All of the 258 limestone-tempered sherds >1/2 inch collected from the 2025 testing at Shell Mound exhibit plain surface treatments. These sherds were distributed widely, if unevenly, across levels of all excavation units. TU15S had the highest density, with levels producing no less than eight non-crumb sherds and basal levels (levels F–H) consistently producing at least 35 sherds each. In both TU15S and TU16, pottery density increased with

depth. In TU15, the highest concentration of pottery was in the middle levels (Levels B, C, and E specifically) of the test unit and subsequently decreased in frequency with depth.

In keeping with the analytical standard of a vessel unit of analysis, sherds from Shell Mound were sorted into vessel lots. After a rigorous effort to conjoin sherds into larger vessel portions, all rim sherds were compared for differences in form, size, paste, surface treatment, and use alteration to establish individual lots. Body sherds were added to vessel lot when appropriate although given the prevalence of plain surface treatments and limestone temper, body sherds were not generally included in vessel lots unless they conjoined to a portion of the rim. A few vessel lots consisted of only body sherds because the paste, surface treatment, and/or wall thickness were unmatched by any of the sherds of vessel lots defined by rim portions.

A minimum of 29 vessel lots are represented in the assemblage of sherds from 2025 salvage work at Shell Mound. Table 3-2 provides data on each of the vessel lots, which are dominated by limestone-tempered wares (Figure 3-1). In fact, all but three of the 29 vessel lots are limestone tempered. Orifice diameters for nine limestone-tempered vessel lots with rim portions large enough to estimate size range from a low of 16 cm to a high of 36 cm, with an average of 26.9 ± 6.9 cm. Vessel wall thickness at 3 cm below the lip also varied across the 12 vessel lots with sufficiently large rim sherds, with a low of 4.9 mm, a high of 8.4 mm, and a mean of 6.92 ± 0.96 mm. A little under a third of the limestone-tempered vessels had smoothed interiors, and only about a fifth had smoothed exteriors. The remaining surfaces were irregular, meaning they exhibit no smoothing or intentionally created alterations in surface texture. Ten of the 26 limestone-tempered vessels had some traces of carbon residue on either interior ($n = 4$) or exterior surfaces ($n = 3$), or both ($n = 3$). Vessels 13 and 18 had especially high amounts of carbon residue on their interior surfaces. These limestone-tempered vessels were most likely used over fire and are consistent with other limestone-tempered vessels from Shell Mound in paste and form, as well as surface treatment.

It is worth noting that none of the vessels from 2025 salvage work at Shell Mound are as large as some of the vessels that were deposited in pits of the north ridge (Sassaman et al. 2019:63). On average, the orifice diameter of limestone-tempered vessels from pits is nearly six centimeters larger than those from the 2025 work, and they include several as large as 50 cm in diameter (Figure 3-2). Other sites in the study area have produced sherds from vessels this large, but the average of limestone-tempered vessels from regional sites, as calculated by O'Donoghue (2009) is only half that size, only 25.2 cm. Although it shares a slightly bimodal distribution with Shell Mound pit assemblages, limestone-tempered vessels from the 2025 salvage excavations bear greater similarity to other regional sites with respect to size than they do the massive vessels from pit fill at Shell Mound. It follows that the assemblage of sherds from 2025 work is not simply redeposited from north ridge fill, where large pits are legion, that was mined for construction fill.

Table 3-2. Metric and Qualitative Data on Vessel Lots from Test Units 15 and 15S, Shell Mound (8LV42).

Vessel Lot #	Temper ^a	Orifice Diam (cm)	Percent Orifice	Wall Thk (mm)	Rim Form ^b	Lip Form ^c	Exterior Surface ^d	Interior Surface ^d	Soot/Carbon ^e
1	LS	36	10	7.3	ST	RD	IR	IR	
2	LS	28	9	6.7	ST	RD	IR	IR	
3	LS	32	5		ST	FL	IR	SM	
4	LS	24	10	7.4	ST	RD	IR	IR	EXT
5	LS		7		ST	RD	IR	IR	EXT
6	LS						IR	SM	INT
7	LS						IR	SM	INT/EXT
8	SP	18	5	6.6	ST	RD	SM	SM	INT/EXT
9	LS	26	6	7.6	ST/IN	RD/FL	IR	IR	INT
10	LS	20	5		ST	RD	IR	IR	
11	LS				ST	FL	SM	IR	EXT
12	LS			4.9	ST	FD	IR	SM	
13	LS			7.7	ST	RD	IR	IR	INT
14	LS				ST	FL	SM	SM	
15	LS	36	5	7.0	ST	RD/TP	IR	IR	
16	LS			7.1	ST	RD	IR	IR	INT
17	LS			7.0	ST	RD	IR	SM	
18	LS				ST	TP	IR	IR	INT/EXT
19	LS	24	5		ST	RD	IR	IR	
20	LS			5.4	ST	TP	SM	SM	
21	LS					RD	IR	IR	
22	LS	16	5	*5.1	ST	FL	IR	IR	
23	LS				ST	FL	IR	IR	
24	SA				ST	RD	IR	SM	
25	LS						IR	IR	INT/EXT
26	LS			8.4	ST	TP	SM	IR	
27	SP						PT	SM	
28	LS				ST	RD	IR	IR	
29	LS					TP	SM	SM	

^a LS = Limestone; SA = Sand; SP = Spicule^b ST = straight; IN = incurvate; EX = excurvate^c RD = rounded; FL = flat; TP = tapered; FD = folded^d IR = irregular; SM = smoothed; PT = painted^e INT = interior; EXT = exterior

Most the limestone-tempered vessels from 2025 salvage work exhibited predominantly straight walls, with minor variations in curvature or slant resulting in slightly restricted or slightly expanded orifices (Figure 3-3). Lip forms are predominantly rounded but include flattened and tapered lips as well, and a single example of a folded rim. Wall thickness is moderate and generally consistent with a few notable exceptions. Vessels 12, 22, 25, and 29 have unusually thin walls, all measuring less than 5.5 mm thick. This falls well outside the range of variation for limestone-tempered vessels from prior excavations. Vessel 22 additionally has a small orifice of 16 cm in diameter, comparable to the spicule-tempered serving vessels that were found in large pits on the north ridge of Shell Mound. Each of these thin-walled vessels has a different paste, ranging from finely crushed limestone to large, assorted particles. Unfortunately, none of the sherds of these thin-walled vessels are of



Figure 3-1. Sherds and vessel portions of limestone-tempered pottery assigned to vessel lots from 2025 salvage excavations at Shell Mound (8LV42).

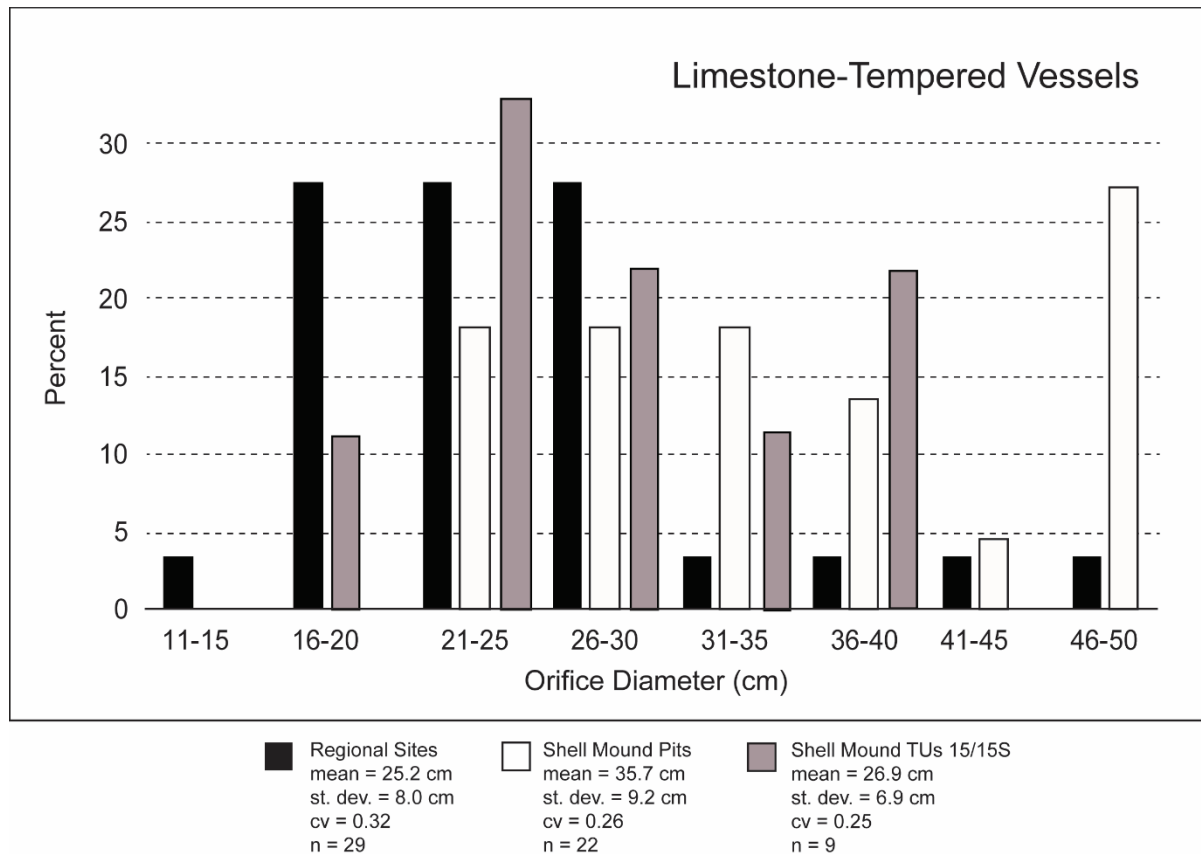


Figure 3-2. Relative frequency distributions of vessel orifice diameters for limestone-tempered vessels from the Lower Suwannee region (n = 29), pits at Shell Mound (n = 22), and Test Units 15 and 15S (n = 9).

sufficient size to collect much metric data, so not much can be said beyond noting their presence.

Spicule-Tempered Sherds

Spicule-tempered pottery exhibits a variety of surface treatments and is found widely across the state. It is typically attributed to the St. Johns tradition of northeast Florida, in the St. Johns River valley, although spicule-tempered pottery found outside the valley may have been locally made rather than transported from the northeast (Block et al. 2019). A total of seven spicule-tempered pottery sherds were recovered from 2025 excavations at Shell Mound: five body sherds with a total weight of 19.4 g; one rim sherd (9.4 g); and one crumb sherd (0.3 g). The majority of these sherds have plain exterior surfaces, except for two sherds that bear traces of red paint, which are classified as Dunns Creek Red (Figure 3-4).

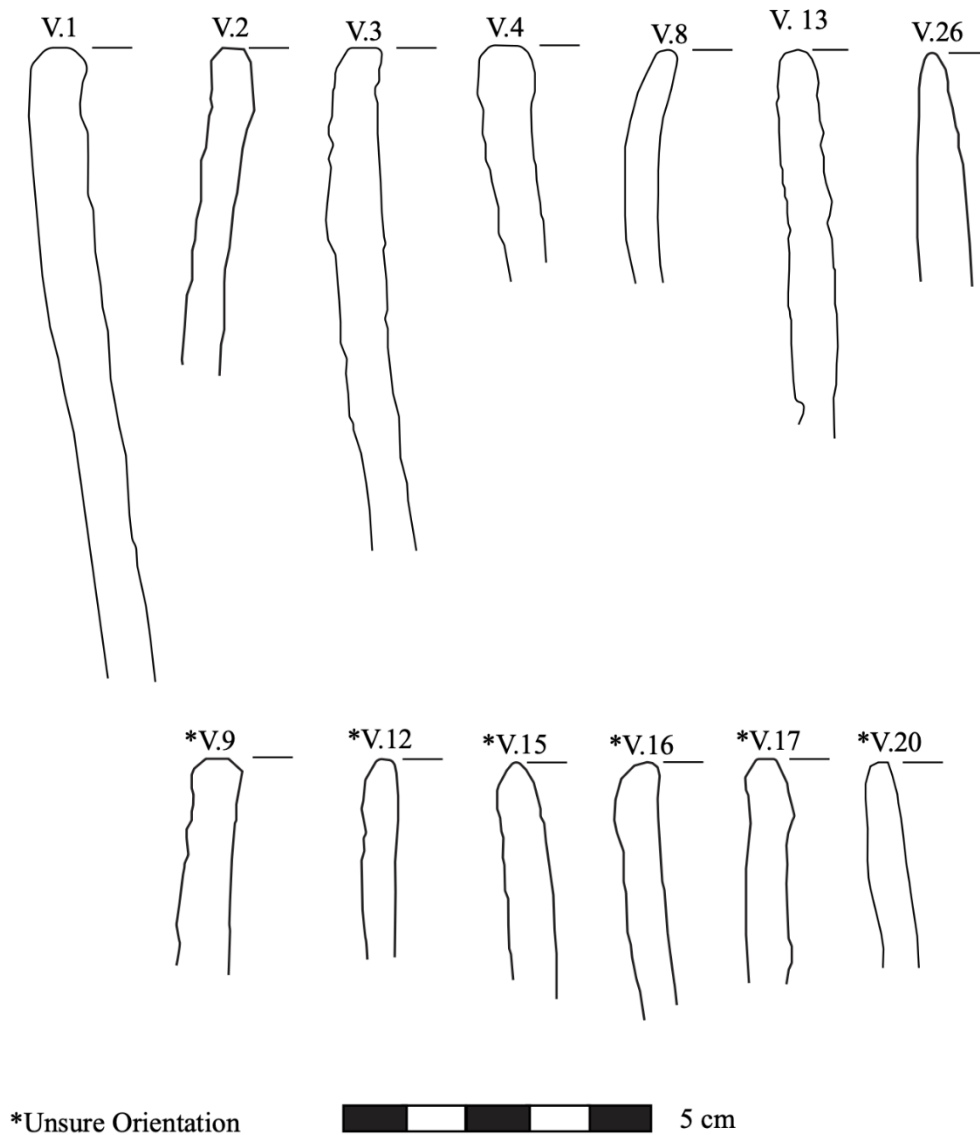


Figure 3-3. Vessel wall profiles of limestone-tempered vessels from 2025 salvage excavations at Shell Mound (8LV42).

Only two of the 29 vessel lots are classified as spicule-tempered (Table 3-2), representing two of the smallest vessels in the assemblage. One of these (Vessel 27) consists of the two Dunns Creek Red sherds, and while neither is a rim, the shape of the two implies the vessel may have been a small asymmetrical bowl. Dunns Creek Red pottery is rare, but not unheard of at Shell Mound, with trace amounts found in four other test units (TU11, TU10, TU8, TU7) that are spread widely across the site. The other spicule-tempered vessel (Vessel 8) consists of a single rim sherd from a bowl, with a form and estimated orifice diameter



Figure 3-4. Spicule-tempered (two left) and sand-tempered (right) sherds from 2025 salvage excavations at Shell Mound (8LV42). Vessel 27 is Dunns Creek Red.

consistent with other spicule-tempered vessels from the site. This sherd had a wall thickness of 6.7 mm and represents approximately 5 percent of an orifice 18 cm in diameter. This sherd also bears traces of carbon residue on both the interior and exterior surfaces.

The percentage of spicule-tempered pottery from 2025 testing (2.0 percent) is consistent with the relative frequencies of these sherds in test units across the site (ranging between 1 and 4 percent, with the exception of some on the north ridge). Sherds of this temper typically represent small, open bowls used for serving, and contrast sharply with the large limestone-tempered cooking vessels common across the site.

Sand-Tempered Sherds

Sand-tempered pottery is represented in the assemblage by two body sherds weighing a total of 11.7 g, a rim sherd weighing 2.2 g, and three crumb sherds with a total weight of 1.3 g. The body sherds were recovered from adjacent basal levels of TU15S and exhibit plain exteriors like the vast majority of the other sherds recovered in recent testing. The rim sherd was recovered in a bulk sample taken 124–144 cmbd in TU15S and also has a plain surface treatment. This rim sherd represents one of the 29 vessel lots identified for this assemblage (Table 3-2), although orifice diameter and wall thickness could not be measured due to its small size. The crumb sherds were excavated from level C of TU15, but otherwise TU15 (excluding TU15S) is devoid of sand-tempered pottery. The low frequency of sand-tempered sherds (1.7 percent) is unusual for an assemblage from Shell Mound, which typically exceeds 14 percent of all sherds. Higher frequencies elsewhere are attributed mostly to the presence of early components (ca. AD 100–400), dating to the centuries immediately prior to the period of summer solstice feasts (ca. AD 400–650). These consists of Deptford, Swift Creek, and coeval sand-tempered wares.

Site-Wide Comparisons

Further situating the pottery assemblage from 2025 salvage excavations in site-wide contexts of Shell Mound, comparisons of basic temper types across units reveal strong patterning. Table 3-3 lists the counts of sherds >1/2 inch by temper type and excavation unit sorted into different areas of the site. The four areas designated include (1) north ridge, (2) north ridge with large pits, (3) plaza, and (4) south ridge. Sherd counts in Table 3-3 do not include any from pit features, just those recovered from the levels of test units that included large pits. Still, sherd counts reported from north ridge units with large pits consist in part of the upper portions of pit fill that was removed by level excavation before features were defined as such and thereafter removed as pit fill.

Table 3-3. Absolute Frequencies of Sherds >1/2-inch by Temper Type and Excavations Units Sorted by Site Area of Shell Mound (8LV42).

Area	Test Unit	Limestone	Sand	Spicule	Other	Total
North Ridge	6	25	14	2	-	41
	8	269	184	10	34	497
	9	186	50	65	-	301
North Ridge w/Large Pits	7	361	99	16	1	477
	10	178	44	30	25	277
	12	1,217	164	43	14	1,438
	13	118	17	1	3	139
	14	82	39	11	15	147
Plaza	3	130	11	5	-	146
	4	341	48	22	1	412
	5	303	44	16	-	363
South Ridge	1	88	17	2	-	107
	2	51	1	2	-	54
	11	387	24	14	4	429
	15/15S	252	3	5	-	260
Total		3,988	759	244	97	5,088

Although the site-wide assemblage of over 5,000 sherds is robust in size, sampling biases preclude comparisons of raw counts across units or areas without standardization. Converting counts to percentages to alleviate bias shows that assemblages from the north ridge differ in meaningful ways from those of the plaza and south ridge (Figure 3-5). Sherds from the three units of the north ridge that lack large, infilled pits (TUs 6, 8, and 9) are among the most diverse, with a collective 30 percent sand tempered, another 10 percent spicule tempered, and a few percentages of additional types, such as grog tempered and sherds with assorted aplastics. As noted earlier, most of these non-limestone-tempered wares trace to the earliest occupations of Shell Mound involving pottery and they were sited either at the base of the dune arm fronting water or astride the dune arm. This latter location was occupied over ensuing centuries, resulting in accreted midden. Shell-rich deposits from dune-top dwelling also

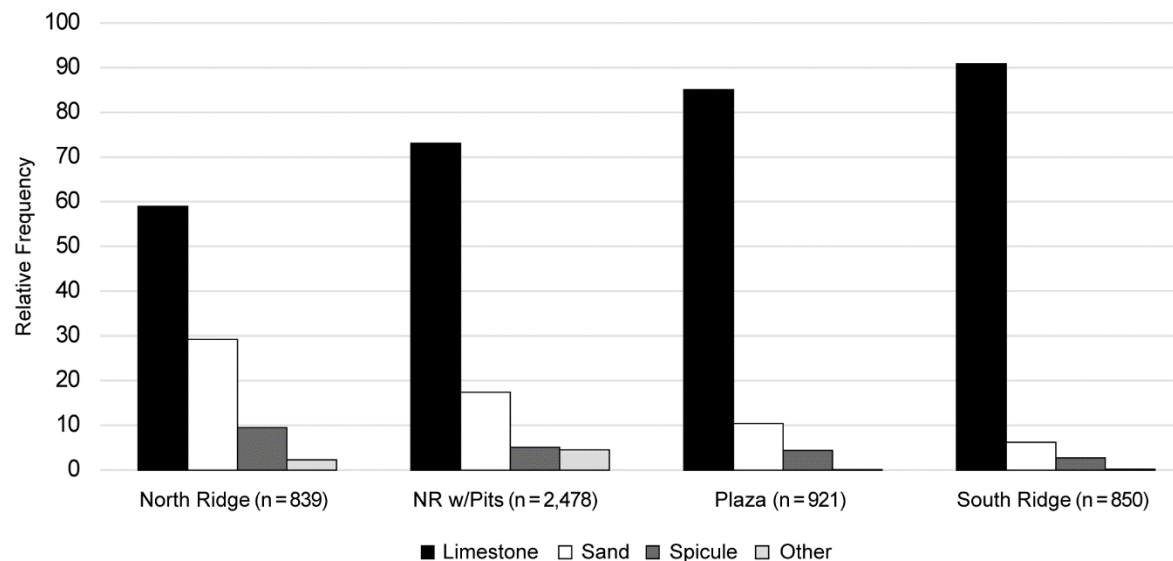


Figure 3-5. Relative frequencies of sherds >1/2-inch by temper type and area of Shell Mound (8LV42). NR w/Pits are units on the north ridge that contained large, back-filled pits.

accumulated along the base of the dune arm, over earlier midden. Thus, locations tested on the north ridge bear stratified deposits of most, if not the entire occupational sequence of Shell Mound.¹ Limestone-tempered pottery dominates the assemblage of north ridge units, as elsewhere, but not in overwhelming proportions. Together, they make up a bit less than 60 percent of all sherds from the north ridge lacking large, infilled pits.

The eastern slope of the dune arm, opposite the shoreline, is where testing uncovered the large, infilled pits that are interpreted as the infrastructure of summer solstice feasts. Pottery from units with large pits (TUs 7, 10, 12, 13, and 14) is nearly as diverse as it is elsewhere on the north ridge, but with a higher percentage of limestone-tempered sherds; if we included sherds from the pits, that fraction would increase. However, the percentage of limestone-tempered pottery varies across units from a low of 57.6 percent (TU14) to a high of 83.0 percent (TU12). The balance of pottery in these units includes none of the sand-tempered wares common to the earlier occupation but instead the sherds of serving vessels, which are likewise represented by small assemblages of spicule-tempered pottery. Unlike other units of the north ridge that encapsulated the entire occupational sequence of Shell Mound, those exposing large, infilled pits are biased towards the 250-year period of summer solstice feasting (AD 400–650)

¹ The deepest stratigraphic sequence (~280 cmbs) of any unit on the north ridge (TU8) reveals a thick organic midden at its base dating to the late Deptford and early Swift Creek periods, ca. AD 200–400. Shell-rich deposits accumulated in sequence starting around AD 550. Shortly thereafter, older shell-rich deposits were emplaced in ring-like fashion around a 10-m-wide depression, presumably the source of the older deposits. This activity is roughly coeval with the construction of the south ridge and occupation of the plaza and signals the major terraforming project that brought Shell Mound into its more-or-less final configuration.

when local cooking wares were largely limestone tempered and nonlocal serving vessels sand or spicule tempered.

