God's Little Acre Condition Assessment Final Report
March 2022

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Executive Summary

On site survey of God's Little Acre (GLA) offered a comprehensive view of the current conditions and needs of its 641 grave markers. The survey included 370 slate, 207 marble, 59 granite, three concrete and one brownstone marker in addition to one metal plaque. Sixty-nine markers were determined to have high priority (P1) for treatment due to their active accelerated deterioration and high risk of loss relative to the inscriptions. Slate markers were the majority of these. Ninety-eight markers were determined to have a Priority 2 (P2) need of treatment due to incipient issues whose progress of deterioration can be reduced. Priority 3 (P3) includes 208 markers that include slates with minor conditions and previous repairs and marble and granite markers requiring structural repair. Two hundred sixty-six markers are Priority 4 (P4), which includes the majority of marble and granite markers that are in good condition and require only monitoring to observe for acute changes in the short and long term. An analysis of findings and discussion of a future conservation program follow.

I. Introduction

In November 2021, a condition survey was conducted of grave markers at God's Little Acre of the Common Burying Ground of Newport, Rhode Island. Amanda Trienens of Cultural Heritage Conservation in collaboration with Sari Uricheck of Acanthus Conservation examined six hundred and forty-two grave markers and documented observations and images of each marker. Individual and cumulative assessment has provided a snapshot of the current state of conservation needs of the visible material culture. Investigations of buried elements provided a window into what lies below the surface, and the potential for future research.

Analyses of field data provides guidance for the long-term preservation of the grave markers by prioritizing markers for conservation treatment. This field report describes and illustrates conditions found at GLA, providing a glossary with treatment recommendations and suggestions for further material testing and analyses, thus outlining a program for conservation treatment at GLA.

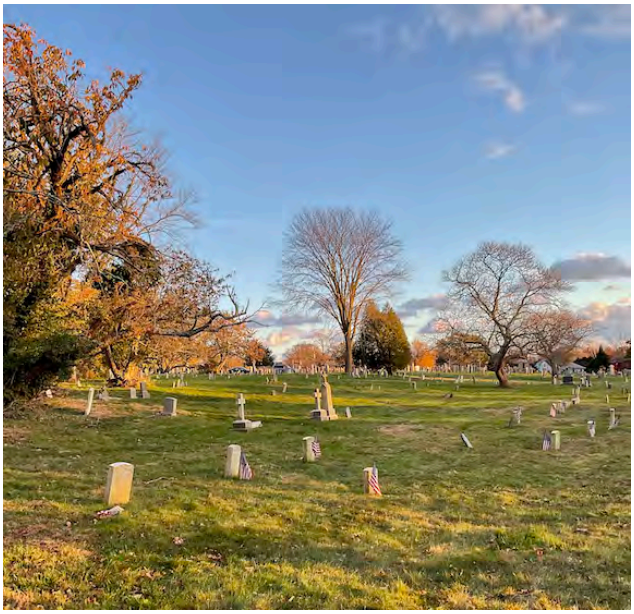
Survey was conducted during three weeks from November 15- 24, and Nov 30-December 2, 2021. Observation and imaging were conducted with natural illumination from sunrise until sunset with augmented light sources as necessary. The climate and weather provided diverse viewing conditions, including rain, frost, clouds, clear, bright, direct, indirect and diffuse sunlight. Frigid temperatures and precipitation, while challenging, provided a glimpse of the normal experience of the markers from morning frost and dew, to complete and partial wetting until maximum warming and drying of mid-day.

Scope of Work

The scope of work was outlined in the Request for Proposal titled RFP GLA Assessment dated September 9, 2021. The RFP stated the work was to include a condition assessment of each cemetery marker with photo-documentation, treatment recommendations, and treatment priority. The documentation of the slate markers should include images of all sides of the markers with their conditions mapped on them; whereas the marble and granite markers were to be individually assessed but not mapped. This survey also added images of each side of those markers unless the monument was too tall to capture an image. A final report was to be drafted including the condition assessment, glossary of conditions, glossary of recommended treatments, and recommendations for material testing and analysis.

Site Description

GLA is the northwest triangle of Newport's Common Burying Ground and is located just over the bridge from the mainland. GLA's borders are defined by three sides: the western edge bounded by Farewell Street, the northeast side separated from other fields of the cemetery by a tree line and fence and the southeastern edge defined by an unpaved driving /vehicular path. GLA includes graves ranging from the early eighteenth century through twentieth century, with many veteran burials of the 19th century, marked with American flags. There are a number of trees in the center and along the edges, some whose root systems are a risk to the grave markers. The burial ground has a slope that runs gradually from the lowest western edge towards the highest elevation at the eastern edge. Grave markers are found concentrated along the perimeters, some in organized rows, and others randomly situated without a standard grid or spacing. While many markers are standing plumb, some on account of resetting, the majority are leaning to some degree. Headstone and monument fronts generally face westward while footstones primarily face towards the east. The southwest corner has a large swath with no visible grave markers. One marker (BE0455) is isolated across the vehicular path from the northeastern corner.



God's Little Acre, view from the northwest corner, November 2022.

GLA's collection of grave markers ranging from the 18th to 20th centuries is comprised of a variety of stones including white marble, various granites, concrete and a number of slates. Their shapes were common typologies from the upright rectangular tablets of marbles, to obelisk of granites, to the simple tablets of slates with an arched tympanum or lunette with side borders and finials. Many headstones, eighty-four in total, had smaller paired footstones, although many locations of footstones are altered from the presumed original adjacent placement. An additional seventeen footstones had no matching headstone. Grave markers of similar types and dates were generally grouped together. Slate varieties of adjacent stones in a group were generally the same, indicating that a temporal or familial connection to stone sources existed (ie: one stone source linked to a time, a family or a carver.)

Methods

Survey included on-site visual examinations with the aid of magnifying lenses and digital capture for zoomed in observation. Photography by tablets at a resolution of 12 megapixels documented conditions and assisted with viewing of subjects that were challenging, for instance, markers set at acute angles under which it was impossible to see. Tapping tests by fingernail or sounding tools were completed to assess the presence of air spaces and detachments between foliate layers and previous mortar fill treatments.

Observations and photo-documentation of grave markers were collected in a customized-made FormConnectPro+ database. The database includes a section of general marker information: Gravestone ID# established in the past by others, the material of the marker, a secondary marker if extant (this would typically consist of a base of a marker

differing from the bulk of the headstone), dimensions of the markers, and whether the marker was a footstone and/or a fragment (or neither). An overall priority rating for treatment considering all factors was assigned by the conservators after surveying each marker. The dimensions were recorded for all elements unless they were buried. Compound markers with Base1 is defined as the stone element in contact with the ground. To note, some markers had two base stones so this stone was called Base 2. The convention of the measurements if not labeled were height by width by depth. The second section of the database is the condition documentation. A list of conditions commonly observed in grave markers was compiled and where appropriate had an associated rating for severity of the condition or priority for treatment of the condition. For two conditions a treatment option is included. A field for notes concludes this section of the form. Pages 2 and 3 of the database form consist of the photo-documentation of all sides of the markers and any detail images that may be informative of the marker's condition or environment. For the slate markers digital documentation allowed the enhanced mapping of conditions, annotated on photographs of the grave markers. An example of a condition diagram and key is provided for the conditions follows in Appendix I. Additional issues were circled or denoted with an arrow that linked all narrative information with image files and condition markups. Detailed photographs and descriptions of unique conditions were added as needed. Assessments of severity of conditions and priority for treatments were made for most conditions.

The assessment of conditions of GLA's 641 markers as a group facilitated comparison and prioritization of markers allowing the roadmap of a staged conservation program. Markers are categorized by the priority of their needs for treatment in the immediate (P1), short (P2), middle (P3) or long-term (P4). Treatment approaches and recommendations relevant to the observed conditions are discussed, however individual marker repair recommendations are not within the scope of work.

II. Observations

Stone varieties

The majority of markers (636/641) were carved from slate, marble and granite, all which are geologically metamorphic rocks, but with markedly different condition profiles due to their chemical and formative origins. Granite which composes the most recent grave markers is the most durable stone on account of its igneous crystal formation prior to metamorphosis. Although marbles and slates are both formed from sedimentary deposits, their different chemical and crystal structures account for their degradation patterns. Marble which is a carbonate has reactivity to water which hastens its overall dissolution. In contrast, the silicates of slates are not soluble in water, however the interstices of its laminar structure create a physical vulnerability to the infiltration of moisture that causes damage during freeze/thaw cycles and when they reach the impurities or inclusions within slate, like pyrite.

To note there are three other grave marker material at GLA: concrete (three in number), brownstone (one), and metal (one).

At GLA, slate markers display a range of different mineralogical varieties, evident from colorations and inclusions. Varieties with prominent iron inclusions were distinctive. A range of hues and density of laminae was evident.



Examples of the wide variety of slate appearances and mineralogy at GLA.

Exact material identification of stone composition was not the purview of this survey. Anecdotal observation found that degree of deterioration correlated with specific mineral typologies. For instance, the presence of iron inclusions or strata was associated with delamination.

Future mineralogical classification and study of the stone types by thin-section would add to a limited body of knowledge of the deterioration of local slates from New England. Correlation with inscription dates could provide insights into historic stone sources, trade, craft and sociological patterns within Newport and the greater colonies.

GLA is undoubtedly a rich source for future materials, technological and sociological studies related to the stone trade and industry of the 17th and 18th centuries.

Markers 411 (left) and 290_fs (right) have delamination occurring at the interface of an iron-rich bedding later.

Markers 202 (left) and marker 289_fs (right) are two different slate varieties with prominent iron-rich mineral inclusions.