Sherds from three units in the plaza of Shell Mound (TUs 3–5) are dominated by limestone tempering with only ~10 percent sand-tempered, less than half of that spicule-tempered, and other varieties of aplastics virtually nonexistent. Age estimates for the pottery of these units are post AD 550, so the lack of greater diversity is not surprising. Similarly, sherds from units of the south ridge (TUs 1, 2, 11, and 15/15S) are dominated by limestone tempering, at least 80.0 percent (TU 1) and as much as 96.5 percent (TU 15/15S). The only major exception is the Deptford component exposed at the base of TU1, below mounded shell and fronting the marsh, much like its counterparts on the northwest side of the north ridge. The pottery confirms that the south ridge was constructed relatively late in the occupational sequence of the site but it does not support the notion that the ridge was constructed from fill mined from the north ridge, at least not parts that included components predating AD 550.

Summary

Limestone-tempered pottery sherds recovered from 2025 salvage excavations at Shell Mound are typical of the Pasco series in the greater Lower Suwannee region and of Shell Mound generally. However, they do not include sherds from the largest of the limestone-tempered vessels represented among sherds from feasting pits at Shell Mound. Likewise, a comparison of site-wide tendencies for temper types shows only limited affinity between pottery from south ridge units, especially TUs 15 and 15S, and assemblages from north ridge units, with or without large, infilled pits. They do, however, compare favorably with sherds from test units in the plaza, the occupation of which postdates AD 550.

Added together, it seems unlikely that all fill of the south ridge was taken from the north ridge, as has long been assumed. Notably, the basal levels of TU15S, from which most of the pottery came, evidently consist of in situ midden that accumulated late in the occupational sequence of the site. Redeposited fill from the north ridge may account for shell strata of TU15 but with less pottery and less diverse pottery than would be expected if all of it was taken from pre-AD 550 deposits of the north ridge.

FLAKED STONE

Recovered in 2025 from Shell Mound are only two items of flaked stone: a nearly whole stemmed hafted biface from a bulk sample (49) near the base of TU15S, and a fragment of an amorphous flake core from Stratum IX of TU15S. This trace of lithic material is not unusual for locations along the outside perimeter of Shell Mound, south and north ridges alike. It is, however, out of stride with the density of flaked stone from test units of the north ridge with large, infilled pits, which exceed 300 artifacts/m³ (Sassaman et al. 2015:80). The density of flaked stone artifacts from the fill of large pits is likewise high.

The hafted biface from TU15S complements the existing inventory from Shell Mound, which is dominated by narrow-bladed forms with expanding stems. The new addition is perhaps classified best as a Bradford point (Figure 3-6), although a series of other expanding-stemmed types may apply (e.g., Columbia, Sarasota, Taylor) (Bullen 1968). Missing the very

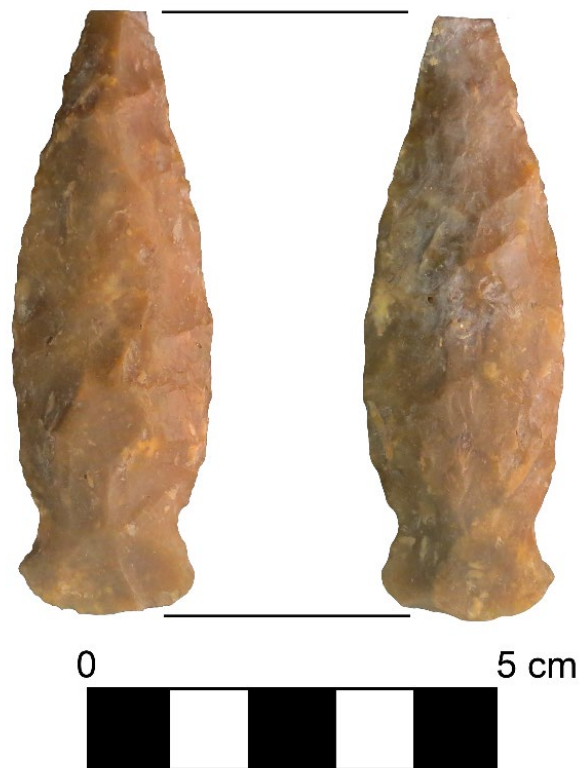


Figure 3.6. Obverse and reverse of Bradford point from Bulk Sample 49 of Test Unit 15S, Shell Mound (8LV42).

tip of the blade, the Bradford point recovered in 2025 is 69.0 mm in maximum length, 21.8 mm in maximum width, and 9.6 mm in maximum thickness. Basal width is 19.1 mm, and the width between notches is 14.7 mm. The item weighs 18.9 g. Edge margins are irregularly retouched and small step fractures occur on both faces. The raw material is chert from the Eocene Crystal River Formation, most likely the Lower Suwannee or possibly Santa Fe quarry clusters (Rafael Peré, personal communication 2026).

OTHER LITHIC MATERIAL

Throughout the deposits of Shell Mound are clasts of limestone, mudstone, and sandstone with no obvious evidence of use or modification. Occasional pieces have tell-tale traces of grinding and/or battering, and some bear traces of thermal alteration. None of the ~1,300 g of miscellaneous rock recovered during 2025 testing shows obvious evidence of use resulting in wear or fracture, but some of it was subjected to heat. As discussed elsewhere, mudstone clasts throughout Shell Mound have laminated cross-sections and curvature that suggest they formed in basins or pits and perhaps lithified over time with the addition of calcium leached from shell and limestone. They typically show the rubification of being heated.

MODIFIED SHELL

Crown conch (*Melongena corona*) hammers are pervasive along the outside perimeter of Shell Mound ridges and the test units of 2025 salvage work are no exception. Thirty-four such items were recovered from these recent units, all but one with at least one hole in the whorl and all with battered siphons. These tools are known to Florida archaeologists as Type G hammers (Marquardt 1992), which Jenkins and Mahar (2022), following Menz (2012), interpret as oystering hammers.

Two of the modified shells from 2025 excavations consist of portions of lightning whelks, both with holes in the whorl. Like the crown conch hammers, those made from lightning whelk shells are common to Shell Mound, but in much lower numbers. The site-wide percentage of hammers made from lightning whelk shell is ~4 percent; in 2025 units it is ~6 percent.

CONCLUSION

Dominated by plain limestone-tempered pottery sherds, the assemblage of artifacts recovered from salvage excavations of Shell Mound in 2025 is consistent with others from the site dating to the last century of occupation, ca. AD 550–650. Its closest parallel is the assemblage of pottery from test units in the open plaza. There is little to recommend that any of the pottery from 2025 testing traces to mined deposits of the north ridge that were used to build the south ridge. Rather, the core of the south ridge consists of autochthonous deposits dating late in the occupational sequence of the site. Missing are sand-tempered wares of the Early Woodland period found at the base of the units on the north ridge, as well as TU 1 on the south ridge. Also missing is evidence of the large limestone-tempered cooking pots prevalent in the fill of large pits of the north ridge. This does not mean that summer solstice feasting ceased before the late-period occupation of the south ridge began, only that, again, the south ridge was not constructed out of repurposed fill from the north ridge, at least not fully.

Other than pottery, material culture from 2025 testing is limited to a small assemblage of lithic artifacts, the usual crown conch hammers, and a couple of fragments of lightning whelk hammers. All of these items would fit comfortably in the assemblage of artifacts from plaza units but likewise assemblages from the first century and a half of summer solstice feasts, ca. AD 400–550.

CHAPTER 4

INVERTEBRATE AND VERTEBRATE FAUNAL REMAINS

The shells of various taxa of mollusks and the bones of vertebrates, notably fishes, are common to archaeological deposits throughout Shell Mound. Besides providing insight into the diet of Shell Mound denizens and the ecology of the biomes from which they collected food, shell and bone provide data on two activities that stand apart from day-to-day subsistence. The first is evidence for oyster mariculture developed by Jessica Jenkins (2016, 2017), the second is evidence for summer solstice feasts first recognized by Josh Goodwin (2018, Goodwin et al. 2020) and later elaborated through analyses conducted by Meggan Blessing (Sassaman et al. 2020). Faunal remains in support of these two inferences came from contexts of the north ridge. If the south ridge was constructed exclusively from midden mined from the north ridge, it follows that traces of oyster mariculture and summer solstice feasts would accompany redeposited fill. Part of the purpose of this chapter is to compare the invertebrate and vertebrate remains of salvage excavations of the south ridge to assemblages of the north ridge, mindful that the south ridge evidently includes autochthonous deposits, as well as redeposited fill, that may not involve either mariculture or feasting.

Before delving into the assemblages of shell and bone from 2025 salvage excavations, we note that not all shell was collected from level excavation. For the first few years of the Lower Suwannee Archaeological Survey, we collected only modified shell from the ¼-inch screens used to process level fill. After recognizing the abundance of Crown conch hammers and other gastropod tools at the site, we started to collect all gastropod shell, modified or not, in order to determine if tools were made from a nonrandom selection of shell (Jenkins and Mahar 2022). Oyster shell and other bivalves with no obvious modifications have never been collected from level fill. In contrast, we process bulk samples by flotation using fine screens (~1 mm), which imposes no bias against any taxa of mollusk. The same is true of vertebrate remains, which are routinely collected in excavations but suffer from the bias of coarse screens because so much of it is less than ¼ inch in its longest dimension. For these reasons, the analysis that follows emphasizes bulk samples over level fill, starting with the shells of invertebrates.

INVERTEBRATE FAUNAL REMAINS

Measured by count or weight, oyster shell comprises the vast majority of invertebrate faunal remains at Shell Mound in general and the test units of 2025 salvage excavations are no exception. Crown conch, lightning whelk, hard clam, scallop, and a variety of other taxa are not uncommon at Shell Mound but never in large quantities. The frequencies of most of these taxa in the test units of 2025 excavations are less than normal, whereas a few other taxa not common at Shell Mound turned up in unexpectedly greater numbers. On balance, the invertebrate remains from recent testing both reinforced what we already know about Shell Mound while adding some novel insights that inform on both the nature of deposits in the south ridge and the environmental conditions under which they deviate from assemblages from other parts of the site.

Table 4-1 provides weights for all bivalve, gastropod, and crustatean shell and shell fragments >1/8-inch from the 18 bulk samples from Test Units 15 and 15S. These samples are grouped by strata ordered from top to bottom. Due to reverse stratigraphy, the chronological order of this sequence is not simply from youngest to oldest in terms of the age of respective matrices. As argued in previous chapters, Stratum X is hypothesized to be an autochthonous unit, part of a conical mound or midden mound that is capped by two strata (VIII and IX) that may likewise be autochthonous (i.e., accretional midden) and then what is arguably redeposited fill (Stratum IV) on the buried surface (Stratum VII) of the presumed conical mound. We can thus expect the lower half of the sequence to reflect deposition over the last century of occupation (ca. AD 550–650), but capped with shell and associated matter from the prior century of occupation (ca. AD 450–550).

Oyster Shell

Oyster shell dominates the matrix of all 18 bulk samples, even those with abundant clastic matter. As noted in Chapter 2, the density of oyster shell by weight varies little across samples (Table 4-2), ranging from a low of 428.18 g/l at the base of the excavation to a high of 503.88 g/l at the top. Mean density of oyster shell for all samples is 468.39 ± 20.49 g/l. Variance from this mean is a mere 4 percent. The consistency across samples is remarkable considering that some are from strata described as “unconsolidated oyster shell with minimal clastic material” (i.e., “clean” shell) and others from organically enriched loamy sand (i.e., “midden”). Evidently, the difference has nothing to do with shell density but rather how much clastic material—organically enriched or not—occupies the interstitial spaces between shells.

The relative fragmentation of oyster shell provides insight on depositional contexts that is lacking in density data. The proportion of whole oyster shell by weight for all 18 samples is 45.2 percent. Across samples, this value varies from a low of 32.3 percent to a high of 53.1 percent. The five lowest values are from the upper-most samples of strata and among the samples of presumed autochthonous midden. The highest values are among the samples of Strata IV and V, presumed deposits of terraforming. The difference here is between shell that was exposed to human traffic and other surface activities for enough time for organic matter to have also accumulated, and shell that was immediately buried under more shell and thus never subjected to either trampling or accumulations of surface debris. In short, data on oyster shell fragmentation support the inference that the lower strata of TU15S consist of accretional midden on a slope suggestive of a conical mound. In sequence from top to bottom, the four bulk samples of Stratum X (Bags 47–50) have whole shell proportions of 41.2, 47.2, 39.9, and 47.1 percent. These alternating values are expected of a depositional unit that accumulated gradually.

Table 4-1. Weight (g) of Unmodified Shells and Shell Fragments >1/8-inch of Bivalve, Gastropod, and Crustacean Taxa in Bulk Samples from Test Units 15 and 15S, Shell Mound (8LV42).

Bag#	Stratum	-----Bivalves-----					-----Gastropods-----					--Crustaceans--			Misc. Shell
		Oyster	Hard Clam	Atl. Ribbed Mussel	Scallop	Marsh Clam	Misc. Bivalve	Crown Conch	Slipper Snail	Moon Snail	Peri-winkle	Barnacle	Crab		
4	STR V	5,290.7		1.6				1.1				33.7		6.2	
6	STR V	5,503.9		1.1				17.1				9.4		0.6	
8	STR V	5,695.1	13.6	0.3				25.2				0.6		0.1	
10	STR V	7,319.6		3.2				62.1	0.9			12.3	2.9	3.8	
13	STR V	6,074.2										14.1			
11	STR IV	4,420.0		0.3	15.9			12.3				17.0	0.5	0.6	
15	STR IV	5,744.1		3.5				3.7	1.3			18.6	0.3	2.0	
17	STR IV	6,050.1		4.5				1.0	2.0			37.5		35.3	
19	STR IV	5,956.9		7.1						31.0		24.1			
55	STR VII	2,165.7	34.6	21.6					0.1			11.0		3.7	
53	STR VIII	5,867.7		21.0	4.7	10.1		33.1	3.1			39.8	1.7	6.5	
54	STR VIII	5,637.6		1.0					1.4			10.0	1.2	12.5	
42	STR IX	6,379.6		2.5		15.8	1.1	92.8	3.4			33.2		8.2	
45	STR IX	3,201.0		5.8				0.5	1.2			26.2			
47	STR X	6,950.8		2.4				11.4	7.5			61.8	1.1	2.2	
48	STR X	7,330.9	38.6	12.4	4.5			62.9	4.8		0.6	30.8	3.3	2.5	
49	STR X	4,959.8		7.7				104.5	2.9			46.5	0.8	10.3	
50	STR X	5,352.3	29.5	1.6				2.0	1.1			16.8	0.3	2.6	
Total		99,900.0	116.3	97.6	25.1	25.9	1.1	429.7	29.7	31.0	0.6	443.4	12.1	97.1	

Table 4-2. Counts, Weights (g), and Derived Statistics of Oyster Shell from Bulk Samples of Test Units 15 and 15S, Shell Mound (8LV42) by Valve (Right vs. Left) and Condition (Whole vs. Fragment).

Bag#	Stratum	Liters	---Whole Right---		---Whole Left---		Fragment		-----Total Shell-----		%Whole by wt		Ratio Right:Left		--Mean wt/Whole Valve--	
			ct	wt	ct	wt	wt	wt	g/liter	wt	by wt	Right:Left	right	left	all	
4	STR V	10.5	107	753.8	79	953.9	3,583.0	5,290.7	503.88	32.3	1.35	7.04	12.07	9.18		
6	STR V	12.0	137	824.4	146	1,605.7	3,073.8	5,503.9	458.66	44.2	0.94	6.02	11.00	8.59		
8	STR V	12.0	251	1,648.7	122	1,276.5	2,769.9	5,695.1	474.59	51.4	2.06	6.57	10.46	7.84		
10	STR V	15.5	248	1,387.8	218	2,327.9	3,603.9	7,319.6	472.23	50.8	1.14	5.60	10.68	7.97		
13	STR V	12.5	126	1,155.5	127	1,864.0	3,054.7	6,074.2	485.94	49.7	0.99	9.17	14.68	11.93		
	<i>Subtotal</i>	<i>62.5</i>	<i>869</i>	<i>5,770.2</i>	<i>692</i>	<i>8,028.0</i>	<i>16,085.3</i>	<i>29,883.5</i>	<i>478.14</i>	<i>46.2</i>	<i>1.26</i>	<i>6.64</i>	<i>11.60</i>	<i>8.84</i>		
11	STR IV	10.0	129	911.6	69	997.9	2,510.5	4,420.0	442.00	43.2	1.87	7.07	14.46	9.64		
15	STR IV	12.0	159	1,115.7	175	1,503.1	3,125.3	5,744.1	478.68	45.6	0.91	7.02	8.59	7.84		
17	STR IV	12.5	158	1,234.7	133	1,541.3	3,274.1	6,050.1	484.01	45.9	1.19	7.81	11.59	9.54		
19	STR IV	12.5	146	1,480.9	110	1,682.2	2,793.8	5,956.9	476.55	53.1	1.33	10.14	15.29	12.36		
	<i>Subtotal</i>	<i>47.0</i>	<i>592</i>	<i>4,742.9</i>	<i>487</i>	<i>5,724.5</i>	<i>11,703.7</i>	<i>22,171.1</i>	<i>471.73</i>	<i>47.2</i>	<i>1.22</i>	<i>8.01</i>	<i>11.75</i>	<i>9.70</i>		
55	STR VII	4.5	57	442.3	43	445.2	1,278.2	2,165.7	481.27	41.0	1.33	7.76	10.35	8.88		
53	STR VIII	12.5	296	1,107.6	131	1,360.0	3,400.1	5,867.7	469.42	42.1	2.26	3.74	10.38	5.78		
54	STR VIII	11.5	199	1,251.9	161	1,519.8	2,865.9	5,637.6	490.23	49.2	1.24	6.29	9.44	7.70		
	<i>Subtotal</i>	<i>24.0</i>	<i>495</i>	<i>2,359.5</i>	<i>292</i>	<i>2,879.8</i>	<i>6,266.0</i>	<i>11,505.3</i>	<i>479.39</i>	<i>45.5</i>	<i>1.70</i>	<i>4.77</i>	<i>9.86</i>	<i>6.66</i>		
42	STR IX	14.5	228	1,025.3	211	1,469.5	3,884.8	6,379.6	439.97	39.1	1.08	4.50	6.96	5.68		
45	STR IX	7.0	120	640.9	89	785.3	1,774.8	3,201.0	457.29	44.6	1.35	5.34	8.82	6.82		
	<i>Subtotal</i>	<i>21.5</i>	<i>348</i>	<i>1,666.2</i>	<i>300</i>	<i>2,254.8</i>	<i>5,659.6</i>	<i>9,580.6</i>	<i>445.61</i>	<i>40.9</i>	<i>1.16</i>	<i>4.79</i>	<i>7.52</i>	<i>6.05</i>		
47	STR X	15.5	219	1,955.8	77	908.1	4,086.9	6,950.8	448.44	41.2	2.84	8.93	11.79	9.68		
48	STR X	15.0	275	1,910.5	150	1,552.6	3,867.8	7,330.9	488.73	47.2	1.83	6.95	10.35	8.15		
49	STR X	11.0	137	871.4	95	1,106.2	2,982.2	4,959.8	450.89	39.9	1.44	6.36	11.64	8.52		
50	STR X	12.5	159	1,343.6	93	1,178.7	2,830.0	5,352.3	428.18	47.1	1.71	8.45	12.67	10.01		
	<i>Subtotal</i>	<i>54.0</i>	<i>790</i>	<i>6,081.3</i>	<i>415</i>	<i>4,745.6</i>	<i>13,766.9</i>	<i>24,593.8</i>	<i>455.44</i>	<i>44.0</i>	<i>1.90</i>	<i>7.70</i>	<i>11.44</i>	<i>8.98</i>		
	Total	213.5	3,151.0	21,062.4	2,229.0	24,077.9	54,759.7	99,900.0	467.92	45.2	1.41	6.68	10.80	8.39		

Evidence for oyster mariculture developed by Jenkins (2016, 2017) comes from a combination of morphological and taphonomic variables. A particularly important variable is the presence or absence of holes bored into the exterior of shell by sponges, which are filter feeders that do not subsist off oysters but take advantage of shells for anchoring themselves. Sponges do not thrive in intertidal conditions so the presence of boring holes on oyster shell is a proxy for subtidal habitat. Granted, not all subtidal oysters are affected by boring sponges, but intertidal oysters tend not to be affected given the constraints of subaerial exposure to sponges at low tide.

Certain bore holes on subtidal oyster shell reflect procurement practices that Jenkins considers maricultural. Bore holes on the exterior attachment scars of oyster shell (i.e., the irregular impression on the left valve where the oyster was attached to substrate, often another oyster in a cluster or burr) indicate that an attached oyster was culled from a cluster but the parent cluster left in or returned to the water, where it was subjected to boring by sponges on freshly exposed shell. In the sample Jenkins analyzed from TU8, 38.1 percent of shells with sponge boring had borings on attachment scars. The proportion of boring scars actually increased up the column from a low of 34.1 percent to a high of 48.4 percent, then dropped back down.

The ratio of right to left valves in any assemblage of oyster shell reflects patterns of disposal with implications for mariculture. If all oysters that were collected and brought to Shell Mound for consumption were shucked and the respective valves tossed to the ground or in a pit together, the ratio of right to left valves would be 1:1. However, the shell stratum of TU8 with a high frequency of boring on attachment scars consisted of mostly left valves, up to four times more than right valves. Jenkins reads this as evidence of shelling, the practice of returning shell to reefs to encourage propagation. Given their overall flatter profile, right valves are better than left valves for creating a clutch for oyster spat to attach. Other contexts at Shell Mound besides TU8 produced assemblages biased towards left valves, but not always so marked.

Finally, the overall size and shape of oysters is an important measure of the age and health of a population, much of it to do with habitat quality, including salinity, but also patterns of predation. Because subtidal oysters can feed continuously, they tend to be larger, on average, than intertidal oysters of comparable age. The overall shape of oysters in these respective habitats differ too, with intertidal oysters elongated and irregular compared to rounded and more uniform subtidal counterparts. However, the range of variation across the board is marked, making it difficult to ascribe any particular oyster to a particular habitat. Similarly, oyster reefs that are harvested aggressively and not allowed to regenerate are subject to resource depression, the result being reduced size and quality over the period of exploitation. Remarkably, no such reduction was evident in the oyster shell of TU8, owing perhaps to the countervailing effects of mariculture.