Conditions

Each marker was assessed for a number of conditions, manifested in microscopic and macroscopic details that indicate physical, chemical and biological agents of change. The evidence of these changes and the underlying causes of these changes were investigated. Gross alterations of a marker, including losses of stone substrate, fragmentation, erosion and legibility of inscriptions, vandalism, prominent staining, presence of biological growth and previous repairs were documented. Critical to determine for the slates, was the degree of delamination of a marker's stone, a primary cause of loss of substrate and urgency of treatment. Other evidence of chemical and physical deterioration, such as flaking, disaggregation and erosion were recorded. Targeted examination for evidence of the causes, progress and severity of conditions was conducted. Cracks and signs of damage such as mechanical impact, ie: scrapes from lawn equipment were recorded. Surface alterations such as fine laminar flaking of the surface, efflorescence of salts, and other soiling were likewise denoted.

The conditions observed at GLA are defined below, known causes are presented, and site specific observations related to these conditions are discussed. Each condition also includes a section of options for potential treatment and repairs. In some cases additional testing is necessary to determine the optimal treatment for a condition and its substrate and often one global approach to a condition is not appropriate. The team of conservators, masons, and/ or restorers engaged to conduct the conservation work are responsible for the marker-specific repair and treatment decisions and implementation.

III. Glossary of Conditions and Treatments

Biogrowth

Biological growth (a.k.a. biogrowth) includes the colonization by any live organism on the surfaces of the stone markers. From microscopic bacteria and algae, to fungi, lichens and vascular plants, biogrowth may be black or colorful and may range in size from fine points to substantive tissue.

Biogrowth is one of the most prevalent conditions found across all the markers of GLA and is not highlighted in diagrams since its marking would obscure all other conditions. Sixty-seven percent of markers including 92% of the marbles and almost 50% of the slates show obvious signs of past and active biogrowth. Recent targeted cleaning of biogrowth (in the Fall of 2020 as noted in the RFP) accounts for the fact that it was not found on 100% of the stones.

The presence of biogrowth is ubiquitous in the outdoors, a result of optimal conditions for its growth, which for all types include the presence of moisture and nutrients for growth. Shady sides of both natural and manmade structures often exhibit biogrowth because they have extended periods of damp without direct exposure to sunlight. At GLA, the biogrowth was unsurprisingly prevalent most noticeably associated with the tree lines. Specific types and species of biological growth were not identified; however, many types were found, presenting textbook cases of the full spectrum of colonization that outdoor stone experiences. From bacteria and algae to crustose lichens, all live matter contributes to the condition of the markers. It is common for multiple species to coexist on an individual stone. The high grass of the landscape likewise affects the stones and was found both obscuring and burying elements and adhered to the surface as clippings. Accumulated organic matter such as grass often harbors moisture and encourages the growth of additional biological organisms.

Marker 295 exhibits black biogrowth and matted grass clippings.

Marker 289 depicts the typical green algae.

Marker 201 exhibits crustose lichens, a hard layer that looks like cement as a result of integration of minerals from the stone into the lichen structure.

Markers 285 (left) and 286 (right) with layers of lichens associated with other biogrowth.

Because of the chemical exudes, some acidic, from the respiration of biogrowth, and the mechanical force of their cellular growth between mineral crystals, biogrowth is generally considered a risk to stone, best removed. Due to compositional differences the stone varieties are affected differently by the chemical effects, with marble more vulnerable than slates and granites. Because of both chemical and mechanical action on stone surfaces, microscopic etching and roughening of surfaces occurs, and as mineral crystals are fractured, localized alteration in appearances result. Heightened texture of surfaces can increase the hospitable environment for biogrowth, so once established, biogrowth propels a cycle of stone deterioration and increased biological population. When advanced to dimensional scales, biological growth can cause disaggregation, spalling and fragmentation. At GLA there was no evidence of this scale of active damage. However, the differential erosion of marble and slate surfaces may indicate the impact of biogrowth now removed. Examination of surface samples by advanced microscopy could confirm that the contrast of surface appearances on Marker 398, for instance, was produced in this manner.

The contrast in surfaces of Marker 398 may reflect damage from biogrowth, though this would require further study to confirm.

The positive contributions of biofilms on stone have been noted and there is some academic debate regarding whether biogrowth should be left in place, harnessing its protective role for stone cultural heritage and avoiding the damage from cleaning techniques . However, when biogrowth obscures the legibility of inscriptions or carving, the most common approach for its removal is by aqueous cleaning with the assistance of mechanical action and/or the application of commercial biocides that aide in breaking down the tenacious layers without mechanical action. At GLA this approach was recently used, employing D/2, the most common commercial biocide.

→ Guidance on treatment: Since there was a recent cleaning campaign of the slate markers at GLA, the reduction of biological growth is not an urgent treatment need, but primarily an aesthetic choice. A maintenance plan that periodically reduces the accumulation of biofilms and biogrowth is however recommended. The maintenance schedule is site specific, but GLA should be assessed for potential cleaning in three years. It is recommended in the future to spray apply D/2 and allow the elements to do the remainder of the cleaning. It is not recommended to scrub the grave markers as the flaking and erosion observed on a significant number of them illustrates their fragility.

Buried/Fallen

This condition consists of grave markers that are no longer standing upright. They include markers that: are all or mostly buried in the ground; a portion of it is buried in the ground; or the grave marker has toppled onto the ground. In some instances the marker has been intentionally buried in part or whole to support it because a significant portion of the marker is lost (for example see Marker 409). Other examples of this category are more minor where a portion of just its base is buried (Marker 348).

There are several causes of this condition. One is the settling of the ground beneath the stone over a long period of time. The ground compacts through weathering after the original digging of the grave loosened and aerated the earth around and under the marker in conjunction with the weight of the stone compacting the earth. Other causes are impacts from either weather, such as high winds, hurricanes, branches falling from trees, or vandalism all of which can knock markers over. They either remain on the surface of the ground or slowly sink into the ground causing it to be buried. Or a marker or a fragment can be intentionally buried for its preservation. It is not known whether any of the buried markers are flat flush tablets that have sunk into the ground and have had grass grow over them or if they fell over in the past and have sunk into the ground; an example is Marker 326. At GLA this was observed largely with marble markers versus slate. It is likely however that these are broken fragments from once larger markers and have settled into the ground.

There are 124 grave markers that are buried or fallen: 76 marble, 37 slate, 10 granite, 1 brownstone.

There are a variety of ways to address these buried and fallen markers.

One option is to carefully excavate and reset them. The grave markers can only be reset after it is determined there is sufficient material to support the marker when reset. If there has been substantial loss of the base of the marker either compensation needs to be done, such as building a new base or designing a new support, or another approach pursued, such as re-burying. If the marker is only a fragment refer to that section of this report on intervention options.

The other option is to leave them buried. If this approach is pursued, then the location of the marker should be documented for future reference. The documentation should be accessible to stakeholders or an organization that can house that information for future generations.

If a marker has fallen over attached to its base such as Marker 139, it can be lifted carefully either by hand when possible or with a gantry and reset.

→ Guidance on treatment: The area where the marker is to be set should be dug approximately 4" deep, filled with 1" to 1.5" diameter gravel and tamped down to provide drainage. The marker should be set in place slightly nestled in the gravel and ensured that it is level and stable. The gravel can be covered with a mixture of smaller gravel and dirt or the existing sod, but it is recommended there is a berth of one foot around the perimeter of the marker at a depth of 4" of gravel to protect the marker from landscaping equipment and allow for drainage.

If the marker is the long stone panel style set directly in the ground such as Marker Unlisted (185), the ground should be dug the depth needed to support the above-ground portion plus an additional four inches to place gravel at the bottom of the trench to provide drainage and follow as described above with a perimeter of gravel.

Experimentation with this technique is advised as the soil composition of GLA and how it drains is not characterized. The concept is the loosely placed gravel provides drainage but if the soil is saturated and dense and cannot absorb the run-off, the water may pool around the marker. Thus, the gravel should be coarse and not tightly packed around the marker (the shape of the gravel also should prevent it from being tightly packed) so that the voids that would fill with water are large enough for the expansion and contraction due to freeze-thaw.

To note, if the gravel is covered with sod for aesthetic purposes, it will more quickly fill the voids intended for drainage with roots and earth making it a shorter-term solution than leaving the gravel exposed. The latter however has stronger aesthetic implications. Dark gray gravel is recommended to better blend in with the landscape, but the techniques can be prototyped to determine the most suitable approach.

Marker 409 was intentionally buried because much of its lower half is missing so it no longer has the support for the above-ground portion of the marker.

Marker 409 after being unearthed for surveying illustrates the piece is only a fragment of the original marker. Discussion of fragments is provided later in this report.

Marker 326 could be a fragment from a larger marker that has gotten buried over time or the only portion visible of a much larger fallen and mostly buried marker. It could also be a flat flush tablet style of marker that has sunk into the ground and grass has grown over it.

Marker Unlisted (185) on the right is a footstone that was mostly buried but once unearthed was discovered to have enough stone (despite some loss) to be reset. The stone can be set slightly deeper than it may have originally been for more support, especially since it is a footstone and the inscription will not be covered. On the left is Marker Unlisted (185x) that is fallen or unearthed but can also be reset.

Marker 139 – the marker has fallen over due to unknown reasons. This would be a high priority to reset because there are new stresses and pressure points on the marker that may cause greater damage in the future.

Crack

A crack is an individual fissure clearly visible by the unaided eye resulting from separation of one part from another. At GLA the cracks in slate are typically hairline cracks which are less than 0.1mm wide and are therefore not treatable. Largely the cracks in the slate were related to delamination which is discussed in a following section. Cracks collect moisture which accelerates the markers decay. Though the cracks are hairline they still have a great capacity for capillary suction which carries water deeper into the stone. Often the cracks were very visible in the morning due to condensation or after rain because they held onto the water longer than the surrounding stone.