None of the variables indicative of mariculture outlined above stand alone in substantiating this practice, or even pointing to a particular habitat of collection. Comparisons of metric and morphological variables of oyster shell must necessarily be restricted to assemblages from known context, like those analyzed by Jenkins. For the purpose of this

report, whole oyster shell from two of the 18 bulk samples of TU15/15S were analyzed using Jenkins' protocols. The shells of Bag 50 come from the basal midden deposit of TU15S (Stratum X) that we infer was authochthonous. Those from Bag 19 come from the stratum of unconsolidated shell (Stratum IV) that we infer was mined from the north ridge to build the south ridge. Provided in Table 4-3 are summary statistics on the variables relevant to mariculture observed on left valves of each sample. Data on the frequency of right and left valves can be found in Table 4-2.

With respect to the incidence of sponge boring on left valves of shells from these two samples, the percentage is only 33.0 percent of shells in Bag 19 but 43.4 percent of shells in Bag 50. The former value matches the submound stratum of TU8 and the latter is close to the value of oyster shell from samples in TU8 indicative of mariculture. Likewise, among shells with attachment scars, only 25 of 101 (24.7 percent) from Bag 19 have sponge boring on scars, compared to 25 of 57 (43.8 percent) from Bag 50.

Table 4-3. Descriptive Statistics of Height (mm), Length (mm), and Height:Length Ratio (HLR) for Left Valves of Oyster Shells from Bags 19 and 50, Test Units 15 and 15S, Shell Mound (8LV42).

Bag 19 (Stratum IV)			
No Sponge Boring (n = 77)	<u>Height</u>	<u>Length</u>	<u>HLR</u>
mean	52.78	36.28	1.46
st. dev.	11.56	7.63	0.18
minimum	31.13	20.56	1.07
maximum	98.94	68.13	2.08
c.v.	0.22	0.21	0.12
Sponge Boring (n = 38)			
mean	61.67	43.09	1.45
st. dev.	15.63	12.68	0.18
minimum	40.69	28.65	1.15
maximum	102.51	89.31	2.00
c.v.	0.25	0.29	0.13
Bag 50 (Stratum X)			
No Sponge Boring (n = 47)			
mean	52.24	34.36	1.53
st. dev.	12.64	8.08	0.21
minimum	24.52	16.93	1.19
maximum	74.97	51.09	2.15
c.v.	0.24	0.24	0.14
Sponge Boring (n = 36)			
mean	63.91	40.69	1.58
st. dev.	14.33	8.56	0.23
minimum	38.74	21.58	1.25
maximum	96.80	62.74	2.17
c.v.	0.22	0.21	0.15

In terms of size, oyster valves with sponge boring and presumed to be from subtidal habitat average ~10 mm longer (height) and ~7 mm wider (length) in both samples compared to valves lacking sponge boring (Table 4-3). Of the subtidal valves, ones with sponge boring on attachment scars are larger than those lacking boring on scars by a similar margin, which suggest that oysters that were left after culling had more time to grow compared to members of their cohort that were removed from the water at the time the attachment scar was exposed. Irrespective of inferred habitat or evidence of mariculture, all samples and subsamples have a similar ratio of height to length, roughly 1.5.

Metric data and the incidence of sponge boring point to the likelihood that at least some of the oysters from TU15/15S were cultured although supporting evidence is lacking. Most notably, the ratio of right to left valves runs counter to expectations for shelling. The overall ratio for samples from TU15/15S is 1.41, ranging from a low of 0.91 from a sample in Stratum IV (Bag 15) to a high of 2.84 in Stratum X (Bag 47) (Table 4-2). Stratum X has an combined ratio of 1.90 and the same sample from this stratum with evidence for mariculture, from Bag 50, has a ratio of 1.71.

The mixed signals on oyster mariculture from shells of TU15/15S likely reflect the pitfalls of conceptualizing this practice in all-or-nothing, canonical terms. That is, the oyster shell recovered in 2025 includes individuals from both intertidal and subtidal reefs or beds, and of those from subtidal habitat, at least some were culled but their right valves not returned to reefs as a means of shelling. These results shed light on mariculture as a multidimensional continuum, as opposed to a fixed set of exclusive practices. Under changing environmental conditions, such as regression of the sea, oyster harvesting and management were likely challenged. We will consider further in the last chapter of this report implications for changing oyster habitat under a purportedly regressive sea. Some of the other mollusk taxa found in association with oyster shell likewise offer insight on habitat change worth considering.

Other Bivalve Shell

Besides oyster, bivalve taxa from Shell Mound typically include hard clam and scallop, always at low frequency, and in some contexts marsh clam at even lower frequency. Percentages of shell by weight of these taxa in TU15/15S are similar to those from other contexts of the site, with the exception of greater values for marsh clam, albeit still minor. Also recovered from bulk samples of TU15/15S are shells of Atlantic ribbed mussel, a taxon not observed in most other contexts. Like marsh clams, Atlantic ribbed mussels prefer lower salinity than scallops or hard clam. The occurrence of lower-salinity taxa in TU15/15S tend to support the inference that sea level regressed starting about AD 550.

Gastropod Shell

Table 4-1 provides weights for all gastropod shell recovered in bulk samples of TU15/15S. As noted earlier, in recent years, unmodified gastropod shell has been collected routinely from the level fill of test units of Shell Mound for various analytical purposes. This was not the case in the salvage operation of 2025. However, as with all types of material culture or faunal and plant remains, bulk samples provide an unbiased look of shell taxa across units.

Moreover, they enable comparisons to assemblages from other areas of the site where features and stratified deposits were also sampled in bulk, the latter often in the form of column samples.

Gastropods from the bulk samples of TU15/15S occur at the lowest relative frequency of any context sampled at Shell Mound. They comprise only 0.5 percent of all mollusk shell by weight, compared to 7–8 percent in large, infilled pits of the north ridge. The relatively low frequency of crown conch in TU15/15S is paired with a total lack of shell from lightning whelk, pear whelk, and tulip, each of which shows up routinely, if at low frequency, in north ridge pit fill. Added to the inventory from TU15/15S are slipper snails and a trace of periwinkle. To the extent slipper snails prefer shallow intertidal water, their occurrence in the last century of site occupation might be attributed to expansion of tidal flats with regressive sea. Because they attach to oyster shells in shallow tidal water, slipper snails, like barnacles, are among the bycatch of oyster harvesting. Although they are crustaceans, not gastropods, barnacles are relatively common to the mollusk assemblages of TU15/15S.

VERTEBRATE FAUNAL REMAINS

As is usually the case at Shell Mound, the 2025 salvage excavations produced abundant vertebrate faunal remains and most of it consists of fish bone. Level excavation in 2025 yielded a total of 2,752.5 g of bone >1/4 inch and bulk samples account for another 488.8 g of bone >1/8 inch. Comprehensive analysis of vertebrate faunal remains, like that reported for pit features of the north ridge (Sassaman et al. 2019:83–92), are beyond the scope of this report. We do, however, provide preliminary analysis of the 1/4-inch fraction bone from two strata, as well as allometric data on mullet, the most common fish taxon, to compare against the size of mullet from feasting pits. As shown below, mullet bone from 2025 salvage excavations is indistinguishable from that in the fill of feasting pits. Rather than inferring that this reflects the repurposing of pit fill to construct the south ridge, the comparability of mullet assemblages from different contexts likely reflects the use of a tidal fish trap at Richards Island (Sassaman et al. 2026) beyond feasting events.

Select Comparisons of Samples of Vertebrate Faunal Remains

For the purpose of this report, vertebrate remains from four bulk samples were sorted by taxa for comparisons between the stratum of a late-period conical midden-mound (Stratum X) and overlying matrix of uncertain origin (Stratum VIII) that is roughly coeval with the stratum of the midden-mound but capped with older, presumably repurposed midden. The results that follow are limited to counts (number of identified specimens, or NISP) and weights of elements. Full-blown analysis of the vertebrate remains from 2025 salvage excavations—including minimum number of individuals (MNI), taphonomy, and modifications—is on the agenda but a low priority. Still, the results reported here underscore the importance of salvaging intact ridge deposits before they are further compromised because they produced novel patterning.

As noted in Chapter 2, the basal stratum of TU15S, Stratum X, is an autochthonous deposit that is believed to be part of a conical midden-mound that was “capped” after ~AD 600

by older, shell-rich midden. Reverse stratigraphy like this means the older deposits were mined from another place and emplaced in this location, evidently to form the south ridge. Stratum VIII is ambiguous in this respect; it is either the final in situ deposit of midden-mound, or the first deposit of repurposed fill. Given that the single AMS age estimate for Stratum VIII is coeval with assays on charcoal from the midden-mound, the former scenario is most likely but it does not eliminate the possibility that the first capping event of the midden-mound entailed extant midden that only slightly predates the final autochthonous deposit.

Table 4-4 provides counts and weights by taxon of vertebrate faunal specimens from each of the four bulk samples selected for analysis: two from Stratum VIII (Bags 53 and 54) and two from Stratum X (Bags 49 and 50). These bulk samples are roughly the same size, 24.0 liters for the two samples combined from Stratum VIII and 23.5 liters combined for Stratum X. As noted earlier, bone is much more frequent in Stratum X than in overlying Stratum VIII. Standardized for volume, the latter has only 4.8 specimens/liter or 1.2 g/liter compared to 31.9 specimens/liter and 57.7 g/liter for Stratum X. Remarkably, oyster shells between these two strata are indistinguishable in density, condition, and size.

Besides differences in density, vertebrate remains from these bulk samples exhibit some strong differences across taxa (Figure 4-1). Most obvious is the dominance of mullet bone in samples from Stratum X. Mullet bone is pervasive at Shell Mound, but not often the dominant fish taxon. At nearly 50 percent of all bone in the combines samples for Stratum 50, mullet rises to nearly three-quarters of all bone that was identified beyond UID fish (i.e., Actinopterygii). Owing to the relatively large size of its assemblage, Stratum X also produced a variety of other fishes (e.g., hardhead catfish, jacks, drums, spotted sea trout, sheepshead), as well as a substantial number of turtle elements that were not taken beyond Testudines. Despite the incidence of various taxa and relatively large size of the assemblage, bone from Stratum X is low in diversity and equitability due to the dominance of mullet. Allometric analyses of mullet vertebrae detailed below add evidence from Shell Mound for the mass capture of mullet.

As for samples from Stratum VIII, although the size of the combined assemblage is relatively small ($n = 116$) compared to the combined assemblage from Stratum X ($n = 748$)—and because of that subject to lower diversity—taxa other than mullet are conspicuous, notably hardhead catfish and jack. Also, two taxa identified in Stratum VIII samples do not appear in samples from Stratum X. Three small elements of white ibis (*Eudocimus albus*) in Bag 54 are likely from a juvenile, much like the dominant bird bone in large, infilled pits of the north ridge. Likewise, Bag 53 of Stratum VIII included definitive sea turtle, also common in large, infilled pits. On balance, the vertebrate faunal remains from Stratum VIII would fit comfortably in any of the six large pits of the north ridge whose bony contents have been analyzed fully (Sassaman et al. 2019). Although mullet bone from pits comprises upwards of one-third all identifiable elements, none of the pits produced assemblages in which mullet bone dominates like it does in samples from Stratum X of TU15S.

Table 4-4. Count (NISP) and Weight (g) of Vertebrate Faunal Elements >1/4-inch by Taxon and Bag Number for Four Bulk Samples from Test Unit 15/15S, Shell Mound (8LV42).

Scientific Name	Common Name	NISP		Weight	
		n	%	g	%
Bag 53					
Actinopterygii	Fishes	46	56.8	5.3	30.8
<i>Ariopsis felis</i>	Hardhead Catfish	10	12.3	1.8	10.5
<i>Caranx</i> sp.	Jack	5	6.2	5.9	34.3
<i>Cynoscion nebulosus</i>	Spotted Sea Trout	2	2.5	0.2	1.2
<i>Mugil cephalus</i>	Striped Mullet	9	11.1	0.7	4.1
Chelonioidae	Sea Turtle	5	6.2	5.9	34.3
Total		81	100.0	17.2	100.0
Bag 54					
Actinopterygii	Fishes	12	34.3	0.9	8.2
<i>Caranx</i> sp.	Jack	12	34.3	8.8	80.0
<i>Sciaenidae</i> sp.	Drum	1	2.9	0.1	0.9
<i>Mugil cephalus</i>	Striped Mullet	6	17.1	0.5	4.5
Testudines	Turtle	1	2.9	0.2	1.8
<i>Eudocimus albus</i>	White Ibis	3	8.6	0.6	5.5
Total		35	100.0	11.0	100.0
Bag 49					
Actinopterygii	Fishes	83	30.9	9.6	19.4
Ariidae	Sea Catfishes	1	0.4	0.2	0.4
<i>Ariopsis felis</i>	Hardhead Catfish	12	4.5	4.0	8.1
<i>Caranx</i> sp.	Jack	18	6.7	12.4	25.1
<i>Archosargus probatocephalus</i>	Sheepshead	9	3.3	2.2	4.4
<i>Cynoscion nebulosus</i>	Spotted Sea Trout	5	1.9	0.4	0.8
Sciaenidae/Carangidae	Drum/Jack	3	1.1	1.2	2.4
<i>Sciaenidae</i> sp.	Drum	2	0.7	0.5	1.0
<i>Pogonias cromis</i>	Black Drum	1	0.4	0.5	1.0
<i>Sciaenops ocellatus</i>	Red Drum	1	0.4	0.2	0.4
<i>Mugil cephalus</i>	Striped Mullet	108	40.1	10.8	21.8
Testudines	Turtle	23	8.6	5.9	11.9
Mammalia	Mammal	3	1.1	1.6	3.2
Total		269	100.0	49.5	100.0
Bag 50					
Actinopterygii	Fishes	165	34.4	12.8	18.9
Ariidae	Sea Catfishes	1	0.2	1	1.5
<i>Ariopsis felis</i>	Hardhead Catfish	7	1.5	7	10.4
<i>Caranx</i> sp.	Jack	2	0.4	0.4	0.6
<i>Archosargus probatocephalus</i>	Sheepshead	1	0.2	1	1.5
Sciaenidae/Carangidae	Drum/Jack	2	0.4	2	3.0
<i>Cynoscion nebulosus</i>	Spotted Sea Trout	16	3.3	3.2	4.7
<i>Sciaenidae</i> sp.	Drum	1	0.2	1	1.5
<i>Sciaenops ocellatus</i>	Red Drum	2	0.4	2	3.0
<i>Mugil cephalus</i>	Striped Mullet	259	54.1	31.6	46.7
<i>Paralichthys albigutta</i>	Gulf Flounder	1	0.2	1	1.5
Testudines	Turtle	23	4.8	23	34.0
Total		479	100.0	67.6	100.0
Grand Total		864		145.3	

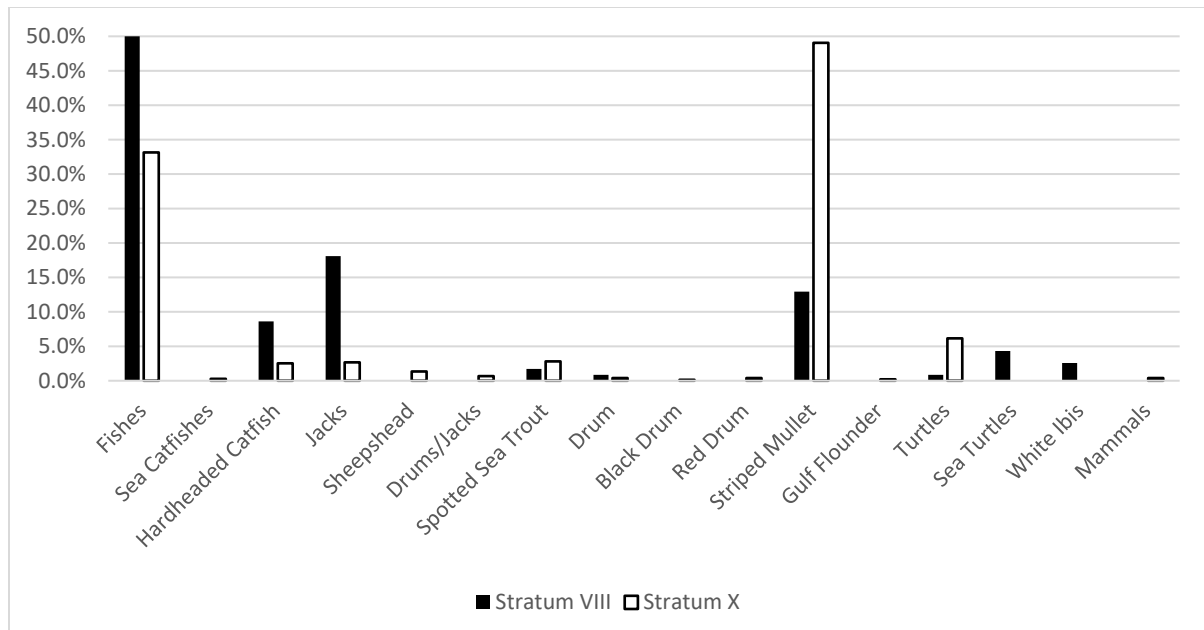


Figure 4-1. Relative frequency of specimens (NISP) of bone >1/4-inch by taxon from the bulk samples of two strata exposed in the excavation of Test Unit 15/15S, Shell Mound (8LV42).

Mullet Allometry

As noted earlier, the bones of mullet are the most pervasive fish bones at Shell Mound. They are found in diverse contexts but are especially abundant in the fill of big pits of the north ridge. Most other contexts investigated to date produced only modest amounts of mullet bone and are often outnumbered by the bones of other fishes. Stratum X of TU15S is an exception. Mullet bone from Level H alone matches or exceeds the density observed in the fill of large pits. Beyond density, how do these two contexts compare with respect to fish size?

Counts of first vertebrae, C1, or atlases, was one of two measures used to calculate MNI of mullet (*Mugil* spp.) from feasting pits (Sassaman et al 2015:94–95). It has also served as the element for estimating standard length of fish with an allometric equation derived from 61 specimens of mullet curated at the Florida Museum (Sassaman et al. 2015:95). Ninety-two mullet from Feature 25 had a mean estimated standard length of 279.9 ± 48.4 mm. The limited variance of this assemblage ($cv = 0.17$) suggests a same-age population, roughly about three years of age given an average length of ~28 cm. Additional allometric data on Shell Mound mullet come from the work of Mahar (2019), whose formula is based on mullet collected in the Lower Suwannee area by the Florida Wildlife Commission. Her archaeological sample of 243 mullet atlases from six large pits produced an average estimated standard length of 290.7 ± 38.1 mm. Like that from Feature 25 alone, the low variance of this larger sample ($cv = 0.13$) points to a population of fish of similar age. Same-age capture implies mass capture, which is the inferred purpose of the tidal fish trap at Richards Island (8LV137), two kilometers south of Shell Mound (Sassaman et al. 2026).

Table 4-5 lists the values of atlas measurements and estimated standard length for 100 mullet represented in the ¼-inch recovery of level matrix from TU15S. As noted earlier, most of the mullet bone from this unit came from the lower two levels, Levels G and H, inferred to be autochthonous deposits of a possible midden mound dating to ca. AD 550–650, the last century of Shell Mound occupation. Descriptive statistics on these variables, by level provenience, are given in Table 4-6. Collectively, 100 mullet from TU15S average 289.1 ± 46.6 mm in estimated standard length, and vary by only 16 percent ($cv = 0.16$). The TU15S population is thus nearly identical to mullet from large, infilled pits in density, body size, and limited variation. This goes to suggest that the mass capture methods used to provision summer solstice feasts were the same as those that resulted in the deposition of mullet bone in shell-rich matrix of TU15S of the south ridge. Given a presumed drop in sea level after about AD 550, the Richards Island fish trap must have become unreliable for timing capture and harvest to specific times of the year, notably mid-to-late June (Sassaman et al. 2026). This does not, however, preclude its use over the final century of Shell Mound occupation to times when the trap was flooded with water, and fish, during spring tides and super tides, irrespective of the timing of annual solar events.

CONCLUSION

Invertebrate and vertebrate faunal remains from the 2025 salvage excavations of Shell Mound are the familiar taxa of previous excavations. Differences among these remains across various contexts at Shell Mound are not always conspicuous but potentially meaningful with respect to site formation and occupational history. As with most deposits investigated at Shell Mound, oyster shell dominates the mollusks remains of TU15/15S, but here at 10 percent more than any other place tested. The higher value owes to lack of other taxa in more than trace frequency. The contrast is starkest with contents of large, infilled pits. The latter includes a substantial amount of hard clam and lightning whelk, as well as crown conch. In its lack of diversity, the mollusk assemblage of TU15/15S is most similar to the assemblage from TU11 of the south ridge (Sassaman et al. 2019:81).

Oyster shell from TU15/15S lacks the evidence for mariculture that was documented by Jenkins (2016, 2017) from samples of the north ridge. Most of the shells from TU15/15S are from relatively small oysters, and right valves dominate over left valves throughout the nearly 4-m-deep profile. Both intertidal and subtidal harvests are indicated by the presence/absence of sponge boring, but the latter are only about 10 mm larger on average and generally the same shape. Sponge boring on attachment scars provides limited evidence for culling.

Finally, vertebrate faunal remains from TU15/15S are split between an assemblage dominated by mullet in the stratum of a presumed midden-mound postdating AD 600, and a smaller but more diverse assemblage from a capping deposit that may or may not have come from extant midden. The former attests to late-period dwelling at Shell Mound at a time just before the south ridge took shape as a more-or-less continuous ridge, evidently in conical midden-mounds and presumably occupied by a single household. If so, residents of midden-mound captured same-age mullet using mass capture methods, such as the fish trap at Richards Island.

Table 4-5. Atlas Widths (mm) and Estimated Standard Length (mm) by Level Provenience of 100 Mullet Represented in the 1/-4-inch Matrix of TU15S, Shell Mound (8LV42).

Provenience	Atlas (mm)	Length (mm)	Provenience	Atlas (mm)	Length (mm)
Lev A BAG 20	8.26	396.55	Lev H BAG 28	6.48	320.07
	5.30	268.02		6.50	320.94
	5.36	270.69		5.20	263.55
Lev B BAG 21	5.96	297.28		6.44	318.32
	4.10	213.66		7.06	345.23
	6.66	327.90		6.92	339.18
	5.88	293.75		6.60	325.29
	5.44	274.26		4.54	233.78
Lev D BAG 23	3.94	206.28		5.68	284.91
	6.62	326.16		6.82	334.85
	5.70	285.80		6.66	327.90
Lev E BAG 24	4.90	250.08		4.34	224.67
	5.06	257.27		5.96	297.28
	7.64	370.15		6.30	312.20
Lev F BAG 25	5.04	256.38		6.28	311.33
	7.64	370.15		6.66	327.90
	5.52	277.82		4.96	252.78
	6.78	333.11		5.10	259.07
	4.50	231.96		5.34	269.80
Lev G BAG 26	4.74	242.85		5.66	284.03
	6.24	309.58		7.12	347.82
	5.94	296.40		6.86	336.58
	5.32	268.91		3.96	207.21
	6.12	304.31		5.08	258.17
	4.72	241.95		6.06	301.68
	5.22	264.44		5.42	273.37
	5.00	254.58		4.98	253.68
	5.38	271.59		5.92	295.52
	6.12	304.31		6.20	307.82
	5.24	265.34		5.50	276.93
	4.76	243.76		5.12	259.96
	5.62	282.26		6.04	300.80
	4.98	253.68		5.10	259.07
	6.58	324.42		4.14	215.50
	7.18	350.41		5.88	293.75
	5.98	298.16		6.10	303.44
Lev H BAG 28	6.70	329.64		5.56	279.59
	6.94	340.04		4.58	235.60
	5.52	277.82		4.34	224.67
	6.08	302.56		5.46	275.15
	6.74	331.38		4.34	224.67
	7.66	371.01		3.88	203.51
	7.38	359.01		5.16	261.76
	7.18	350.41		5.90	294.64
	6.78	333.11		4.86	248.27
	7.32	356.43		4.48	231.05
	8.54	408.40		4.54	233.78
	7.98	384.66		4.12	214.58
	6.82	334.85		4.36	225.58
	6.74	331.38		4.14	215.50

Table 4-6. Descriptive Statistics of Atlas Width (mm) and Estimated Standard Length (mm) by Level Provenience of 100 Mullet Represented in the 1/-4-inch Matrix of TU15S, Shell Mound (8LV42).

Mullet Atlases (mm)						
Level	n	mean	sd	min	max	cv
A	3	6.31	1.69	5.30	8.26	0.27
B	6	5.33	1.09	3.94	6.66	0.20
D	2	6.16	0.65	5.70	6.62	0.11
E	4	5.66	1.32	4.90	7.64	0.23
F	5	5.84	1.34	4.50	7.64	0.23
G	18	5.78	0.76	4.72	7.18	0.13
H	62	5.80	1.10	3.88	8.54	0.19
Total	100	5.79	1.05	3.88	8.54	0.18

Mullet Standard Length (mm)						
Level	n	mean	sd	min	max	cv
A	3	311.76	73.45	268.02	396.55	0.24
B	6	268.86	48.80	206.28	327.90	0.18
D	2	305.98	28.54	285.80	326.16	0.09
E	4	283.47	57.88	250.08	370.15	0.20
F	5	291.18	59.19	231.96	370.15	0.20
G	18	289.10	33.36	241.95	350.41	0.12
H	62	289.58	48.49	203.51	408.40	0.17
Total	100	289.08	46.56	203.51	408.40	0.16

CHAPTER 5

MEASURING AND MODELING STORM SURGE IMPACT

In January 2025, efforts to quantify impacts to Shell Mound from Hurricane Helene were initiated by Lukas M. Desjardins. Drone-mounted LiDAR data of Shell Mound collected in November 2018 and December 2024 by the GatorEye Unmanned Flying Laboratory provided a baseline for this analysis. Digital elevation models (DEMs) from this LiDAR data were used to produce a DEM of difference (DoD) that measures the change in elevation across these two datasets. The DoD provides a means to examine hurricane impacts at an intra-site level, quantifying how the surface of a site has changed over time.

Analysis of the DoD supports the conclusion that erosion from Hurricane Helene was concentrated along existing road cuts. Significant erosion was further identified along historical shell mining cuts at the southern end of the site. Following analysis of the 2018–2024 DoD, generalized additive models (GAMs) were used to evaluate the relationships between topographic factors (slope, elevation, curvature, and aspect) and hurricane vulnerability. Slope and curvature were found to have the most significant effect on vulnerability, with areas of high slope and high curvature displaying the greatest frequency of severe erosion. At Shell Mound, high slope and high curvature areas tend to concentrate in places where mechanical earthmoving has truncated the original slope of the site.

This chapter begins by summarizing the data and methods used for development and analysis of the 2018–2024 DoD of Shell Mound. Second, results from the quantification efforts are presented. Finally, the DoD is presented as a tool for evaluating future hurricane vulnerability at Shell Mound through GAM-based vulnerability modelling.

DATA AND METHODS

Topographic data were collected by GatorEye Unmanned Flying Laboratory using drone-mounted LiDAR in November 2018 and December 2024 (Broadbent et al. 2018). Deliverables provided by GatorEye for Shell Mound included point cloud data, digital elevation models (DEMs), digital surface models (DSMs), and canopy height models (CHMs). The GatorEye DEMs (0.5 m resolution) were used for the current investigation. DEMs were prepared for analysis using ArcGIS Pro (v3.5.3). The DEMs were cropped to a primary area of interest centered on Shell Mound, and areas inundated by water were removed from the two DEMs to minimize the effect of changes in water level on the analysis (Figure 5-1). The area of interest comprises 33,724 m² (3.37 ha).

The DoD is a raster measuring change in elevation across two points in time. The DoD was used to measure change in elevation at Shell Mound between 2018 and 2024, before and after Hurricane Helene. The DoD was developed in RStudio (v2024.12.1+563) using raster algebra to subtract the 2018 DEM from the 2024 DEM (Figure 5-2). DEM derivatives for slope, curvature, and aspect were also produced for comparison between terrain factors and the DoD.

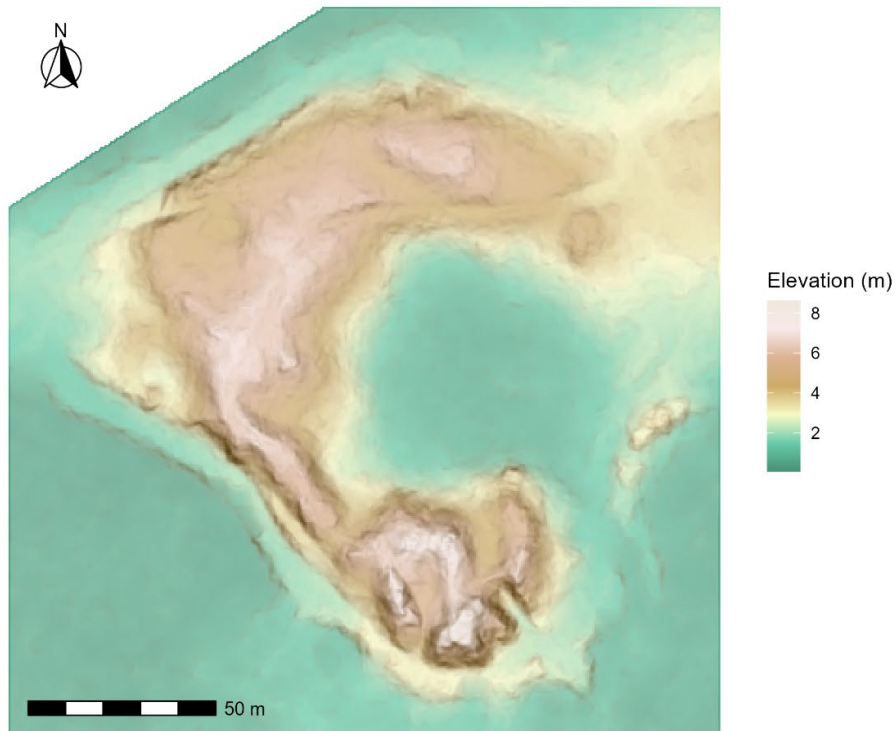
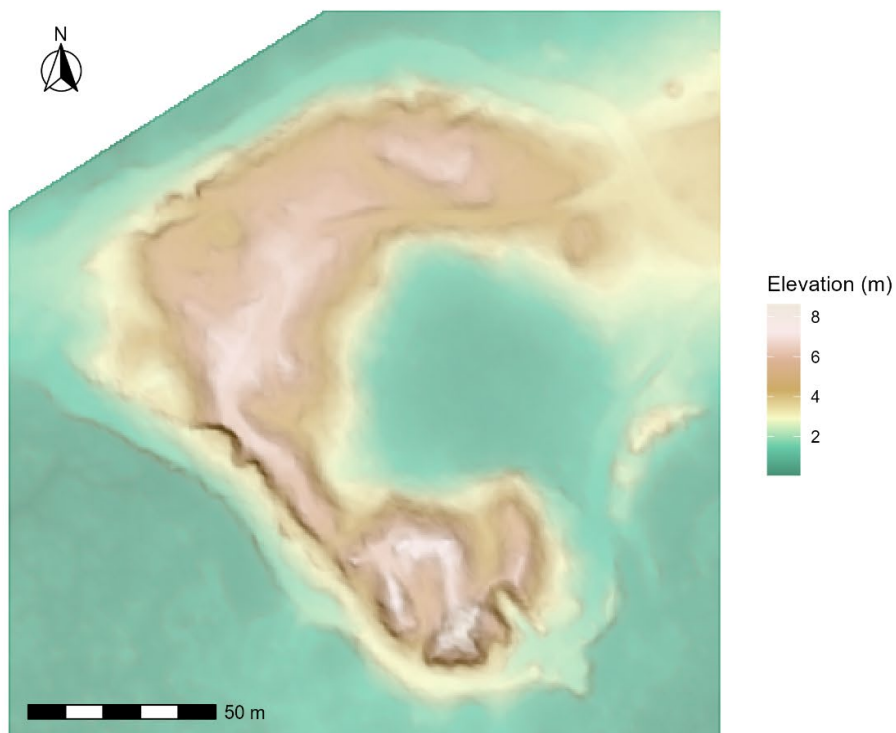
Shell Mound (8LV42) - 2018**Shell Mound (8LV42) - 2024**

Figure 5-1. Slope over DEM of Shell Mound from 2018 (top) and 2024 (bottom).

Positive change in elevation corresponds to deposition, and negative change in elevation corresponds to erosion. In Figure 5-2, erosion is indicated in brown and deposition is indicated in blue.

For this analysis, the most significant impacts are assumed to be acute impacts from Hurricane Helene. Data are not available for the intervening years (2019–2023), and therefore it is likely that the impacts identified here constitute a palimpsest of hurricane impacts, the long-term effects of coastal erosion, and land subsidence. Based on field reconnaissance immediately following Hurricane Helene, the most severe impacts can be attributed to Hurricane Helene, and are of primary concern for evaluating site vulnerability.

To quantify measurement uncertainty, the DoD of a stable area (a road northeast of the site) was analyzed. This DoD had a standard deviation of approximately 5 cm, which was used as a threshold for change detection in the following section. Areas of significant erosion/deposition were separated from areas of minor erosion/deposition using a 15-cm threshold (see Figure 5-2). Three thresholds were therefore used to quantify erosion and deposition: 0 cm, 5 cm, and 15 cm. The volume of material added or removed from each cell was calculated by multiplying the change in elevation by 0.25 m^2 .

QUANTIFICATION RESULTS

A cursory examination of the DoD was consistent with findings from field reconnaissance following Hurricane Helene. The most significant impacts were concentrated along existing anthropogenic disturbances, including the circumferential road cut and cuts from shell mining at the southern end of the site. The effects of mechanical earth moving in the past century created steep escarpments that are liable to erode during storm surges. The most severe area of erosion corresponds to the escarpment along the south ridge which is the subject of this report.

Table 5-1 provides a statistical summary of the DoD using a 0-, 5-, and 15-cm threshold for change. The maximum erosion depth was 178 cm, and the maximum deposition height was 95 cm. At the 0-cm threshold, including all measured change, erosion affected 52.1 percent of the site area with a mean depth of 8.5 cm, while deposition covered 47.9 percent of the area with a mean height of 8.6 cm. The parity between these values suggests that at the scale of individual cells, erosion and deposition were roughly balanced in spatial extents, though the greater maximum erosion depth indicates more extreme erosional processes.

Applying a 5-cm threshold, which filters out minor changes attributable to measurement noise, revealed that 30.5 percent of the total area exhibited erosion with a mean depth of 12.8 cm, and 27.0 percent of the total area exhibited deposition with a mean height of 13.4 cm. The total area remaining stable comprises 42.5 percent, with a change in elevation between -5 and 5 cm. Using the 15-cm threshold for severe erosion, 7.7 percent of the total area exhibited severe erosion with a mean depth of 23.7 cm, and 7.1 percent of the total area

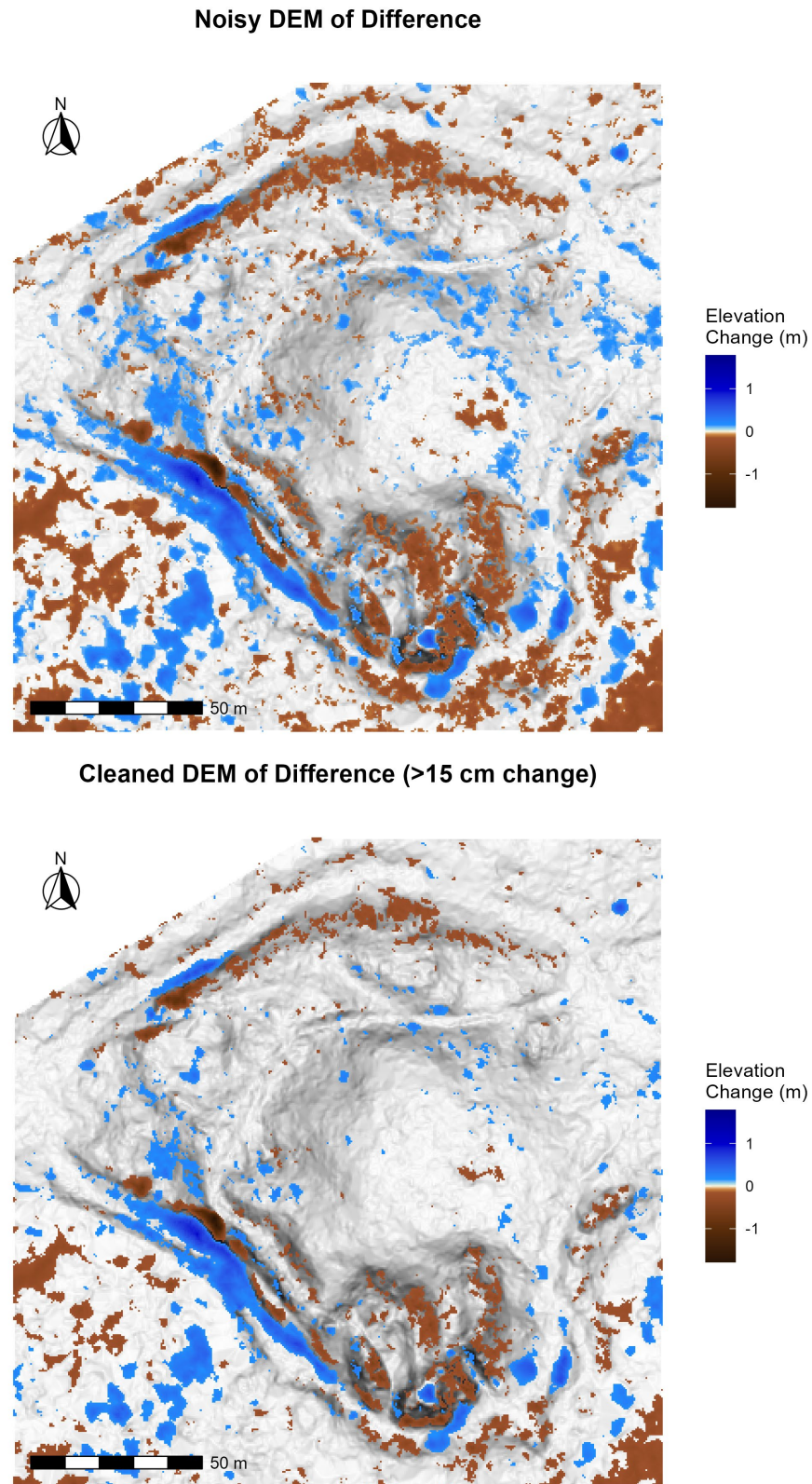


Figure 5-2. Noisy (top) and Cleaned (bottom) DoD (2018-2024 comparison).

Table 5-1. Statistical Summary of DoD.

Threshold (cm)	Mean Erosion (cm)	Mean Deposition (cm)	Eroded cells (%)	Deposited cells (%)	Stable cells (%)
0	8.5	8.6	52.1	47.9	0.0
5	12.8	13.4	30.5	27.0	42.5
15	23.7	26.4	7.7	7.1	85.2

exhibited severe deposition with a mean height of 26.4 cm. The total area remaining stable comprises 85.2 percent, with a change in elevation between -15 and 15 cm.

Across all thresholds, erosion affected a slightly greater proportion of the site than deposition, though mean deposition heights were consistently higher than mean erosion depths. Spatial clustering was also examined using Moran's I, which tests whether eroded/deposited areas were spatially clustered. Positive values indicate clustering, while values near zero suggest random distribution. Moran's I revealed significant positive spatial clustering across all thresholds for erosion ($I = 0.746$ at 0 cm and 5 cm, $I = 0.715$ at 15 cm, all p -values $< 2.22e^{-16}$). Similar clustering was found with deposition, however clustering was found to increase above the 15 cm threshold ($I = 0.773$).

Volume of change was also calculated across the 0-, 5-, and 15-cm thresholds. Table 5-2 provides a summary of the volume quantification. At the 0-cm threshold, the volume of erosion was $1,494.04 \text{ m}^3$ and the volume of deposition was $1,392.75 \text{ m}^3$, for a net loss of 101.28 m^3 of material. At the 5-cm threshold, the volume of erosion was $1,315.77 \text{ m}^3$ and the volume of deposition was $1,225.11 \text{ m}^3$, for a net loss of 90.66 m^3 of material. At the 15-cm threshold, the volume of erosion was 616.35 m^3 and the volume of deposition was 632.86 m^3 , for a net gain of 16.51 m^3 . The relatively small net volume changes across all thresholds relative to gross erosion/deposition volumes suggests that much of the impact from Hurricane Helene involved redistribution of material within or immediately adjacent to the site rather than removal of material. The slight net gain in volume at the 15-cm threshold is likely related to high spatial clustering at this threshold, with material accumulating into piles of redeposited shell.

Table 5-2. Volume of Erosion at 0-, 5-, and 15-cm Thresholds.

Threshold (cm)	Erosion volume (m^3)	Deposition volume (m^3)	Net change (m^3)
0	1,494.04	1,392.75	-101.28
5	1,315.77	1,225.11	-90.66
15	616.35	632.86	16.51

The analysis of both depth and volume of erosion indicates that patterns of erosion and deposition remained relatively consistent across multiple thresholds. Erosion and deposition were found to be spatially clustered, and visual examination of the DoD indicates that this spatial clustering occurred along existing anthropogenic disturbances. The vulnerability modelling presented in the following section further elaborates on the relationship between specific terrain factors and the occurrence of erosion. Further data are required to differentiate the acute impacts of hurricanes and the long-term effects of coastal erosion.

VULNERABILITY MODELLING

The goal of vulnerability modelling is to identify the relationship between terrain factors (slope, curvature, aspect and elevation) and the presence or absence of severe erosion. Severe erosion is defined as erosion values greater than 15 cm, and is likely the result of acute impacts from Hurricane Helene. Using this threshold, the DoD was converted into a binomial dataset. The use of a binomial dataset supports statistical techniques such as binomial logistic regression to calculate the probability of an event occurring (Vaughn and Crawford 2009; Yaworsky et al. 2020).

The vulnerability modelling for Shell Mound utilizes generalized additive models (GAMs) developed in R using the *bam* function. A GAM is a statistical model that compares response values, in this case the presence of severe erosion, with a set of covariates (Yaworsky et al. 2020). The binomial GAM can be expressed as:

$$\log(p/1 - p) = b_0 + f(x_1) + f(x_2) \dots + f(x_p)$$

Where p is the probability of erosion occurring, b_0 is the intercept, and $f(x_n)$ are a set of functions for covariates. $\log(p/1 - p)$ is the logit link function that converts probabilities from 0–1 to an unbounded value, allowing for additive combinations of covariates. For making predictions, the logit-link function can be converted back into a probability ranging from 0–1 through the inverse logit function:

$$p = \frac{1}{(1 + e^{(-x)})}$$

Where p is the probability of erosion occurring, and x is the log-odds from the GAM. Nonlinear covariate relationships are modelled through polynomial transformations and spline functions, while linear relationships are modelling using binomial logistic regression. A generalized linear model (GLM) is a special case of a GAM where all variable relationships are linear.

An initial set of five models were generated for Shell Mound to account for different sets of linear and non-linear relationships with the selected covariates. A sixth model was produced following assessment of the initial models. This analysis included four covariates: slope, curvature, aspect, and elevation. Models were produced with and without spatial autocorrelation, which the X and Y coordinates of each cell to account for spatial patterns not otherwise accounted for by other covariates. The six models are summarized in Table 5-3.

Table 5-3. Summary of Six Models.

Model	Linear factors	Nonlinear factors	Spatial autocorrelation
1	Slope, aspect, curvature, elevation	None	False
2	Slope, aspect, curvature, elevation	None	True
3	None	Slope, aspect, curvature, elevation	True
4	None	Slope, aspect, curvature, elevation	False
5	Slope, curvature	Aspect, elevation	True
6	Elevation, curvature	Slope	False

Models were assessed based on the degrees of freedom (DF) and Akaike information criterion (AIC) values. Degrees of freedom indicate the flexibility of the model, with lower values corresponding to greater generalizability. AIC measures the prediction error and indicates how well the model fits observed values. In general, higher AIC also corresponds to high degrees of freedom. Results for all models are presented in Table 5-4. Deviance explained values indicate how well a model predicts erosion compared to a null model using average erosion values. All deviance explained values display a moderate to very good fit for the data.

All terrain factors displayed some predictive power across all models. Partial effects plots for models 1, 3, and 6 that illustrate the relationship between terrain factors and erosion are presented in Figure 5-4. For model 1, curvature was found to be the strongest predictor, with a coefficient of 5.45 and a p value of $2e^{-16}$. This suggests that convex areas tend to be the most vulnerable to erosion. For slope, a strong positive effect was found with a coefficient of 0.11 and a p value of $2e^{-16}$. For elevation, a strong negative effect was found, with a coefficient of -0.25 and a p value of $2e^{-16}$. However, a strong positive effect between elevation and erosion was found in models with spatial autocorrelation, indicating some spatial confounding in the influence of elevation on erosion. Aspect generally displayed a weak effect, suggesting minimal influence from directionality in erosion patterns. For this reason, it was excluded from Model 6.

Table 5-4. Model Results.