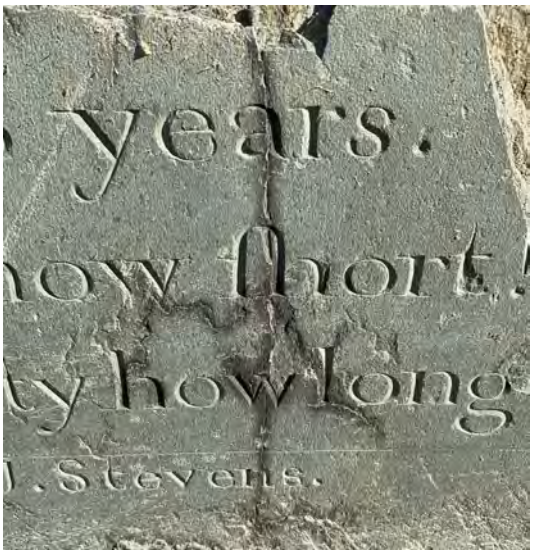
Some of the cracks run vertically in the middle front of a marker and if they were not surrounded by or adjacent to obvious delamination were marked as Cracks, even if the cause is likely delamination.

In marble there were several cracks observed not related to delamination. Many however were repaired in the past. The repaired cracks were typically fractures which went completely across and/or through the stone. To note, the cracks that were repaired are marked as Previous Repair in the database and not a Crack since it is no longer a crack.

In some cases, cracks appeared to be from impact because they were located at the corners of bases or edges of markers perhaps from landscaping equipment and work (Marker 70).

There are a total of 97 grave markers exhibiting cracks: 55 slate, 38 marble, 1 granite, 3 concrete.

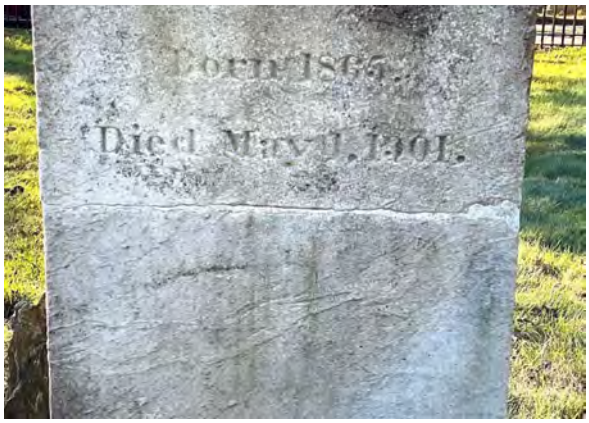
→ Guidance on treatment: If cracks are 0.6mm wide or larger they can be filled with a crack filler such as VoidSpan 400 Series PHLc70 Crack Filler colored to match stone. If cracks are deep, they can be injected with a compatible grout, such as VoidSpan 600 Series PHLc70 Injection Grout, through drilled portholes or deep fissures along the crack.



Marker Unlisted (252) exhibits cracks in slate that hold the moisture of the morning condensation. These are related to delamination but present differently as they traverse down the front flat plane of the slate.

Marker with cracks that are too thin to fill. The dark discoloration on either side of the cracks is not moisture as in the image on the left but soiling that is attracted to the moisture the cracks hold.

Marker 70 cracks in marble that require repair before additional loss of material results



Marker 54 with a repaired crack/fracture, but entered as Previous Repair in the database.

Delamination

Delamination is the detachment process affecting laminated stones. It corresponds to a physical separation into one of several layers following the stone laminae. The thickness and shape of the layers are variable. The layers may be oriented in any direction with regard to the stone surface.

This condition plagues slates due to their geologic bedding and the practice of setting the grave markers against the slate's bedding planes. Slate is a metamorphic rock which is formed by the heat and compaction of sedimentary shale over time which creates the foliation endemic to the stone. The fabrication and placement of slate grave markers results in the edges of their bedding planes facing skyward which allows water ingress from rain and any moisture. Thus, they are susceptible to freeze-thaw damage because the water that goes deep into its layering expands when it freezes applying pressure against the stone layers, some of which are very thin. This is a cyclical phenomenon, and its associated stresses cause the loss of significant amounts of material as observed at GLA. The exposure to moisture in spring, summer, and fall also has an associated stress from wet/dry cycling and the dark color of the slate results in thermal cycling and shock from heat of the sun in the day and cooling at night.

All of these stresses result in pressure within the stone that is manifested in the "peeling off" of its layers. One of those layers is the front of the grave marker which contains its inscription – the most historically valuable part of the grave marker – which is why delamination presents a significant threat to a grave marker.

The database includes a Priority scale (1 through 4) in association with Delamination. The Priority refers to the grave marker's need for treatment of that condition. Even though delamination is extant on the majority of the slate grave markers, it doesn't necessarily mean it is treatable. Degradation from delamination is on a spectrum of severity: the foliation layers can be densely stacked providing no space or void to receive a fill; there may be a large void that can be filled; or there is just enough room for a small fill but it is critical to implement because it is in a location that threatens the inscription.

Priority 1 needs to be addressed as soon as possible due to severe separation of the foliation layers and there are sufficient voids and gaps extant that can receive a fill. P1 Delamination also may indicate there is a threat of loss of the inscription that may be reduced by treatment. Priority 2 is somewhat less urgent to repair and has minor voids and gaps to fill. This category also includes markers with very little inscription remaining, but which is under threat of imminent loss and has any size or quantity of treatable area to fill. Priority 3 has only one or two areas that should receive a fill and there is less threat of loss to the marker. Also in this category are markers that have treatable delamination but it is located on the backside of the marker and the threat of material loss is small and thin. Priority 4 includes untreatable delamination and is only an indication that the condition is extant and should be monitored. The majority of the slate markers will have this designation because of the nature of the stone. This level of delamination presents itself as densely stacked, but with visible striations depicting the foliation layers.

The Delamination condition was accompanied by a "Fill" button in the database. Though this was not a repair survey the obvious voids and losses from delamination that could receive a fill were marked as such. To note this repair is not the only option to address delamination but is the most common.

There are 314 slate grave markers exhibiting Delamination and one marble grave marker. Of these 188 markers have voids and gaps from delamination that are fillable. The Priority designations are as follows: 87 Priority 1, 56 Priority 2, 67 Priority 3, 105 Priority 4. To note there are a total of 370 slate grave markers at GLA so nearly 85% of them are exhibiting delamination.

There are a few treatment options to address delamination however they are either visually intrusive, are short-term, or are experimental. Because the condition is endemic to the stone and its geologic formation, and the stone is outdoors and constantly exposed to the elements it is still recommended to treat this condition despite the limitations.

One approach to treating delamination is filling the voids, cracks, and gaps created by the delamination. This can be done with lime- cement- and pozzolan-based mortars, such as VoidSpan and/or lime- and cement-based mortars, such as Jahn. It is recommended to only fill the gaps and stabilize the edges but avoid applying mortar over the whole area and reconstructing losses as has been done at GLA in the recent past. Regardless of how compatible the mortar is to the slate it is a different material compositionally and will behave differently mechanically. For instance, the thermal expansion and contraction are dissimilar between the materials so when the dark slate heats up during the day and cools at night, in addition to seasonal changes, there is a slight differential of movement and over time results in cracking in the patch and its separation from the substrate, both which have been observed at GLA. These failures allow water into the patch and stone causing additional deterioration.

Another treatment option that is still in its experimental stage is filling the voids and gaps with an elastomeric crack filler. These commercial products have the capacity to stretch and compress with the movement of the stone. They can be tinted with mason's pigments to match the color of the stone. It is typically not recommended to fill cracks and joints with elastomerics on buildings because it traps moisture in the masonry system causing further damage to the building materials and potential issues at the interior of the building. However, in the case of stand-alone masonry units such as grave markers this concern is less of an issue. An elastomeric approved for use on masonry and outdoors should be used. The use of elastomerics in slate gravestones is a recent development so its success rate has not been compared to that of mortar fills. GLA provides an opportunity to apply this repair in some of the delamination voids and decayed edges to assess its performance and visual compatibility over time. There may be a visual impact with this repair because elastomerics are smooth and have a slight sheen so that should be taken into consideration but appropriate application can limit its obtrusion. Some crack fillers may be able to be mixed with stone dust or sand to give it a grittier texture and improve aesthetics - that should be discussed with the product manufacturers. This type of repair may be more reversible than a mortar fill. The latter can be difficult to remove from the stone once failed, even when using softer lime-based materials because the work typically involves masonry chisels and hammers.

Capping the top of the markers with custom-made metal sheathing is a treatment that can also be considered. In the past this has been a controversial repair because it can be visually obtrusive, however if properly fabricated by a metalsmith can be more aesthetically compatible than some past renditions. This type of treatment necessitates a primarily intact top profile of the grave marker so is less appropriate for a marker that has experienced loss at a majority of its top. It is recommended to use lead as it does not have associated disfiguring corrosion staining and has the benefit of being a biocide. Copper has often been used but is more likely to be stolen for its resale and salvage value so is not recommended. The capping should be adhered to the top of the grave marker with spot welds of silicone so it is removable in the future to assess the stone and its condition and possibly apply newly developed treatments in the future.

There is one grave marker at GLA that currently has a cap (Marker 9) but it is somewhat poorly executed and was noted to be failing because two breaches were observed in the lead. Archival images depict other markers having had metal caps in the past, but it is not known when and why they were removed.

Some preventive measures could be considered in the instances where the delamination does not present voids to fill. This would be instead of metal capping and could be considered for less intact tops of grave markers. Though conservation measures typically do not recommend coating stone where it has not previously been coated, grave markers as individual stones and not building assemblies may allow for experimental techniques to be tested. Thus, if GLA presents an opportunity of testing experimental techniques, coatings custom-matched to each individual stone

might be implemented. This may entail mineral (such potassium silicates) or elastomeric coatings applied to the tops of the grave markers to help prevent water ingress through the early stages of delamination, perhaps preventing or stalling its progression. This may have a visual impact but that may be minimized by the products selected and either a clear coating or the custom matching of color and texture in addition to potentially benefiting the heritage in the long term. Research on what products could be tested is recommended.

Another typical area of delamination and loss on the slate grave markers is on their side elevations where the stone is in contact with the earth. It may be a combination of impact from lawn maintenance equipment and rising damp from the earth exacerbating the delamination at those locations. The use of gravel for drainage as discussed under the Buried/Fallen section may help improve/prevent this phenomenon.