Model	Deviance Explained (%)	DF	AIC	Description
1	14.8	5.00	6948	Basic GLM
2	33.2	32.84	5500	Basic GLM with spatial autocorrelation
3	38.5	50.01	5104	Full GAM with spatial autocorrelation
4	21.1	22.29	6470	Full GAM
5	38.3	44.57	5108	Hybrid GAM (linear slope, non-linear aspect, linear curvature, non-linear elevation) with spatial autocorrelation
6	16.5	9.71	6820	Hybrid GAM (non-linear slope, linear elevation, linear curvature)

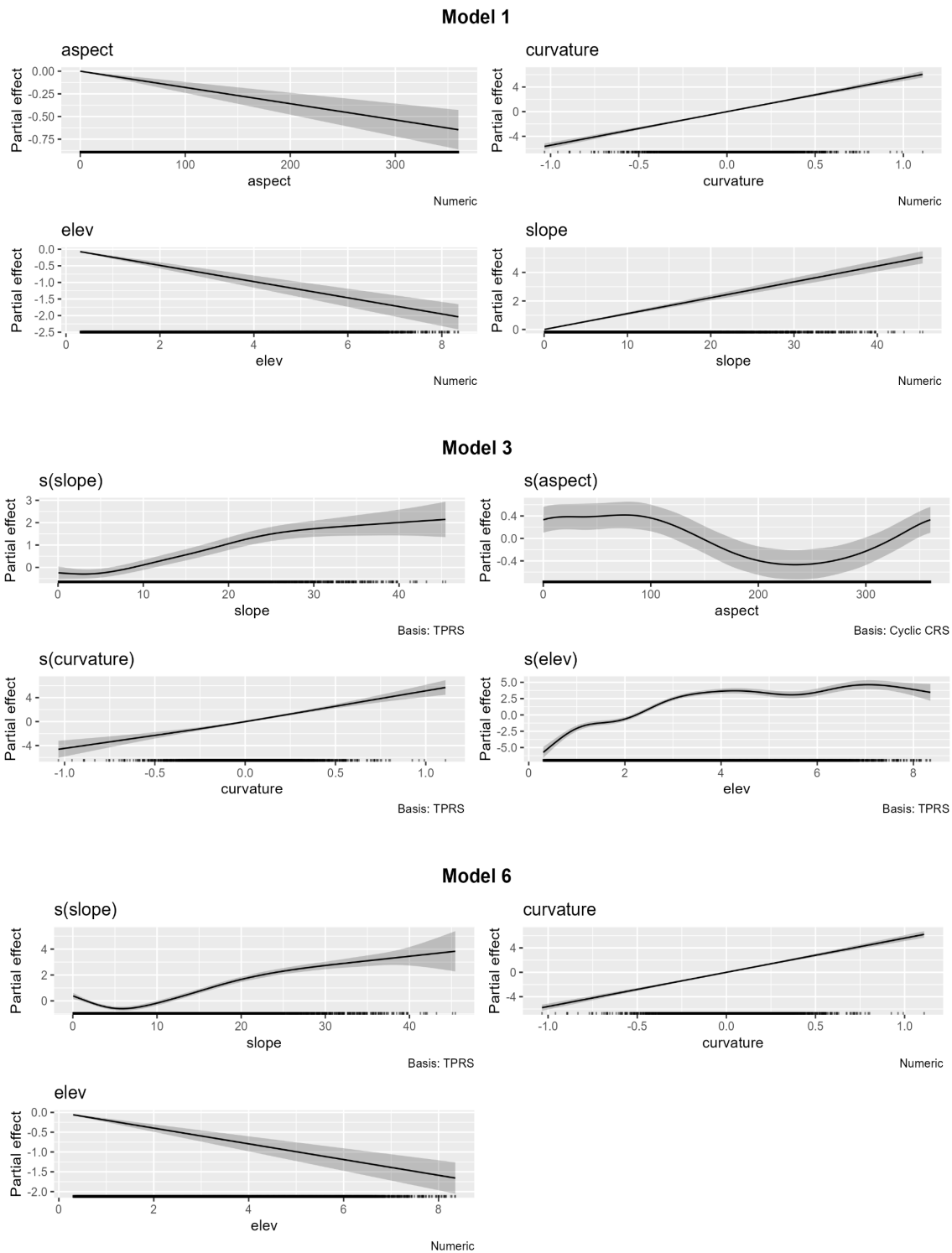


Figure 5-4. Partial Effects Plots for Models 1, 3, and 6.

After initial generation of the models, each was tested against the observed values by generating prediction plots, which were compared to the binary DoD. The prediction plots indicate the probability of erosion occurring at each cell based on the terrain factors from the 2018 DEM. Figure 5-5 presents four of the prediction plots. Visual comparison suggests that models 1, 4, and 6 were the closest to accurately representing the observed outcome.

Comparison between predicted and observed values was also made by classifying the data into four categories: true positive, false positive, false negative, and true negative. For this purpose, an erosion likelihood of 15 percent in the prediction plot was considered positive. A relatively low threshold for positive erosion was selected to provide a conservative estimate of vulnerability. The comparison for prediction accuracy was conducted for Models 1, 3, 4, and 6 and the results are presented in Table 5-5. Accuracy corresponds to the overall rate of correct

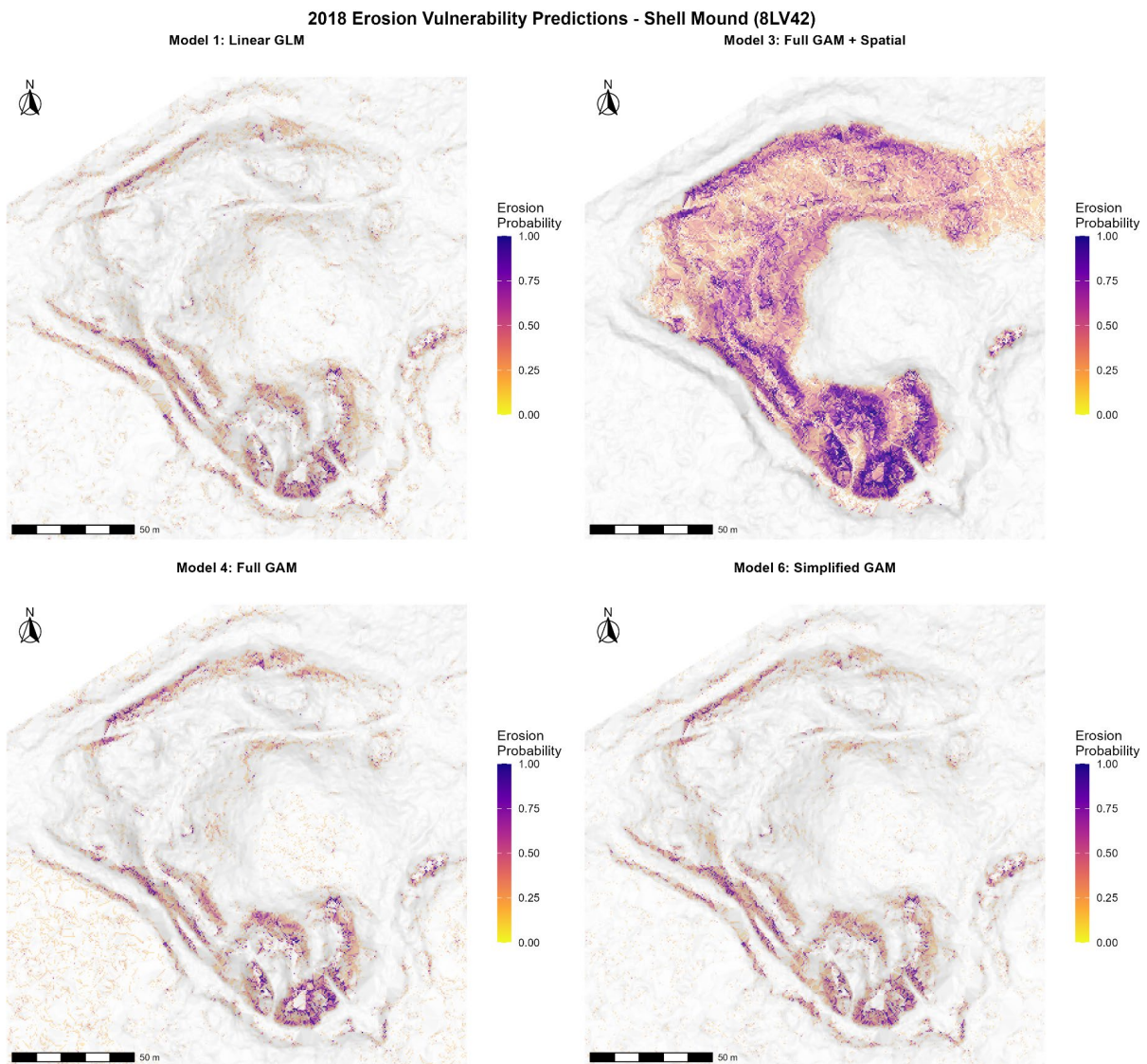


Figure 5-5. 2018 Prediction Plots for Models 1, 3, 4, and 6.

predictions. Sensitivity indicates the rate of true positives for each model. Precision indicates the rate at which each model correctly predicted erosion. All models tend towards false positives. Spatial patterns of prediction accuracy contrast with the prediction accuracy metrics (Figure 5-6). While there was a high rate of false positives for all models, false positives were clustered around areas where severe erosion did occur in Models 1, 4, and 6, and few false negatives were represented in the data. False negatives also tend to be clustered outside of the mound itself.

Table 5-5. Prediction Accuracy Comparison.

Model	Accuracy (%)	Sensitivity (%)	Precision (%)
1	88.5	40.9	31.3
3	88.7	73.8	38.2
4	88.4	46.7	32.4
6	89.0	39.8	32.5

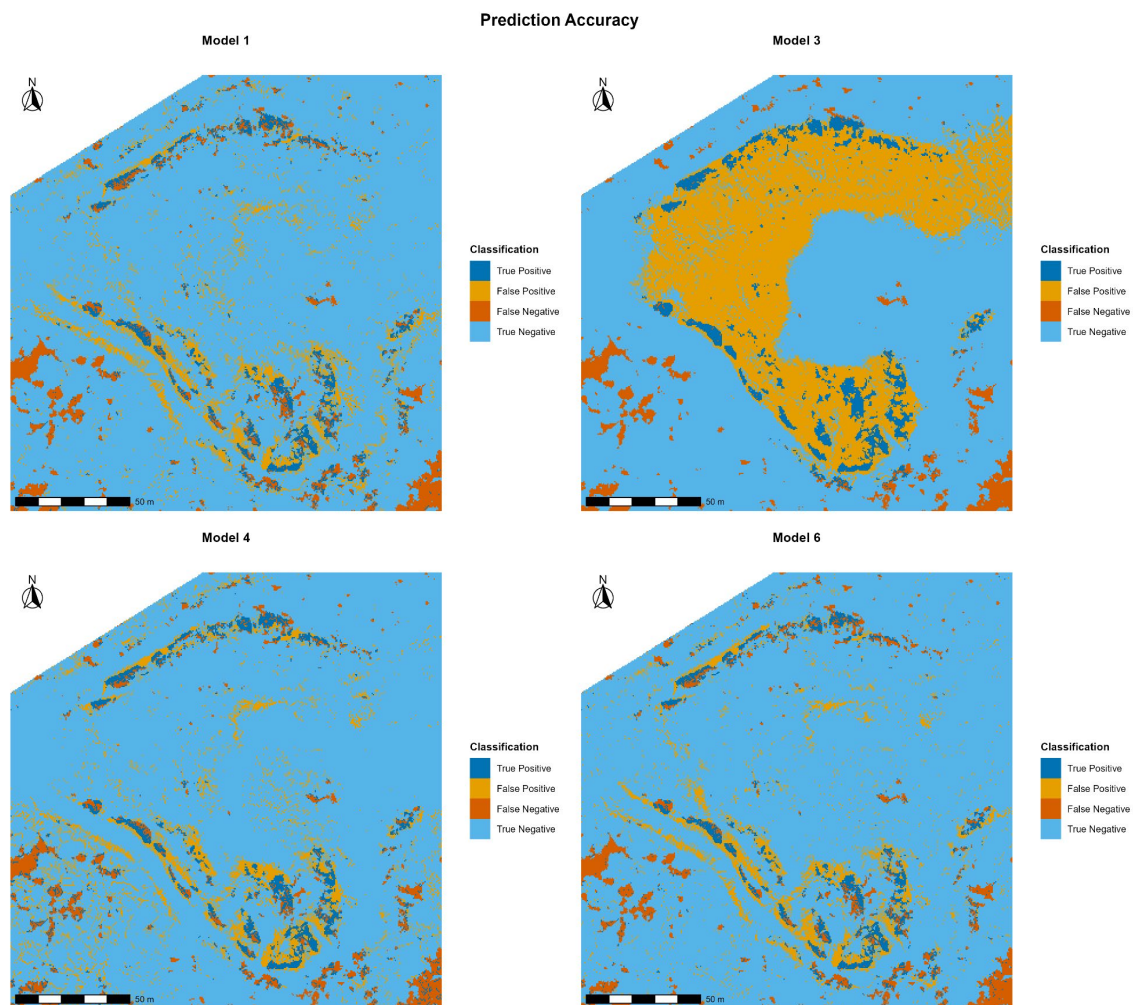


Figure 5-6. Prediction Accuracy Plots for Models 1, 3, 4, and 6.

Model 1 was used to examine vulnerability of Shell Mound following Hurricane Helene based on the 2024 DEM (Figure 5-7). Comparison of the vulnerability plots between 2018 and 2024 indicated that vulnerability remains clustered along modern anthropogenic disturbances, primarily the circumferential roads running along the north and south ridges of the site (Figure 5-8). Mean vulnerability fell, from 7.71 to 6.61 percent, suggesting an overall reduction in vulnerability. This reduction in vulnerability primarily corresponds to areas of high vulnerability in the 2018 prediction plot.

Vulnerability was also classified into low (0–15 percent), moderate (15–30 percent), and high (>30 percent) bands for comparison between the 2018 and 2024 prediction plots. Moderate and high vulnerability areas displayed a decrease of 2.1 and 1.7 percent,

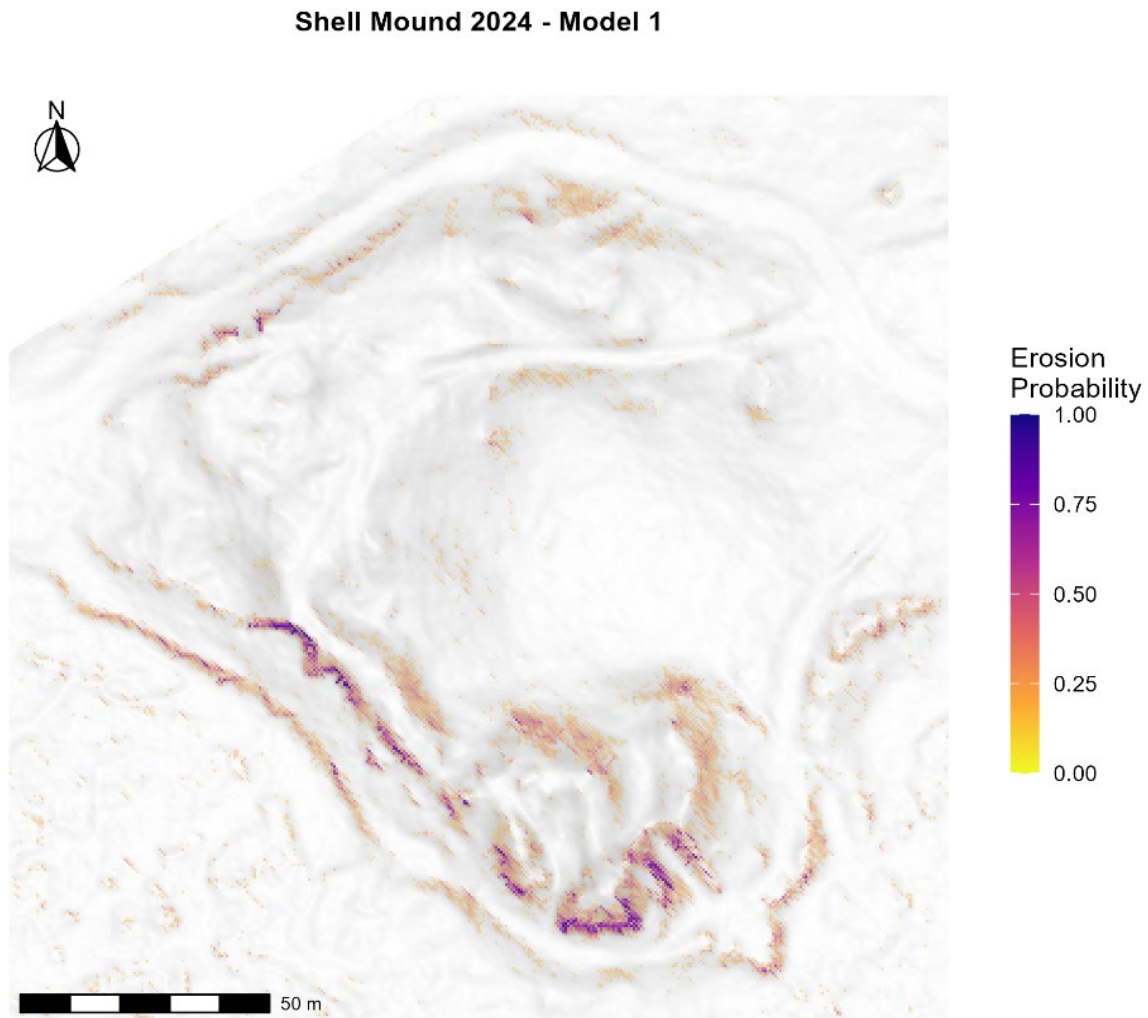


Figure 5-7. Prediction Plot for Model 1 for Shell Mound (2024).

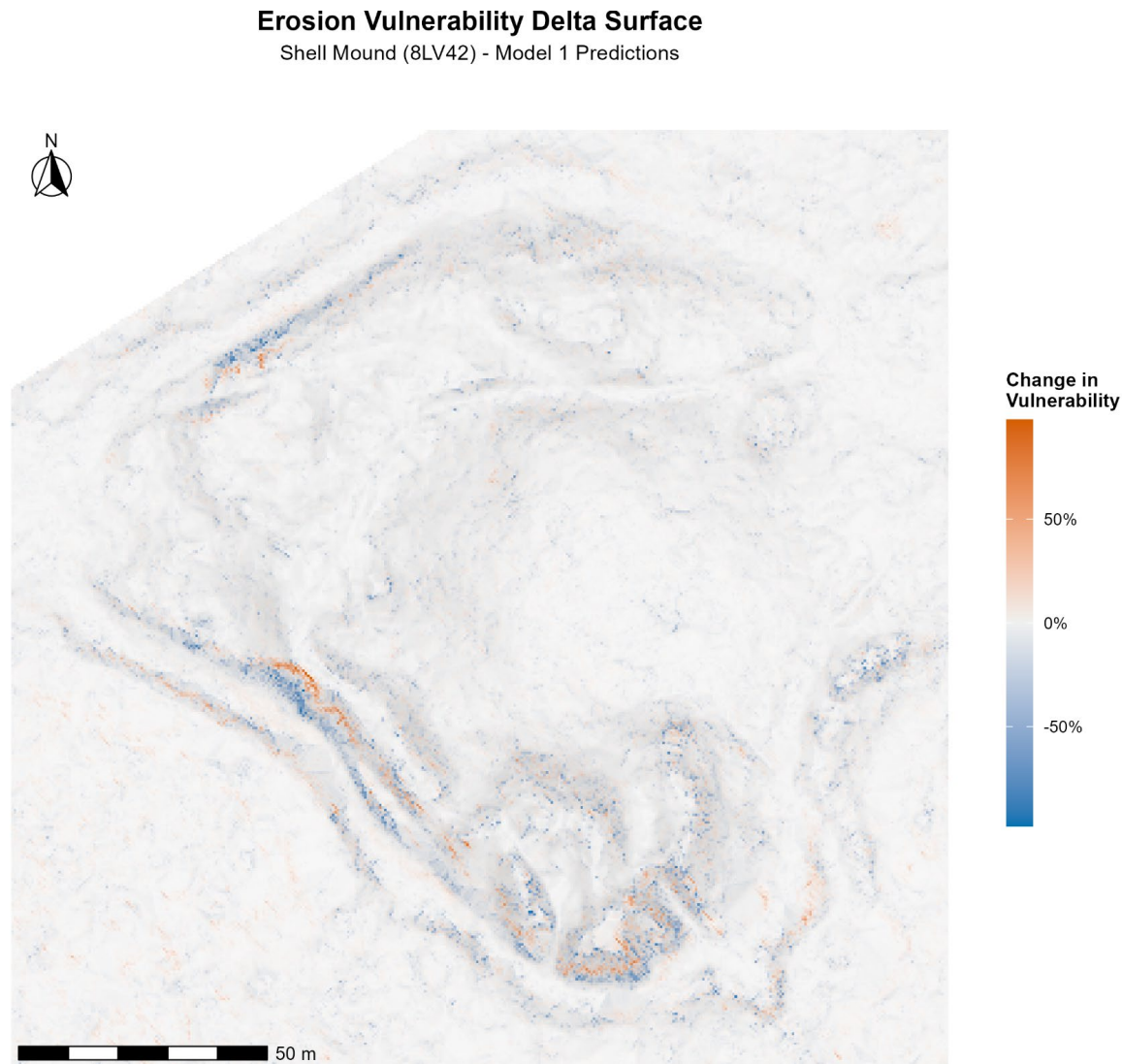


Figure 5-8. Change in Erosion Vulnerability (2018-2024).

respectively. However, the maximum vulnerability did increase from 98.5 to 99.1 percent. In this case, the eroded escarpment along the south ridge displayed a slight increase in vulnerability at specific points while covering a less extensive area. In real world terms, a mass of shell collapsing from this escarpment left behind a smaller but less stable surface, while the redeposited shell shored up unstable surfaces beneath it.

The influence of terrain factors examined here is consistent with the premise that recent anthropogenic disturbances are a primary contributor to vulnerability at Shell Mound. The cuts from road construction and shell mining created escarpments with high slope and curvature that were bombarded by wave action during storm surges. Preparation for future hurricanes should consider how topography influences the differential impacts to the site, and prioritize mitigative interventions in those areas with the greatest vulnerability.