→ Guidance on treatment: There is not one approach to treating delamination. As described above, there is a complex decision-making process for the appropriate course of action. Sometimes no treatment is appropriate and monitoring for changes is best. And it is recommended to test the several different techniques discussed above to explore options – including those that may be preventive measures. In this survey, all P1 markers should have treatable delaminations filled. Qualified conservators should be enlisted to design and implement custom-made approaches to each individual stone, aligning with the above considerations. P2 stones should be monitored and filled during the next course of treatment in the short term. P3 delaminations should be monitored- if they continue to progress, they may need treatment in the next 5-10 years. P4 delaminations should be monitored for need of treatment in the long-term.




Examples of Priority 1 Delamination. The bottom right image depicts a grave marker that does not have a number of voids to fill and largely the top delamination is densely packed however there is a small area of delamination on the front that threatens the inscription and is wide enough to receive a fill. This could also be a candidate for a cap due to the intact nature of the top of the grave marker.

Example of Priority 2 Delamination that consist of treatable voids and gaps due to delamination/ The little legible inscription that remains is under threat of loss.

An example of Priority 3 Delamination – the grave marker has only a couple small areas that are treatable; it also has little potential for loss of material of its front face which no longer contains an inscription.

Example of Priority 4 Delamination – there are no treatable areas but the condition is extant.

Marker 9 is currently the only gravestone that has a lead cap on it. This cap is breached in two locations so it is recommended to remove and perhaps re-cap depending on the condition of the slate underneath it. This is a viable repair option when caps are fitted and customized to each marker.

This lead cap is somewhat better in its execution (online image) than the one at GLA.

This is a far superior cap but it is fabricated out of copper which is not recommended due to salvage value (online image).

Disaggregation

Disaggregation is a condition that occurs when minerals of stone begin to loosen and break apart at the crystal level. It is caused by differential solubility and thermodynamic properties of individual crystals that causes them to separate from their adjacent neighbors. Marbles may develop this condition as aqueous solutions dissolve the carbonate matrix at different rates, but disaggregation can develop in any stone variety, dependent on mineral content. Disaggregation is commonly called sugaring when particulate is actively brushing off the surface. When the texture of a stone is emphasized by the loss of some minerals and not others, namely differential dissolution of components, this is disaggregation. Often disaggregation will be evident because the heightened contrast of texture captures and is spotlighted by atmospheric soiling. If disaggregation is actively occurring with crystals mobile to the touch, consolidation of the substrate may be prescribed.

At GLA, disaggregation was found to occur in 22 markers including one concrete and 21 marbles. Only one example (Marker 461) is active with a Severity of 2, but it does not warrant a consolidation treatment at this time. However, the surface character of a few marble surfaces (for instance Marker 148) may indicate that they have been previously consolidated. Archival information notes the use of Conservare onsite (See Resources), and perhaps this is one example. Large crystals are in high relief due to the loss of the finer crystal lattice surrounding them, however no active sugaring was found. All markers with evidence of disaggregation should be monitored for further deterioration.

→ Guidance on treatment: At this time no treatment is recommended for disaggregation except monitoring for changes in Severity. If active sugaring is observed on marble, consolidation may be elected with a commercial product such as HCT followed by Conservare OH100. Consolidation can only be completed in a mild and dry environment above 45F so should be planned in temperate months. The substrate must be cleaned of other contaminants such as biogrowth and atmospheric grime. Application should be completed by an experienced conservator with the proper handling and health and safety precautions.


Marker 461 has the highest of all markers Severity 2 for Disaggregation.


Marker 148 exhibits Disaggregation Severity 4, with fine crystals lost, larger crystals are exposed on the surface. That so much fine particulate has been lost but the surface is not sugaring at present may indicate a consolidation treatment was applied in the past.

Marker 149 is an example of a marble with mild Disaggregation of a Severity of 4.

Efflorescence

Efflorescence is the product and process by which a compound is dissolved and carried to the surface of a substrate by the capillary action of evaporation. In essence, when a powdery substance appears on a surface, it indicates that an inorganic compound has been carried to the surface during an evaporation process as the stone dried. Most often it indicates a soluble salt was present in the material, the composition of which depends upon its source. Efflorescence may be a result of a natural contaminant or the residues of an applied product such as a cleaner or patching compound. Tide lines of efflorescence usually have an amorphous irregular shape with cloudy borders.

At GLA, only two markers exhibited efflorescence, both slates which had previous repairs. The source of the efflorescence was most likely the previous mortar repairs and activation of elements therein by precipitation or cleaning. This indicates that an element of the applied mortar composition, most likely the calcium carbonate of the lime in the mix an inorganic was drawn to the surface from the washing action of water. Salts can have damaging effects on stone, causing disaggregation, spalling and loss. Therefore, the presence of the efflorescence is a trigger for treatment, namely a removal of potential sources. This can be accomplished by water washing in some cases or a slightly acidic cleaning for calcium carbonate deposits. In these examples at GLA, the cleaning can be executed but complete removal of the patching mortar and replacement with conservation grade materials is recommended, since it is already compromised by the salts. Identification of the efflorescence via sampling and spectroscopy is possible, however the exact identification will not change the treatment recommendation.