Vulnerability modelling provides a method for identifying areas with a high likelihood for loss of information during future hurricane impacts. Based on the 2024 LiDAR data, the escarpment along the south ridge continues to pose the highest vulnerability for future impacts. However, the 2024 LiDAR data were collected prior to the mitigative excavation presented in this report, and additional LiDAR data need to be collected to determine the impact of this intervention on the site's vulnerability. Vulnerability modelling is also intended as an iterative process, with additional data integrated to further refine models. The single comparison presented here does not represent the entire range of possibilities for site destruction from hurricanes, and further efforts will focus on generating data useful for discriminating between the acute impacts from hurricanes and the long-term effects of erosion.

CONCLUSION

The DoD and vulnerability modelling presented in this chapter are tools that can inform future mitigation strategies for Shell Mound. The statistical analysis of the DoD indicates that impacts from Hurricane Helene followed nonrandom patterns of spatial clustering across multiple thresholds of erosion severity. Vulnerability modelling further accounts for how terrain factors contributed to this spatial clustering, with erosion concentrated in areas displaying high slope and curvature. In general, vulnerable areas tend to be clustered around locations where mechanical earthmoving truncated the original slope of the site. Future management and mitigation plans should account for vulnerability at an intra-site level. Areas with both high vulnerability and high information potential are important candidates for future research excavations. Active mitigation measures should also be considered for areas with a high likelihood of collapse during future hurricanes.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

The storm surge of Hurricane Helene hit directly the south ridge of Shell Mound, where a road cut from the 1970s made it vulnerable to undercutting and mass wasting. The main objective of salvage excavations in 2025, in response to hurricane damage, was to face the tallest eroded profile and to excavate below to substrate to reveal the deepest stratigraphic profile of the south ridge to date. Although the original ground surface beneath the ridge could not be reached without compromising safety, salvage excavations exposed nearly four meters of stratified deposits, the lower half of which attest to autochthonous deposits of possibly a conical midden-mound. The south ridge has long been interpreted as a late-period construction made from extant oyster-rich midden and related deposits, presumably mined from the north ridge, where the earliest occupations and activities took place. The results of salvage work in 2025 undermine this assertion while providing an alternative hypothesis: the south ridge consists of a series of conical midden-mounds dating to the last century of Shell Mound's occupational sequence (AD 550–650) that were later infilled with repurposed shell midden to form a more-or-less continuous ridge.

In this final chapter we put into context the results of 2025 salvage excavations with a focus on the formation of the south ridge. Throughout this report we have compared the results of salvage work to that of prior testing to show that the south ridge was not simply constructed from extant deposits, at least not entirely. Although some of the matrix comprising the south ridge compare favorably to north ridge deposits, oyster shell and pottery from the south ridge differ appreciably from that of the north ridge. The difference between the two is partly due to timing, and it will take additional testing of the south ridge to determine if and how the differences can also be attributed to the types of activities taking place in these respective locations.

The need for additional testing along the south ridge is pressing because it is among the most vulnerable parts of the site to storm surge due to the relatively vertical escarpment created by the road cut dating to the 1970s. The same applies to the access road to the site, which follows the northwest margin of the north ridge, comprised mostly of dune sands. Vulnerability modeling reported by Desjardins in Chapter 5 provides an objective means of prioritizing salvage work relative to questions of relevance, especially the formation of the south ridge but also the earliest components of the north ridge, which formed atop the sand of a parabolic dune arm. Our recommendations for additional salvage work follow at the end of this chapter.

FORM AND FORMATION OF THE SOUTH RIDGE

Prior to salvage work in 2025, our perspective on the formation of the south ridge was predicated on testing near the distal end of the ridge, both its exterior (TU1 and TU2) and interior (TU11) slopes. In the former location we observed Late Archaic and Early Woodland (Deptford) deposits on the original ground surface, beneath mounded shell. But we also documented a pit feature intrusive to these earlier components that produced a calibrated AMS

age estimate of AD 600–660 (Sassaman et al. 2013:21). Much of the overlying shell strata proved to be older than this basal feature (ca. AD 430–600), establishing the first instance of reverse stratigraphy and supporting the inference that the south ridge was constructed from fill mined from elsewhere, presumably the north ridge, and late in the occupational sequence of the site.

Testing of the interior slope of the south ridge duplicated the results of testing of the exterior slope except it lacked basal components predating AD 400. Charcoal from the basal midden of a ~2-m-thick sequence in TU11 returned an age estimate of AD 620–670. Although high water precluded excavation to substrate, we have little reason to suspect earlier components exist beneath the seventh-century AD component. Absent were diagnostic sherds of the Early Woodland period, such as the Deptford Linear Check-Stamped sherds recovered from TU1. Overlying these basal deposits in TU11, like TU1, was redeposited shell midden dating to ca. AD 570–665. Given the overlap of these age estimates, capping deposits could have followed quickly in sequence, but their discombobulated structure resembles redeposited fill, not accretional midden. This was our second observation of reverse stratigraphy in the south ridge.

The results of salvage work in 2025, in TU15/15S, add to the inventory of late-period basal components capped with earlier deposits. As with TU11, the substrate of TU15/15S could not be reached through conventional excavation. The midden observed beneath roughly 3.5 m of shell strata contained charcoal estimated to date AD 565–649. Charcoal from strata immediately above this midden (Stratum X) returned estimates of AD 601–671 (Stratum IX) and AD 583–657 (Stratum VIII). The macrounit of bedded oyster shell above these coeval strata returned three identical AMS age estimates on charcoal of AD 430–600, which matches the age of overlying shell in TU1.

In sum, all three locations of testing in the south ridge have basal components dating to the seventh century AD and overlying shell strata that predate that by a century or two. The Deptford component at the base of TU1 was not observed in either TU11 or TU15/15S, although neither of these units reached the pre-mound substrate. Still, nothing about the Deptford component in TU1 relates to ridge formation; the center of activity during the Deptford phase and up until AD 550 appears to be the north ridge, where a thick early midden (ca. AD 200–400) exists at its apex. We are confident that the south ridge took form after AD 600, most likely after AD 650, and that its construction involved the excavation and emplacement of midden and related deposits that formed over the prior two centuries.

We suspect that before extant midden was mined and emplaced to form the south ridge, occupations starting at about AD 600 resulted in the formation of conical midden-mounds in an arc that would later become the south ridge (Figure 6-1). Based on stratigraphic structure alone, the profile of TU15/15S reveals dip and strike that defies the current outer slope of the ridge. We have seen hints of this before and speculated that the south ridge was initiated as a series of conical mounds (Sassaman et al. 2019:56). However, we never speculated that conical mounds in the ridge consisted of the accretional deposits of daily living. By using the term “midden-mound” we are suggesting that midden formed in place, and was thus autochthonous, not the result of mining and displacing shell midden from elsewhere (i.e., allochthonous).

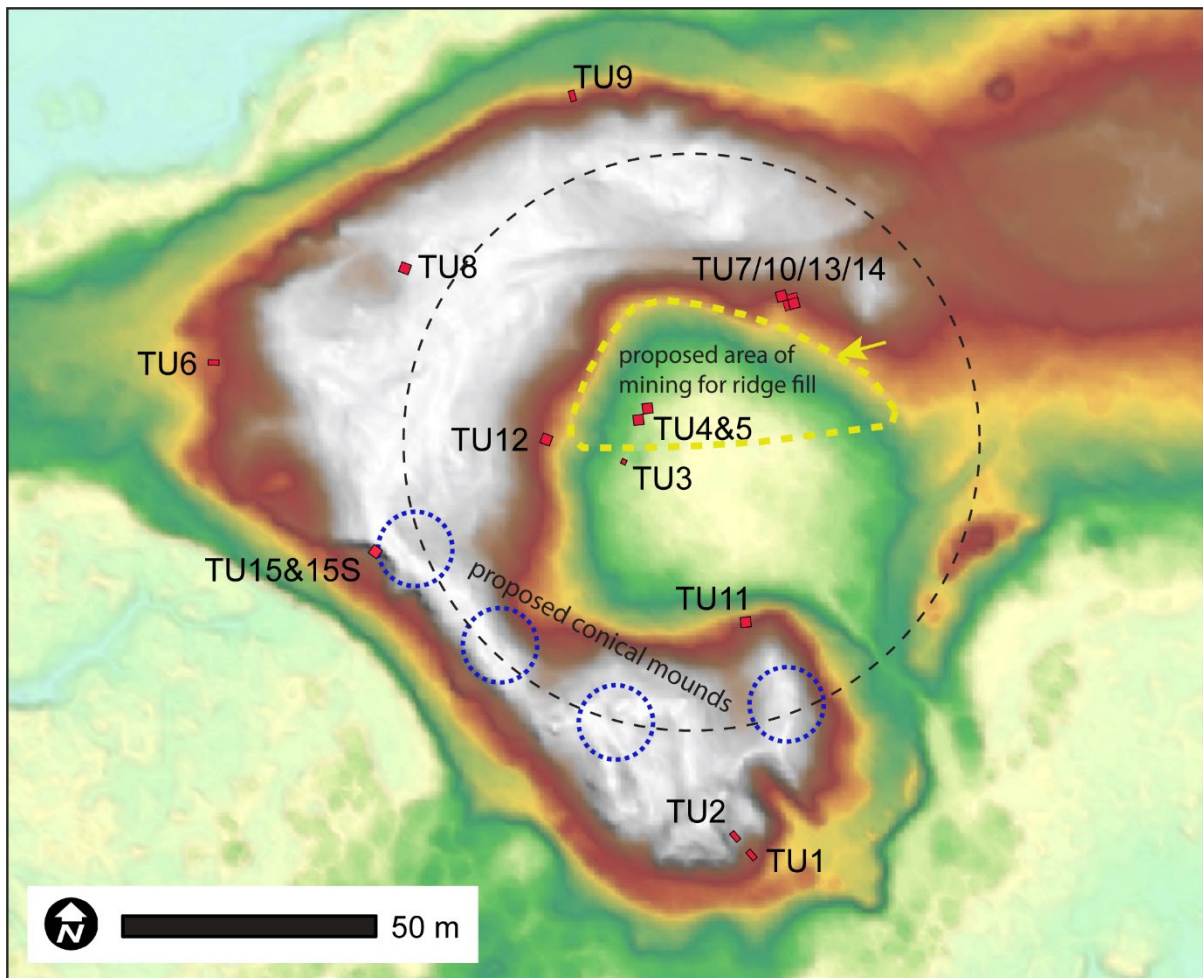


Figure 6-1. Model of the distribution of conical midden-mounds beneath the south ridge of Shell Mound (8LV42) and the proposed location from which extant midden was mined to form the ridge.

Given the evidence for reverse stratigraphy in all test units of the south ridge, its final form indeed included mined and displaced deposits, but not throughout and evidently not at the base of TU15/15S.

Beyond stratigraphic data for a possible conical mound, TU15/15S produced an assemblage of pottery, oyster shell, and vertebrate fauna that deviates in multiple ways from assemblages from the north ridge. Starting with pottery, sherds from TU15/15S lack the diversity of assemblages from the north ridge. Rather, they are overwhelmingly limestone tempered, and plain. The site-wide diversity of pottery at Shell Mound is due mostly to sand-tempered wares, almost all of them early and concentrated in the subshell midden of the north ridge. Some Weeden Island series sherds have turned up in small numbers across the site, but the majority of sand-tempered sherds consists of Early Woodland types (Deptford, Swift Creek), almost all with stamped surface treatments. Sand-tempered cordmarked and fabric-impressed sherds of Early Woodland age accompany those of stamped wares in small numbers.

Lacking an early component, TU15/15S is not expected to include much sand-tempered pottery. More to the point, it is not expected to consist exclusively of repurposed north ridge fill because that is where most of the sand-tempered pottery was first deposited. If the north ridge was mined for constructing the south ridge in the area shown in Figure 6-1, it would include more diverse pottery, not only the aforementioned Early Woodland wares but also the spicule-tempered and sand-tempered bowls that were brought to Shell Mound from elsewhere for summer solstice feasts (Sassaman et al. 2019:70–72).

As for the dominant limestone-tempered sherds from TU15/15S, they conform to parameters for Pasco pottery in the greater Lower Suwannee region, but they are from vessels smaller on average than those from the fill of large pits of the north ridge of Shell Mound. Attributed to the processing of large quantities of food for feasts, the 50-cm-diameter cooking pots from north ridge pits are completely absent in TU15/15S, further discounting the possibility that the south ridge was constructed exclusively from north ridge fill.

Oyster shell from TU15/15S is from a mix of intertidal and subtidal individuals, the latter with some evidence for mariculture but not in the ratio of right to left valves. The differences between oyster shell from the south and north ridges likely involve myriad factors such as season of harvest, where they were collected, taphonomy, and more. Whatever the case may be, nonrandom differences of any sort further undermine the claim that the south ridge consists of only repurposed north ridge fill.

Finally, vertebrate fauna from TU15/15S is not as diverse as the fill of large pits or Early Woodland assemblages from the north ridge, but it does include an abundance of mullet bone, as do the pit assemblages. Allometric analysis shows that the TU15/15S mullet bone comes from fish ~28–30 cm in standard length with limited variance. This same profile matches mullet from pit fill and suggests mass capture of roughly three-year-old fish. Although the similarity here may reflect the mining and repurposing of pit fill from the north ridge, it is also possible that the fish trap for harvesting mullet at Richards Island was used to provision events other than summer solstice feasts (Sassaman et al. 2026).

Substantiating the tentative inference that the south ridge of Shell Mound started as a series of midden-mounds dating to the last century of occupation will require much more than the results of 2025 salvage excavations. In the balance of this chapter, we offer recommendations for additional salvage excavations in places that are most vulnerable to future impacts from storm surge and have the greatest potential for contributing new information on Shell Mound and its history. Clearly, the entire Gulf-facing façade of the south ridge fits the bill, as does the erosional escarpment of the north ridge along the active access road, which has its own research potential on Early Woodland origins.

RECOMMENDATIONS FOR PROACTIVE MITIGATION

Shell Mound will continue to feel the impact of surging storm water and other climatic forces that take advantage of vulnerabilities created by modern human land use. It is unreasonable to advocate for site protection by hardening the shoreline or for mitigating future

impacts through total excavation. It is reasonable, however, to pursue a well-planned, staged program of salvage excavations that are justified by both modeled vulnerability and research potential.

For testing the conical midden-mound model of south ridge formation, we see at least four places along the south ridge where topographic peaks provide datum points for projecting possible locations of mounds (Figure 6-1). Simple cone projections with slopes of 30 degrees determine areas of likely intercepts with downslope surfaces like that inferred from the profiles of TU15/15S. Overlaying these zones with modeled vulnerabilities results in targets for testing that are at highest risk not simply because they are physically compromised but because they have information worth preserving.

It is worth underscoring the need for more data on the final century of occupation at Shell Mound, basically the seventh century AD. The south ridge was constructed during this time, enclosing a plaza that became a focus of settlement, presumably a small circular settlement. The results of salvage work in 2025 add to this chapter the occupation of midden-mounds in an arc projected east and south of the north ridge, which is comprised mostly of dune sand. These results also help to substantiate, in part, the longstanding assertion that the south ridge was constructed of fill taken from the north ridge. The caveat here is that repurposed fill from the north ridge was used to cap existing midden-mounds, not to build the entirety of the south ridge. Evidence in support of a north-ridge provenance for construction fill remains ambiguous. Ambiguity aside, the critical point regarding this century of terraforming is that it coincides with a regression of sea level. Whereas the construction of the south ridge would appear to provide some protection against storm surge for those dwelling in the interior plaza, the risks of flooding should have diminished with falling sea level. Rather, this flurry of terraforming is likely to reflect broader changes, such as the abandonment of other civic-ceremonial centers in the region. Because we have evidence for mass capture of mullet from the midden-mound bone collected in TU15S (Stratum X), sea level had not dropped much, if at all, before AD 600, but over the ensuing decades, changes unfolded that resulted in the terraforming at Shell Mound, more terraforming at the nearby Komar site (8LV290), and by the end of the century, the abandonment of Shell Mound and use of the Richard's Island fish trap, which was a tidal trap vulnerable to changing sea level (Sassaman et al. 2026). It was a time of rapid and dramatic change that can be better understood with more data.

Although it was not part of the 2025 salvage operations, the north ridge of Shell Mound has also been badly impacted by recent storms, mostly along the road cut of its northwest margin. The eroded escarpment here is shallow compared to the south ridge but it follows the margin of the dune arm fronting the water of what was once the blowout of the dune. Our testing along this margin is limited but enough to document an Early Woodland component in basal stratum of accreted shell midden. Likely coeval with occupations of the dune top, these downslope components hold valuable clues to the origins of Shell Mound rituality. An ongoing petrographic project aims to document the variation of pottery attending the founding of Shell Mound as a place of ritual gathering. Preliminary results show marked diversity, with a sizeable fraction of pottery coming from northeast Florida. Shell Mound may be one of the

best places in Florida to document connections among communities spanning the northern peninsula, and its eroding north ridge holds relevant evidence.

A third area of severe impacts from recent storms is along shell mining cuts on the southern margin of the south ridge. Continuous monitoring of this area is pertinent. Because this is one of the more topographically complex portions of the site, impacts from hurricanes are not immediately obvious from visual examination of the surface. The extent and severity of erosion there was primarily identified using Desjardins' DoD. However, additional testing along the shell mining cuts is not recommended at this time, due to the potential for excavation to negatively affect integrity and the previous testing of this area by TU1 and TU2.

Methods of profile facing deployed in 2025 will serve well additional testing of vulnerable profiles of both the south and north ridge. The challenge in both places is the density and size of roots of undercut trees. The siting of TU15/15S was partly a matter of convenience; it was one of the few places along the eroded escarpment that lacked substantial tree cover. Most other places have roots that are now exposed by undercutting and when these trees fall, exposed deposits will be rendered even more vulnerable to storm surge or any storms with heavy rain. Some select cutting of the most vulnerable trees is warranted.

The other challenge, as we encountered in 2025, is the depth of deposits below the modern exterior slope of the south ridge. Additional salvage operations in this location would benefit from large test units, perhaps trenches oriented perpendicular to the ridge. Judicious use of heavy equipment to strip redeposited fill is recommended. The same may be justified for removal of all fill to acquire the deepest and widest profiles possible should the vulnerability of the south ridge of Shell Mound to storm surge grow in coming decades. Much stratigraphic data can be gathered using this method but it does compromise the recovery of artifacts, shell, bone, and other matter by disturbing context. Bulk sampling the walls of trenches dug with heavy equipment is a reasonable compromise.

If and when the time comes to engage in further salvage work, the vulnerability model developed by Desjardins and the midden-mound model proposed here can be compared to find locations of greatest articulation: places that are the most vulnerable to storm surge and with the greatest potential to provide information pertinent to questions of relevance. To best serve this purpose, annual flights to collect Lidar data would enable modeling to take into account both the effects of climate events like hurricanes and the ambient effects of tides, rain, wind, and such on the surface topography of the site. Ultimately, annual data collection on site condition is needed to better plan for Shell Mound's future, be it safe from erosion like it experienced in 2024 or, more likely, subject to bigger and stronger storms as global climate continues to warm.

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**APPENDIX A:
CATALOG**

Catalog Number	Prov.	Level	Material	Material Type	Form	Surf. Treat.	Count	Weight Notes
8LV42.1.1	TU15 A		Invert.	Crown Conch	Hammer		1	27.5 Holes in whorl
8LV42.1.2	TU15 A		Historic	Glass	Bottle Frag		11	5.9 Orange-Brown coloration
8LV42.1.3	TU15 A		Historic	Glass	Bottle Frag		37	23.3 Green coloration
8LV42.1.4	TU15 A		Historic	Metal	Bottle Cap and Seal		2	2.3
8LV42.1.5	TU15 A		Historic	Aluminum	Pull Tab		9	4.8 Different sizes
8LV42.1.6	TU15 A		Historic	Metal	22 Cal Shell		5	4.7
8LV42.1.7	TU15 A		Historic	Metal	Nail		3	5.7
8LV42.1.8	TU15 A		Historic	Metal	Screw		1	1.5
8LV42.1.9	TU15 A		Historic	Synthetic Fiber	Mesh		1	0.3
8LV42.1.10	TU15 A		Historic	Plastic	Seal		1	<0.1
8LV42.1.11	TU15 A		Misc. Rock	UID	UID		1	3.2 Potentially gravel fill - granite like material
8LV42.1.12	TU15 A		Misc. Rock	UID	UID		2	48.4 Potentially coral or limestone
8LV42.1.13	TU15 A		Pottery	Limestone Temp.	Body	Plain	1	14.8 Heterogeneous aplastics
8LV42.1.14	TU15 A		Pottery	Limestone Temp.	Body	Plain	1	2.8
8LV42.1.15	TU15 A		Pottery	Limestone Temp.	Crumb		1	1.6
8LV42.1.16	TU15 A		Pottery	Spicule Temp.	Body	Plain	1	5.3 St. Johns
8LV42.1.17	TU15 A		Vert. Fauna					8.6
8LV42.2.1	TU15 B		Invert.	Crown Conch	Hammer		2	64.5 Holes in whorl
8LV42.2.2	TU15 B		Historic	Metal	Nail		1	4.6
8LV42.2.3	TU15 B		Historic	Aluminum	Pull Tab		3	1.7
8LV42.2.4	TU15 B		Historic	Aluminum	Fixed Tab		1	0.5
8LV42.2.5	TU15 B		Historic	Metal	Bottle Cap		1	1.5
8LV42.2.6	TU15 B		Historic	Aluminum	Pouch Seal		1	0.9
8LV42.2.7	TU15 B		Historic	Glass	Bottle Frag		1	2.2 Orange-Brown coloration
8LV42.2.8	TU15 B		Historic	Glass	UID		2	2.2 Clear/no coloration
8LV42.2.9	TU15 B		Historic	Glass	UID		2	0.8 Green coloration
8LV42.2.10	TU15 B		Pottery	Limestone Temp.	Body	Plain	1	1.7 Heterogeneous aplastics
8LV42.2.11	TU15 B		Pottery	Limestone Temp.	Crumb		5	6.7
8LV42.2.12	TU15 B		Misc. Rock	UID	UID		1	10.8 Potentially gravel fill; granite like material
8LV42.2.13	TU15 B		Misc. Rock	Mudstone	UID		1	58.3
8LV42.2.14	TU15 B		Vert. Fauna					15.9
8LV42.3.1	Surface		Pottery	Limestone Temp.	Body	Plain	2	28.5 Heterogeneous aplastics
8LV42.3.2	Surface		Invert.	Crown Conch	Hammer		1	63.1
8LV42.4.1	TU15 B		Misc. Rock	UID	UID		2	109.8 Potentially coral or limestone
8LV42.4.2	TU15 B BULK		Pottery	Limestone Temp.	Crumb		5	2.6
8LV42.4.3	TU15 B		Invert.	Barnacle	Whole and Frag			33.7
8LV42.4.4	TU15 B		Invert.	Atlantic Rib Mussel	Whole and Frag			1.6
8LV42.4.5	TU15 B		Invert.	Crown Conch	Whole and Frag		2	1.1
8LV42.4.6	TU15 B		Invert.	Misc. Shell	Frag.			6.2
8LV42.4.7	TU15 B		Botanical	Charred Wood				<0.1
8LV42.4.8	TU15 B		Vert. Fauna					6.6
8LV42.4.9	TU15 B		<1/8" Assort. Mat.					619.7
8LV42.4.10	TU15 B		1/4">1/8" Vert. Fauna					17.9

Catalog Number	Prov.	Level	Material	Material Type	Form	Surf. Treat.	Count	Weight Notes
8LV42.4.11	TU15 B		1/4">1/8" Invert.	Misc. Gastropod	Whole and Frag			0.2 Complete, or nearly complete shells
8LV42.4.12	TU15 B		1/4">1/8" Invert.	Assorted Species				660.1
8LV42.4.13	TU15 B		Invert.	Oyster	Right Valve		107	753.8
8LV42.4.14	TU15 B		Invert.	Oyster	Left Valve		79	953.9
8LV42.4.15	TU15 B		Invert.	Oyster	Other			3,583.0
8LV42.5.1	TU15 C		Pottery	Sand Temp.	Crumb		3	1.4
8LV42.5.2	TU15 C		Pottery	Limestone Temp.	Body	Plain	2	5.6
8LV42.5.3	TU15 C		Pottery	Limestone Temp.	Crumb		1	0.7
8LV42.5.4	TU15 C		Historic	Metal	22 Cal Shell		3	1.9
8LV42.5.5	TU15 C		Misc. Rock	UID	UID		1	19.6
8LV42.5.6	TU15 C		Vert. Fauna					51.8
8LV42.5.7	TU15 C		Invert.	Lightning Whelk	Frag.		2	292.9 Fragments, but mostly whole
8LV42.6.1	TU15 C BULK		Pottery	Limestone Temp.	Body	Plain	1	1.9
8LV42.6.10	TU15 C		1/4">1/8" Invert.	Assorted Species				292.0
8LV42.6.11	TU15 C		<1/8" Assort. Mat.					298.4
8LV42.6.12	TU15 C		Invert.	Oyster	Right Valve		137	824.4
8LV42.6.13	TU15 C		Invert.	Oyster	Left Valve		146	1,605.7
8LV42.6.14	TU15 C		Invert.	Oyster	Other			3,073.8
8LV42.6.2	TU15 C		Misc. Rock	UID	UID		1	2.0 Potentially coral or limestone
8LV42.6.3	TU15 C		Invert.	Crown Conch	Whole		1	17.7 Holes in whorl
8LV42.6.4	TU15 C		Invert.	Atlantic Rib Mussel	Frag.			1.1
8LV42.6.5	TU15 C		Invert.	Barnacle	Whole and Frag			9.4
8LV42.6.6	TU15 C		Invert.	Misc. Shell	Frag.		3	0.6
8LV42.6.7	TU15 C		Vert. Fauna					5.7
8LV42.6.8	TU15 C		1/4">1/8" Vert. Fauna					16.4
8LV42.6.9	TU15 C		1/4">1/8" Pottery	Limestone Temp.	Crumb		2	0.1
8LV42.7.1	TU15 D		Pottery	Limestone Temp.	Body	Plain	3	11.2
8LV42.7.2	TU15 D		Misc. Rock	UID	UID		2	13.6 Potentially coral or limestone
8LV42.7.3	TU15 D		Vert. Fauna					49.4
8LV42.8.1	TU15 D		Invert.	Crown Conch	Hammer		1	25.2 Holes in whorl
8LV42.8.2	TU15 D		Invert.	Barnacle	Whole and Frag			0.6
8LV42.8.3	TU15 D		Invert.	Atlantic Rib Mussel	Frag.		2	0.3
8LV42.8.4	TU15 D		Invert.	Hard Clam	Frag.		1	13.6
8LV42.8.5	TU15 D		Invert.	Misc. Shell	Frag.			0.1
8LV42.8.6	TU15 D		Misc. Rock	UID	UID		6	92.7 Possibly limestone, two pairs can be recombined
8LV42.8.7	TU15 D		Vert. Fauna					3.8
8LV42.8.8	TU15 D		<1/8" Assort. Mat.					249.8
8LV42.8.9	TU15 D		1/4">1/8" Vert. Fauna					12.0
8LV42.8.10	TU15 D		1/4">1/8" Assort. Mat.					284.4
8LV42.8.11	TU15 D		Invert.	Oyster	Right Valve		251	1,648.7
8LV42.8.12	TU15 D		Invert.	Oyster	Left Valve		122	1,276.5
8LV42.8.13	TU15 D		Invert.	Oyster	Other			2,769.9
8LV42.9.1	TU15 E		Pottery	Spicule Temp.	Body	Plain	2	10.0 Dunn's Creek Red; recombina

Catalog Number	Prov.	Level	Material	Material Type	Form	Surf. Treat.	Count	Weight Notes
8LV42.9.2	TU15 E		Pottery	Limestone Temp.	Body	Plain	2	17.7
8LV42.9.3	TU15 E		Pottery	Limestone Temp.	Body	Plain	2	21.9 Heterogeneous aplastics
8LV42.9.4	TU15 E		Pottery	Limestone Temp.	Crumb		3	1.3
8LV42.9.5	TU15 E		Vert. Fauna					46.1
8LV42.10.1	TU15 E BULK		Pottery	Limestone Temp.	Crumb		10	9.3
8LV42.10.2	TU15 E BULK		Pottery	Limestone Temp.	Rim	Plain	2	9.3 One folded rim
8LV42.10.3	TU15 E BULK		Pottery	Limestone Temp.	Body	Plain	1	2.7
8LV42.10.4	TU15 E		Misc. Rock	Mudstone	UID		1	5.4
8LV42.10.5	TU15 E		Misc. Rock	UID	UID		1	1.6
8LV42.10.6	TU15 E		Invert.	Crown Conch	Hammer		2	63.8 Holes in whorl
8LV42.10.7	TU15 E		Botanical	Charcoal			4	0.5
8LV42.10.8	TU15 E		Invert.	Crown Conch	Whole and Frag			62.1
8LV42.10.9	TU15 E		Invert.	Barnacle	Whole and Frag			12.3
8LV42.10.10	TU15 E		Invert.	Slipper Snail	Whole and Frag			0.9
8LV42.10.11	TU15 E		Invert.	Atlantic Rib Mussel	Whole and Frag			3.2
8LV42.10.12	TU15 E		Invert.	Misc. Shell	Frag.			3.8
8LV42.10.13	TU15 E		Invert.	Crab	Claw Frag.			2.9
8LV42.10.14	TU15 E		Vert. Fauna					14.6
8LV42.10.15	TU15 E		1/4">1/8" Assort. Mat.					376.1
8LV42.10.16	TU15 E		<1/8" Assort. Mat.					494.8
8LV42.10.17	TU15 E		Invert.	Oyster	Right Valve		248	1,387.8
8LV42.10.18	TU15 E		Invert.	Oyster	Left Valve		218	2,327.9
8LV42.10.19	TU15 E		Invert.	Oyster	Other			3,603.9
8LV42.11.1	TU15 E BULK		Pottery	Limestone Temp.	Rim	Plain	1	2.6
8LV42.11.2	TU15 E		Misc. Rock	UID	UID		3	71.0 Potentially limestone
8LV42.11.3	TU15 E		Invert.	Scallop	Frag.		1	15.9 Mostly complete
8LV42.11.4	TU15 E		Invert.	Barnacle	Whole and Frag			17.0
8LV42.11.5	TU15 E		Invert.	Crown Conch	Whole and Frag		3	12.3
8LV42.11.6	TU15 E		Invert.	Atlantic Rib Mussel	Whole and Frag		3	0.3
8LV42.11.7	TU15 E		Invert.	Crab	Claw Frag.		1	0.5
8LV42.11.8	TU15 E		Invert.	Misc. Shell	Frag.		2	0.6
8LV42.11.9	TU15 E		Vert. Fauna					1.6
8LV42.11.10	TU15 E		<1/8" Assort. Mat.					356.3
8LV42.11.11	TU15 E		1/4">1/8" Invert.	Misc. Gastropod	Whole		6	<0.1
8LV42.11.12	TU15 E		1/4">1/8" Vert. Fauna					9.9
8LV42.11.13	TU15 E		1/4">1/8" Invert.	Assorted Species				342.0
8LV42.11.14	TU15 E		Invert.	Oyster	Right Valve		129	911.6
8LV42.11.15	TU15 E		Invert.	Oyster	Left Valve		69	997.9
8LV42.11.16	TU15 E		Invert.	Oyster	Other			2,510.5
8LV42.12.1	TU15 F		Pottery	Limestone Temp.	Body	Plain	1	36.3 Heterogeneous aplastics
8LV42.12.2	TU15 F		Vert. Fauna					37.1
8LV42.13.1	TU15 F		Invert.	Barnacle	Whole and Frag			14.1
8LV42.13.2	TU15 F		Vert. Fauna					3.0

Catalog Number	Prov.	Level	Material	Material Type	Form	Surf. Treat.	Count	Weight	Notes
8LV42.13.3	TU15	F	Botanical	Charcoal			1	<0.1	
8LV42.13.4	TU15	F	<1/8" Assort. Mat.					145.7	
8LV42.13.5	TU15	F	1/4">1/8" Vert. Fauna					6.5	
8LV42.13.6	TU15	F	1/4">1/8" Invert.					124.5	
8LV42.13.7	TU15	F	Invert.	Oyster	Right Valve		126	1,155.5	
8LV42.13.8	TU15	F	Invert.	Oyster	Left Valve		127	1,864.0	
8LV42.13.9	TU15	F	Invert.	Oyster	Other			3,054.7	
8LV42.14.1	TU15	G	Pottery	Limestone Temp.	Body	Plain	4	37.8	
8LV42.14.2	TU15	G	Pottery	Limestone Temp.	Crumb		4	5.2	
8LV42.14.3	TU15	G	Vert. Fauna					34.0	
8LV42.15.1	TU15	G	Invert.	Crown Conch	Whole and Frag		3	3.7	
8LV42.15.2	TU15	G	Invert.	Slipper Snail	Whole and Frag			1.3	
8LV42.15.3	TU15	G	Invert.	Barnacle	Whole and Frag			18.6	
8LV42.15.4	TU15	G	Invert.	Atlantic Rib Mussel	Whole and Frag			3.5	
8LV42.15.5	TU15	G	Invert.	Crab	Claw Frag.		1	0.3	
8LV42.15.6	TU15	G	Invert.	Misc. Shell	Frag.		2	2.0	
8LV42.15.7	TU15	G	Vert. Fauna					4.5	
8LV42.15.8	TU15	G	<1/8" Assort. Mat.					121.8	
8LV42.15.9	TU15	G	1/4">1/8" Assort. Mat.					140.4	
8LV42.15.10	TU15	G	Invert.	Oyster	Right Valve		159	1,115.7	
8LV42.15.11	TU15	G	Invert.	Oyster	Left Valve		175	1,503.1	
8LV42.15.12	TU15	G	Invert.	Oyster	Other			3,125.3	
8LV42.16.1	TU15	H	Pottery	Limestone Temp.	Rim	Plain	1	20.0	
8LV42.16.2	TU15	H	Pottery	Limestone Temp.	Crumb		2	1.5	
8LV42.16.3	TU15	H	Pottery	St. Johns (Spicule Temp)	Crumb		1	0.3	
8LV42.16.4	TU15	H	Vert. Fauna					69.8	
8LV42.17.1	TU15	H	Misc. Rock	UID	UID		3	155.7	
8LV42.17.2	TU15	H	Invert.	Barnacle	Whole and Frag			37.5	
8LV42.17.3	TU15	H	Invert.	Slipper Snail	Whole and Frag			2.0	
8LV42.17.4	TU15	H	Invert.	Atlantic Rib Mussel	Whole and Frag			4.5	
8LV42.17.5	TU15	H	Invert.	Crown Conch	Whole		1	1.0	
8LV42.17.6	TU15	H	Invert.	Misc. Shell	Frag.		4	35.3	
8LV42.17.7	TU15	H	Vert. Fauna					2.2	
8LV42.17.8	TU15	H	1/4">1/8" Assort. Mat.					181.5	
8LV42.17.9	TU15	H	<1/8" Assort. Mat.					223.0	
8LV42.17.10	TU15	H	Invert.	Oyster	Right Valve		158	1,234.7	
8LV42.17.11	TU15	H	Invert.	Oyster	Left Valve		133	1,541.3	
8LV42.17.12	TU15	H	Invert.	Oyster	Other			3,274.1	
8LV42.18.1	TU15	I	Pottery	Limestone Temp.	Body	Plain	1	6.0	
8LV42.18.2	TU15	I	Pottery	Limestone Temp.	Crumb		1	1.9	
8LV42.18.3	TU15	I	Misc. Rock	Mudstone	UID		1	9.8	
8LV42.18.4	TU15	I	Misc. Rock	UID	UID		1	0.6	Potentially coral or limestone
8LV42.18.5	TU15	I	Invert.	Crown Conch	Hammer		2	100.5	Holes in whorl

Catalog Number	Prov.	Level	Material	Material Type	Form	Surf. Treat.	Count	Weight	Notes
8LV42.23.8	TU15-S D		Invert.	Lightning Whelk	Whorl Frag		1	30.9	
8LV42.23.9	TU15-S D		Vert. Fauna					338.0	
8LV42.24.1	TU15-S E		Pottery	Limestone Temp.	Crumb		4	6.5	
8LV42.24.2	TU15-S E		Pottery	Limestone Temp.	Rim		2	45.5	Sooted
8LV42.24.3	TU15-S E		Pottery	Limestone Temp.	Body	Plain	4	64.6	
8LV42.24.4	TU15-S E		Pottery	Limestone Temp.	Body	Plain	6	47.8	Heterogeneous aplastics
8LV42.24.5	TU15-S E		Misc. Rock	UID	UID		1	144.9	Potentially coral or limestone, oyster valve attachment
8LV42.24.6	TU15-S E		Misc. Rock	Mudstone	UID		2	19.0	
8LV42.24.7	TU15-S E		Invert.	Crown Conch	Hammer		1	38.8	Holes in whorl
8LV42.24.8	TU15-S E		Vert. Fauna					176.1	
8LV42.25.1	TU15-S F		Pottery	Limestone Temp.	Rim	Plain	6	64.3	
8LV42.25.2	TU15-S F		Pottery	Limestone Temp.	Crumb		4	5.5	
8LV42.25.3	TU15-S F		Pottery	Limestone Temp.	Body	Plain	15	110.6	One sooted
8LV42.25.4	TU15-S F		Pottery	Limestone Temp.	Body	Plain	14	122.6	One sooted; heterogeneous aplastics
8LV42.25.5	TU15-S F		Misc. Rock	Mudstone	UID		2	37.0	One potential heat exposure
8LV42.25.6	TU15-S F		Invert.	Crown Conch	Hammer		5	242.0	Holes in whorl
8LV42.25.7	TU15-S F		Vert. Fauna					196.7	
8LV42.26.1	TU15-S G - Zone A		Pottery	Limestone Temp.	Rim	Plain	1	2.9	
8LV42.26.2	TU15-S G - Zone A		Pottery	Limestone Temp.	Body	Plain	10	97.1	Two sooted
8LV42.26.3	TU15-S G - Zone A		Pottery	Limestone Temp.	Body	Plain	5	45.5	Heterogeneous aplastics
8LV42.26.4	TU15-S G - Zone A		Pottery	Limestone Temp.	Crumb		3	6.2	
8LV42.26.5	TU15-S G - Zone A		Invert.	Crown Conch	Hammer		1	78.6	Holes in whorl
8LV42.26.6	TU15-S G - Zone A		Vert. Fauna					96.9	
8LV42.27.1	TU15-S G - Zone B		Pottery	Limestone Temp.	Crumb		1	1.5	
8LV42.27.2	TU15-S G - Zone B		Pottery	Limestone Temp.	Rim	Plain	2	12.8	
8LV42.27.3	TU15-S G - Zone B		Pottery	Limestone Temp.	Body	Plain	9	23.9	
8LV42.27.4	TU15-S G - Zone B		Pottery	Limestone Temp.	Body	Plain	8	52.9	One sooted, one smudged; heterogeneous aplastics
8LV42.27.5	TU15-S G - Zone B		Misc. Rock	Mudstone	UID		1	7.4	Potential heat treatment
8LV42.27.6	TU15-S G - Zone B		Invert.	Crown Conch	Hammer		1	30.4	Holes in whorl
8LV42.27.7	TU15-S G - Zone B		Vert. Fauna					121.3	
8LV42.28.1	TU15-S H		Pottery	Sand Temp.	Body	Plain	1	5.3	
8LV42.28.2	TU15-S H		Pottery	Limestone Temp.	Body	Plain	9	69.8	Heterogeneous aplastics
8LV42.28.3	TU15-S H		Pottery	Limestone Temp.	Body	Plain	22	209.2	Two sooted
8LV42.28.4	TU15-S H		Pottery	Limestone Temp.	Rim	Plain	3	24.3	
8LV42.28.5	TU15-S H		Pottery	Limestone Temp.	Crumb		11	15.4	
8LV42.28.6	TU15-S H		Misc. Rock	UID	UID		1	10.2	
8LV42.28.7	TU15-S H		Invert.	Crown Conch	Hammer		1	49.0	Holes in whorl
8LV42.28.8	TU15-S H		Vert. Fauna					512.4	
8LV42.29.1	TU15-S Wall Clean Up East		Pottery	Limestone Temp.	Rim	Plain	2	28.6	One sooted
8LV42.29.2	TU15-S Wall Clean Up East		Pottery	Limestone Temp.	Body	Plain	4	89.0	Two sooted
8LV42.29.3	TU15-S Wall Clean Up East		Pottery	Limestone Temp.	Body	Plain	5	59.3	Two sooted; heterogeneous aplastics
8LV42.29.4	TU15-S Wall Clean Up East		Pottery	Limestone Temp.	Crumb		2	2.5	
8LV42.29.5	TU15-S Wall Clean Up East		Misc. Rock	Mudstone	UID		1	2.4	Coarse grain

Catalog Number	Prov.	Level	Material	Material Type	Form	Surf. Treat.	Count	Weight Notes
8LV42.29.6	TU15-S Wall Clean Up East		Vert. Fauna					
8LV42.30.1	TU15-S Wall Clean Up West		Pottery	Limestone Temp.	Body	Plain	2	55.6
8LV42.30.2	TU15-S Wall Clean Up West		Vert. Fauna					20.2
8LV42.31.1	TU15-S Bucket Auger 344 cmbd		Pottery	Limestone Temp.	Body	Plain	1	54.8
8LV42.32.1	TU16 A		Pottery	Spicule Temp.	Rim	Plain	1	10.1
8LV42.32.2	TU16 A		Vert. Fauna				4	1.5 St. Johns; potential red paint
8LV42.32.2	TU16 A		Vert. Fauna				1	1.6
8LV42.33.1	TU16 B		Vert. Fauna				1	0.4
8LV42.34.1	TU15-S North Profile Clean Up 0-180 cmbd		Pottery	Limestone Temp.	Crumb		3	4.0
8LV42.34.2	TU15-S North Profile Clean Up 0-180 cmbd		Pottery	Limestone Temp.	Rim	Plain	2	28.5 One sooted
8LV42.34.3	TU15-S North Profile Clean Up 0-180 cmbd		Pottery	Limestone Temp.	Body	Plain	11	95.4 Two sooted
8LV42.34.4	TU15-S North Profile Clean Up 0-180 cmbd		Pottery	Limestone Temp.	Body	Plain	6	23.5 Heterogeneous aplastics
8LV42.34.5	TU15-S North Profile Clean Up 0-180 cmbd		Invert.	Crown Conch	Hammer		1	72.2 Holes in whorl
8LV42.35.1	TU16 C		Misc. Rock	UID	UID		2	46.8 Potentially burnt
8LV42.35.2	TU16 C		Vert. Fauna				2	0.2
8LV42.36.1	TU16 D		Pottery	Limestone Temp.	Body	Plain	2	3.7
8LV42.36.2	TU16 D		Invert.	Crown Conch	Hammer		3	111.6 Holes in whorl
8LV42.36.3	TU16 D		Vert. Fauna				4	3.0
8LV42.37.1	TU16 E		Pottery	Limestone Temp.	Body	Plain	1	9.9
8LV42.37.2	TU16 E		Invert.	Crown Conch	Hammer		2	42.1 Holes in whorl
8LV42.37.3	TU16 E		Vert. Fauna				3	9.4
8LV42.38.1	TU16 Bucket Auger 115-223 cmbd		Pottery	Limestone Temp.	Body	Plain	1	2.5
8LV42.38.2	TU16 Bucket Auger 115-223 cmbd		Pottery	Limestone Temp.	Crumb		5	1.7
8LV42.38.3	TU16 Bucket Auger 115-223 cmbd		Vert. Fauna					10.4
8LV42.40.1	TU15-S STR I - Hi Grade		Pottery	Limestone Temp.	Rim	Plain	1	8.8
8LV42.41.1	TU15-S STR III 29-49 cmbd Hi-Grade		Pottery	Limestone Temp.	Body	Plain	2	10.8 Heterogeneous aplastics
8LV42.41.2	TU15-S STR III 29-49 cmbd Hi-Grade		Pottery	Limestone Temp.	Crumb		1	2.0 Heterogeneous aplastics
8LV42.41.3	TU15-S STR III 29-49 cmbd Hi-Grade		Misc. Rock	Mudstone	UID		2	13.4
8LV42.42.1	TU15-S STR III 49-69 cmbd		Invert.	Crown Conch	Hammer		2	105.6 Holes in whorl
8LV42.42.2	TU15-S STR III 49-69 cmbd		Invert.	Crown Conch	Whole		4	92.8
8LV42.42.3	TU15-S STR III 49-69 cmbd		Invert.	Marsh Clam	Whole		1	15.8
8LV42.42.4	TU15-S STR III 49-69 cmbd		Invert.	Hard Clam	Frag.		1	1.5
8LV42.42.5	TU15-S STR III 49-69 cmbd		Invert.	Slipper Shell	Whole and Frag			3.4
8LV42.42.6	TU15-S STR III 49-69 cmbd		Invert.	Atlantic Rib Mussel	Whole and Frag			2.5
8LV42.42.7	TU15-S STR III 49-69 cmbd		Invert.	Barnacle	Whole and Frag			33.2
8LV42.42.8	TU15-S STR III 49-69 cmbd		Invert.	UID Bivalve	Frag.		2	1.1
8LV42.42.9	TU15-S STR III 49-69 cmbd		Misc. Rock	UID	UID		3	71.6
8LV42.42.10	TU15-S STR III 49-69 cmbd		Vert. Fauna					1.4 vertebrae
8LV42.42.11	TU15-S STR III 49-69 cmbd		Vert. Fauna					3.1 Assorted bones
8LV42.42.12	TU15-S STR III 49-69 cmbd		<1/8" Assort. Mat.					312.5
8LV42.42.13	TU15-S STR III 49-69 cmbd		1/4">1/8" Assort. Mat.					195.0
8LV42.42.14	TU15-S STR III 49-69 cmbd		Invert.	Oyster	Right Valve		228	1,025.3
8LV42.42.15	TU15-S STR III 49-69 cmbd		Invert.	Oyster	Left Valve		211	1,469.5
8LV42.42.16	TU15-S STR III 49-69 cmbd		Invert.	Oyster	Other			3,884.8

Catalog Number	Prov.	Level	Material	Material Type	Form	Surf. Treat.	Count	Weight Notes
8LV42.44.1	TU15-S STR III 49-69 cmbd	Hi-Grade	Pottery	Limestone Temp.	Body	Plain	3	43.0 One sooted
8LV42.44.2	TU15-S STR III 49-69 cmbd	Hi-Grade	Pottery	Limestone Temp.	Crumb		3	2.6
8LV42.44.3	TU15-S STR III 49-69 cmbd	Hi-Grade	Lithic	UID	Core		1	22.9 Fragment
8LV42.44.4	TU15-S STR III 49-69 cmbd	Hi-Grade	Misc. Rock	Mudstone	UID		1	2.9
8LV42.44.5	TU15-S STR III 49-69 cmbd	Hi-Grade	Invert.	Crown Conch	Hammer		1	62.7 Holes in whorl
8LV42.45.1	TU15-S STR III 90-100 cmbd		Pottery	Limestone Temp.	Body	Plain	1	2.1
8LV42.45.2	TU15-S STR III 90-100 cmbd		Misc. Rock	Mudstone	UID		1	2.9
8LV42.45.3	TU15-S STR III 90-100 cmbd		Botanical	Charcoal			4	0.6
8LV42.45.4	TU15-S STR III 90-100 cmbd		Lithic	Mica	Frag.			<0.1
8LV42.45.5	TU15-S STR III 90-100 cmbd		Invert.	Atlantic Rib Mussel	Frag.			5.8
8LV42.45.6	TU15-S STR III 90-100 cmbd		Invert.	Slipper Snail	Whole and Frag			1.2
8LV42.45.7	TU15-S STR III 90-100 cmbd		Invert.	Barnacle	Whole and Frag			26.2
8LV42.45.8	TU15-S STR III 90-100 cmbd		Invert.	Crown Conch	Whole		1	0.5
8LV42.45.9	TU15-S STR III 90-100 cmbd		Invert.	Misc. Shell	Frag.			8.2
8LV42.45.10	TU15-S STR III 90-100 cmbd		Vert. Fauna					5.2
8LV42.45.11	TU15-S STR III 90-100 cmbd		<1/8" Assort. Mat.					159.8
8LV42.45.12	TU15-S STR III 90-100 cmbd		1/4">1/8" Assort. Mat.					177.1
8LV42.45.13	TU15-S STR III 90-100 cmbd		Invert.	Oyster	Right Valve		120	640.9
8LV42.45.14	TU15-S STR III 90-100 cmbd		Invert.	Oyster	Left Valve		89	785.3
8LV42.45.15	TU15-S STR III 90-100 cmbd		Invert.	Oyster	Other			1,774.8
8LV42.46.1	TU15-S Top of STR IV Hi-Grade		Pottery	Limestone Temp.	Body	Plain	1	3.4 Heterogeneous aplastics
8LV42.46.2	TU15-S Top of STR IV Hi-Grade		Vert. Fauna				1	7.1 W - 7 deer
8LV42.47.1	TU15-S STR IV 104-124 cmbd		Misc. Rock	Mudstone	UID		1	12.7
8LV42.47.2	TU15-S STR IV 104-124 cmbd		Misc. Rock	UID	UID		11	10.4 Potentially coral or limestone
8LV42.47.3	TU15-S STR IV 104-124 cmbd		Invert.	Barnacle	Whole and Frag			61.8
8LV42.47.4	TU15-S STR IV 104-124 cmbd		Invert.	Slipper Snail	Whole and Frag			7.5
8LV42.47.5	TU15-S STR IV 104-124 cmbd		Invert.	Atlantic Rib Mussel	Frag.			2.4
8LV42.47.6	TU15-S STR IV 104-124 cmbd		Invert.	Crown Conch	Whole and Frag			11.4
8LV42.47.7	TU15-S STR IV 104-124 cmbd		Invert.	Misc. Shell	Frag.			2.2
8LV42.47.8	TU15-S STR IV 104-124 cmbd		Invert.	Crab	Claw Frag.		2	1.1
8LV42.47.9	TU15-S STR IV 104-124 cmbd		Vert. Fauna					7.8 Vertebrae
8LV42.47.10	TU15-S STR IV 104-124 cmbd		Vert. Fauna					33.6 Assorted bones
8LV42.47.11	TU15-S STR IV 104-124 cmbd		<1/8" Assort. Mat.					902.9
8LV42.47.12	TU15-S STR IV 104-124 cmbd		1/4">1/8" Invert.	Slipper Snail	Whole and Frag			5.8
8LV42.47.13	TU15-S STR IV 104-124 cmbd		1/4">1/8" Invert.	Barnacle	Whole and Frag			152.2
8LV42.47.14	TU15-S STR IV 104-124 cmbd		1/4">1/8" Invert.	Crab	Claw Frag.			1.8
8LV42.47.15	TU15-S STR IV 104-124 cmbd		1/4">1/8" Invert.	Atlantic Rib Mussel	Frag.			4.4
8LV42.47.16	TU15-S STR IV 104-124 cmbd		1/4">1/8" Invert.	UID	Frag.			1.3 Consistent triangular breakage
8LV42.47.17	TU15-S STR IV 104-124 cmbd		1/4">1/8" Invert.	Crown Conch	Whole and Frag		4	0.3
8LV42.47.18	TU15-S STR IV 104-124 cmbd		1/4">1/8" Invert.	UID	Whole and Frag			0.7 Assorted shells and snails
8LV42.47.19	TU15-S STR IV 104-124 cmbd		1/4">1/8" Vert. Fauna					6.3 Burned
8LV42.47.20	TU15-S STR IV 104-124 cmbd		1/4">1/8" Vert. Fauna					7.2 Vertebrae
8LV42.47.21	TU15-S STR IV 104-124 cmbd		1/4">1/8" Vert. Fauna					45.3 Assorted bones

Catalog Number	Prov.	Level	Material	Material Type	Form	Surf. Treat.	Count	Weight Notes
8LV42.47.22	TU15-S STR IV 104-124 cmbd		1/4">1/8" Invert.	Oyster	Frag.			407.6
8LV42.47.23	TU15-S STR IV 104-124 cmbd	Invert.		Oyster	Right Valve		219	1,955.8
8LV42.47.24	TU15-S STR IV 104-124 cmbd	Invert.		Oyster	Left Valve		77	908.1
8LV42.47.25	TU15-S STR IV 104-124 cmbd	Invert.		Oyster	Other			4,086.9
8LV42.48.1	TU15-S STR IV 124-144 cmbd	Pottery		Limestone Temp.	Rim	Plain	2	12.4
8LV42.48.2	TU15-S STR IV 124-144 cmbd	Pottery		Limestone Temp.	Body	Plain	1	5.2
8LV42.48.3	TU15-S STR IV 124-144 cmbd	Pottery		Limestone Temp.	Crumb		2	2.2
8LV42.48.4	TU15-S STR IV 124-144 cmbd	Misc. Rock		UID	UID		1	5.3 Potentially coral or limestone
8LV42.48.5	TU15-S STR IV 124-144 cmbd	Botanical		Charcoal			11	1.0
8LV42.48.6	TU15-S STR IV 124-144 cmbd	Invert.		Crown Conch	Whole and Frag		7	62.9
8LV42.48.7	TU15-S STR IV 124-144 cmbd	Invert.		Barnacle	Whole and Frag			30.8
8LV42.48.8	TU15-S STR IV 124-144 cmbd	Invert.		Scallop	Frag.		1	4.5
8LV42.48.9	TU15-S STR IV 124-144 cmbd	Invert.		Periwinkle Snail	Whole		1	0.6
8LV42.48.10	TU15-S STR IV 124-144 cmbd	Invert.		Atlantic Rib Mussel	Frag.			12.4
8LV42.48.11	TU15-S STR IV 124-144 cmbd	Invert.		Slipper Snail	Whole and Frag			4.8
8LV42.48.12	TU15-S STR IV 124-144 cmbd	Invert.		UID Bivalve	Whole		2	<0.1 Potentially a Tellin, maybe Rose Petal Tellin
8LV42.48.13	TU15-S STR IV 124-144 cmbd	Invert.		Hard Clam	Frag.		4	38.6
8LV42.48.14	TU15-S STR IV 124-144 cmbd	Invert.		Misc. Shell	Frag.		5	2.5
8LV42.48.15	TU15-S STR IV 124-144 cmbd	Invert.		Crab	Claw Frag.			3.3
8LV42.48.16	TU15-S STR IV 124-144 cmbd	Vert. Fauna						32.5
8LV42.48.17	TU15-S STR IV 124-144 cmbd	Invert.		Oyster	Right Valve		275	1,910.5
8LV42.48.18	TU15-S STR IV 124-144 cmbd	Invert.		Oyster	Left Valve		150	1,552.6
8LV42.48.19	TU15-S STR IV 124-144 cmbd	Invert.		Oyster	Other			3,867.8
8LV42.48.20	TU15-S STR IV 124-144 cmbd	1/4">1/8" Assort. Mat.						422.7
8LV42.48.21	TU15-S STR IV 124-144 cmbd	<1/8" Assort. Mat.						1,299.3
8LV42.49.1	TU15-S STR IV 144-164 cmbd	Lithic		Chert	Biface		1	19.0 Bradford, whole
8LV42.49.2	TU15-S STR IV 144-164 cmbd	Pottery		Limestone Temp.	Body	Plain	1	8.8
8LV42.49.3	TU15-S STR IV 144-164 cmbd	Pottery		Limestone Temp.	Crumb		5	3.6
8LV42.49.4	TU15-S STR IV 144-164 cmbd	Invert.		Crown Conch	Hammer		1	77.8 Holes in whorl
8LV42.49.5	TU15-S STR IV 144-164 cmbd	Botanical		Charcoal			4	0.5
8LV42.49.6	TU15-S STR IV 144-164 cmbd	Invert.		Crown Conch	Whole and Frag			104.5
8LV42.49.7	TU15-S STR IV 144-164 cmbd	Invert.		Barnacle	Whole and Frag			46.5
8LV42.49.8	TU15-S STR IV 144-164 cmbd	Invert.		Atlantic Rib Mussel	Frag.			7.7
8LV42.49.9	TU15-S STR IV 144-164 cmbd	Invert.		Slipper Snail	Whole and Frag			2.9
8LV42.49.10	TU15-S STR IV 144-164 cmbd	Invert.		Misc. Shell	Frag.			10.3
8LV42.49.11	TU15-S STR IV 144-164 cmbd	Invert.		Crab	Claw Frag.		2	0.8
8LV42.49.12	TU15-S STR IV 144-164 cmbd	Misc. Rock		UID	UID		2	0.8
8LV42.49.13	TU15-S STR IV 144-164 cmbd	Vert. Fauna						12.8 Vertebrae
8LV42.49.14	TU15-S STR IV 144-164 cmbd	Vert. Fauna						39.7 Assorted bones
8LV42.49.15	TU15-S STR IV 144-164 cmbd	<1/8" Assort. Mat.						988.7
8LV42.49.16	TU15-S STR IV 144-164 cmbd	1/4">1/8" Assort. Mat.						417.4
8LV42.49.17	TU15-S STR IV 144-164 cmbd	Invert.		Oyster	Right Valve		137	871.4
8LV42.49.18	TU15-S STR IV 144-164 cmbd	Invert.		Oyster	Left Valve		95	1,106.2

Catalog Number	Prov.	Level	Material	Material Type	Form	Surf. Treat.	Count	Weight Notes
8LV42.49.19	TU15-S STR IV 144-164 cmbd	Invert.	Oyster	Other				2,982.2
8LV42.50.1	TU15-S STR IV 164-180 cmbd	Pottery	Limestone Temp.	Body	Plain		2	7.5
8LV42.50.2	TU15-S STR IV 164-180 cmbd	Pottery	Limestone Temp.	Crumb			3	1.4 One very light grey
8LV42.50.3	TU15-S STR IV 164-180 cmbd	Botanical	Charcoal				1	<0.1
8LV42.50.4	TU15-S STR IV 164-180 cmbd	Invert.	Barnacle	Whole and Frag				16.8
8LV42.50.5	TU15-S STR IV 164-180 cmbd	Invert.	Hard Clam	Frag.			3	29.5 Fit together, from same shell
8LV42.50.6	TU15-S STR IV 164-180 cmbd	Invert.	Atlantic Rib Mussel	Frag.				1.6
8LV42.50.7	TU15-S STR IV 164-180 cmbd	Invert.	Crown Conch	Whole and Frag			3	2.0
8LV42.50.8	TU15-S STR IV 164-180 cmbd	Invert.	Misc. Shell	Frag.			6	2.6
8LV42.50.9	TU15-S STR IV 164-180 cmbd	Invert.	Crab	Claw Frag.			1	0.3
8LV42.50.10	TU15-S STR IV 164-180 cmbd	Vert. Fauna						1.6 Atlas vertebrae
8LV42.50.11	TU15-S STR IV 164-180 cmbd	Vert. Fauna						36.5 Vertebrae
8LV42.50.12	TU15-S STR IV 164-180 cmbd	Vert. Fauna						35.3 Assorted bones
8LV42.50.13	TU15-S STR IV 164-180 cmbd	1/4">1/8" Invert.	Barnacle	Whole and Frag				26.0
8LV42.50.14	TU15-S STR IV 164-180 cmbd	1/4">1/8" Invert.	Misc. Shells	Whole and Frag				0.1 Assorted shells and snails
8LV42.50.15	TU15-S STR IV 164-180 cmbd	1/4">1/8" Vert. Fauna						2.7 Burned
8LV42.50.16	TU15-S STR IV 164-180 cmbd	1/4">1/8" Vert. Fauna					2	<0.1 Atlas vertebrae
8LV42.50.17	TU15-S STR IV 164-180 cmbd	1/4">1/8" Vert. Fauna						75.7 Assorted bones
8LV42.50.18	TU15-S STR IV 164-180 cmbd	1/4">1/8" Assort. Mat.						180.6 Mostly oyster
8LV42.50.19	TU15-S STR IV 164-180 cmbd	<1/8" Assort. Mat.						538.7
8LV42.50.20	TU15-S STR IV 164-180 cmbd	Invert.	Oyster	Right Valve			159	1,343.6
8LV42.50.21	TU15-S STR IV 164-180 cmbd	Invert.	Oyster	Left Valve			93	1,178.7
8LV42.50.22	TU15-S STR IV 164-180 cmbd	Invert.	Oyster	Other				2,830.0
8LV42.50.23	TU15-S STR IV 164-180 cmbd	Invert.	Slipper Snail	Whole and Frag				1.1
8LV42.51.1	TU15-S STR IV 120-124 cmbd Hi-Grade	Pottery	Limestone Temp.	Body	Plain		1	6.6
8LV42.52.2	TU15-S STR IV 140-144 cmbd	Pottery	Limestone Temp.	Body	Plain		1	5.7
8LV42.53.1	TU15-S STR II 60-80 cmbd	Pottery	Limestone Temp.	Body	Plain		1	4.7
8LV42.53.2	TU15-S STR II 60-80 cmbd	Invert.	Crown Conch	Frag.				33.1
8LV42.53.3	TU15-S STR II 60-80 cmbd	Invert.	Barnacle	Whole and Frag				39.8
8LV42.53.4	TU15-S STR II 60-80 cmbd	Invert.	Slipper Snail	Whole and Frag				3.1
8LV42.53.5	TU15-S STR II 60-80 cmbd	Invert.	Marsh Clam	Whole, one valve			1	10.1
8LV42.53.6	TU15-S STR II 60-80 cmbd	Invert.	Scallop	Frag.				4.7
8LV42.53.7	TU15-S STR II 60-80 cmbd	Invert.	Atlantic Rib Mussel	Whole and Frag				21.0
8LV42.53.8	TU15-S STR II 60-80 cmbd	Invert.	Misc. Shell	Frag.				6.5
8LV42.53.9	TU15-S STR II 60-80 cmbd	Misc. Rock	UID	UID			1	0.6
8LV42.53.10	TU15-S STR II 60-80 cmbd	Invert.	Crab	Claw Frag.				1.7
8LV42.53.11	TU15-S STR II 60-80 cmbd	Vert. Fauna						3.8 Vertebrae
8LV42.53.12	TU15-S STR II 60-80 cmbd	Vert. Fauna						13.9 Assorted bones
8LV42.53.13	TU15-S STR II 60-80 cmbd	1/4">1/8" Assort. Mat.						245.2
8LV42.53.14	TU15-S STR II 60-80 cmbd	<1/8" Assort. Mat.						405.0
8LV42.53.15	TU15-S STR II 60-80 cmbd	Invert.	Oyster	Other				3,400.1
8LV42.53.16	TU15-S STR II 60-80 cmbd	Invert.	Oyster	Right Valve			296	1,107.6
8LV42.53.17	TU15-S STR II 60-80 cmbd	Invert.	Oyster	Left Valve			131	1,360.0

Catalog Number	Prov.	Level	Material	Material Type	Form	Surf. Treat.	Count	Weight Notes
8LV42.54.1	TU15	STR VII 200-210 cmbd	Pottery	Limestone Temp.	Body	Plain	2	9.5
8LV42.54.2	TU15	STR VII 200-210 cmbd	Misc. Rock	UID	UID		1	0.3 Potentially coral or limestone
8LV42.54.3	TU15	STR VII 200-210 cmbd	Invert.	Barnacle	Whole and Frag			10.0
8LV42.54.4	TU15	STR VII 200-210 cmbd	Invert.	Atlantic Rib Mussel	Frag.			1.0
8LV42.54.5	TU15	STR VII 200-210 cmbd	Invert.	Slipper Snail	Whole and Frag			1.4
8LV42.54.6	TU15	STR VII 200-210 cmbd	Invert.	Crab	Claw Frag.		3	1.2
8LV42.54.7	TU15	STR VII 200-210 cmbd	Invert.	UID	Frag.		7	10.8 Likely crown conch
8LV42.54.8	TU15	STR VII 200-210 cmbd	Invert.	UID	Frag.		4	1.4 Consistent grey coloration
8LV42.54.9	TU15	STR VII 200-210 cmbd	Invert.	UID	Frag.		2	0.3
8LV42.54.10	TU15	STR VII 200-210 cmbd	Vert. Fauna					11.4
8LV42.54.11	TU15	STR VII 200-210 cmbd	<1/8" Assort. Mat.					228.4
8LV42.54.12	TU15	STR VII 200-210 cmbd	1/4">1/8" Assort. Mat.					167.1
8LV42.54.13	TU15	STR VII 200-210 cmbd	Invert.	Oyster	Right Valve		199	1,251.9
8LV42.54.14	TU15	STR VII 200-210 cmbd	Invert.	Oyster	Left Valve		161	1,519.8
8LV42.54.15	TU15	STR VII 200-210 cmbd	Invert.	Oyster	Other			2,865.9
8LV42.54.1	TU15	STR VIII	Pottery	Limestone Temp.	Body	Plain	1	2.3
8LV42.55.2	TU15	STR VIII	Invert.	Hard Clam	Frag.		1	34.6
8LV42.55.3	TU15	STR VIII	Invert.	Barnacle	Whole and Frag			11.0
8LV42.55.4	TU15	STR VIII	Invert.	Slipper Snail	Whole		4	0.1
8LV42.55.5	TU15	STR VIII	Invert.	Atlantic Rib Mussel	Frag.			21.6
8LV42.55.6	TU15	STR VIII	Invert.	Misc. Shell	Frag.			3.7
8LV42.55.7	TU15	STR VIII	Vert. Fauna					2.1 Vertebrae
8LV42.55.8	TU15	STR VIII	Vert. Fauna					2.6 Assorted bones
8LV42.55.9	TU15	STR VIII	<1/8" Assort. Mat.					81.3
8LV42.55.10	TU15	STR VIII	1/4">1/8" Assort. Mat.					80.9
8LV42.55.11	TU15	STR VIII	Invert.	Oyster	Right Valve		57	442.3
8LV42.55.12	TU15	STR VIII	Invert.	Oyster	Left Valve		43	445.2
8LV42.55.13	TU15	STR VIII	Invert.	Oyster	Other			1,278.2
8LV42.56.1	TU15	East Profile Clean up 180-230 cmbd	Pottery	Limestone Temp.	Body	Plain	6	104.9
8LV42.56.2	TU15	East Profile Clean up 180-230 cmbd	Pottery	Limestone Temp.	Crumb		1	0.1
8LV42.56.3	TU15	East Profile Clean up 180-230 cmbd	Misc. Rock	Mudstone	UID		1	12.8
8LV42.56.4	TU15	East Profile Clean up 180-230 cmbd	Invert.	Oyster	Left Valve		1	118.2
8LV42.56.5	TU15	East Profile Clean up 180-230 cmbd	Invert.	Lightning Whelk	Whole, unmod.		1	175.7

**APPENDIX B:
RADIOCARBON DATA**

Prov.	Material	Beta Lab Number	Conventional 14C Age BP	13C/12C Ratio (o/oo)	2-sigma cal AD (prob. %)	2-sigma cal BP
TU15 Bag 4	charcoal	736712	1440 ± 30	-24.9	557–653 (95.4)	1373–1297
TU15 Bag 8	charcoal	736713	1330 ± 30	-22.4	649–706 (56.8) 726–773 (38.6)	1301–1244 1224–1177
TU15 Bag 11	charcoal	736714	1530 ± 30	-25.9	527–603 (68.5) 434–519 (26.8)	1423–1347 1516–1431
TU15 Bag 13	charcoal	736715	1530 ± 30	-25.7	527–603 (68.5) 434–519 (26.8)	1423–1347 1516–1431
TU15 Bag 19	charcoal	736716	1530 ± 30	-26.4	527–603 (68.5) 434–519 (26.8)	1423–1347 1516–1431
TU15 Bag 54	charcoal	751463	1430 ± 30	-24.3	583–657 (95.4)	1367–1293
TU15S Bag 42	charcoal	751464	1390 ± 30	-25.5	601–671 (95.4)	1349–1279
TU15S Bag 50	charcoal	751465	1460 ± 30	-26.1	565–649 (95.4)	1385–1301