→Guidance on treatment: Monitor markers for progress of efflorescence and any damage related to it. If efflorescence continues to develop, consider removal of adjacent mortar fill.

Markers 60 (left) and 81 (right) have effloresence at the perimeter of a mortar repair.

Erosion

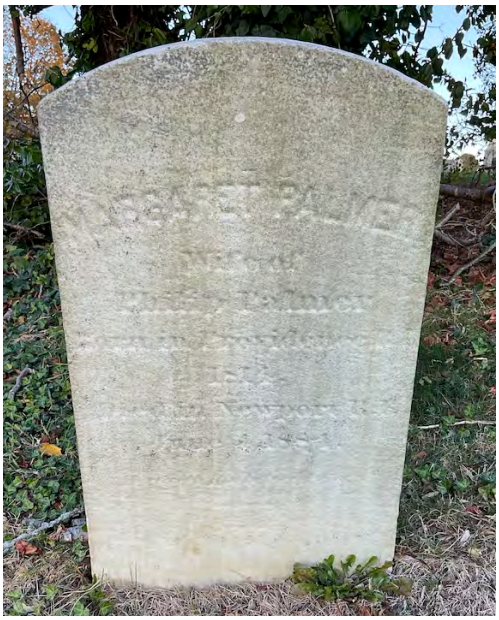
Erosion of stone is due to the natural forces of wind and water gradually wearing away stone substrate. Weathering of stone is due to both the physical action of these elements, and the chemical action of water reacting with carbonate minerals, creating a weakly acidic environment that breaks down stone chemically. Erosion causes the rounding of edges, loss of carved details and for grave markers most detrimental, the reduced legibility of inscriptions.

The marine environment of Newport, with high atmospheric water and salt content, is particularly aggressive in terms of its erosive action. The location of GLA, close to the coast leaves it relatively unprotected from direct exposure to these forces. At GLA, all markers showed some signs of erosion, while approximately 25 percent exhibited moderate erosion. Erosion is evident from the rounding of edges and loss of crisp carved strokes in lettering and imagery.

Exceptions exist however, such as one marker from the 18th century (Marker 418) whose carving details are still so crisp that one can see the scribed guidelines for the lettering. Two other examples at the Common Burial Ground by the same carver exhibit the same material and manufacturing quality.

→ Guidance on treatment: No treatment can arrest or remedy erosion, except for the sheltering or removal of grave markers from the outdoor environment. To mitigate the risks of loss associated with erosion, three-dimensional documentation of grave marker inscriptions should be considered. Laser scanning and 3-d photography of relief surfaces is becoming more accessible with tools such as iPhone's LIDAR. Investment in documentation can produce the greatest long-term return on investment for a collection of outdoor monuments that will inevitably continue to erode with time. A digital record of individual markers and the landscape as a whole would provide valuable assets for future research, educational and engagement initiatives.

Marker 193_fs (left) and Marker 268 (right) are examples of Erosion Severity 1.




Left: Marker 229 shows the typical appearance of how erosion blurs details of carving, Severity 2. Right: Marker 418 dated 1763 retains crisp details of the lettering guidelines.

Flaking

Flaking is the detachment of stone as a scale in millimetric to centimetric thicknesses. This condition is also related to the geologic formation of the slate and its foliation. Largely at GLA the flaking is not treatable because it is dense flaking or stacking of flakes without voids or detachment between them or the bulk of the stone. It was mostly observed at the front face of the slate grave markers so may have some correlation between the geologic formation of the stone in combination with its tooling during fabrication. There are a few instances where the detachment creates large enough voids for a fill.

Along with this condition is a gradation of severity in the database. Severity 1 is a majority of the surface with the inscription has a flaked appearance whether it is dense or loose and Severity 4 is minor surface area of flaking with 2 and 3 being gradations in between.

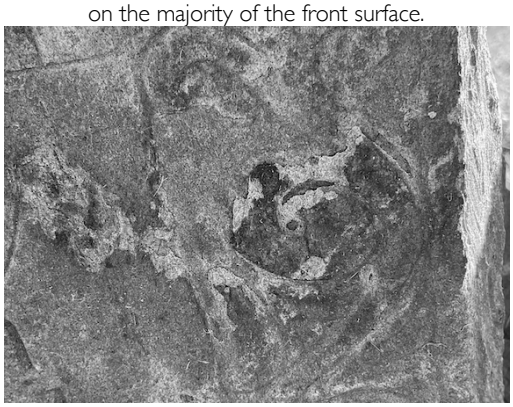
There are 180 grave markers that exhibit flaking: 175 slate (47% of all the slate gravestones) and 5 marble. Of these, 24 are a Severity 1 designation, 34 Severity 2, 56 Severity 3, and 66 Severity 4.

Where the flaking is densely packed and there is no void to fill there is unfortunately not a known treatment to address this condition. If a fragment(s) from site exists that exhibits this condition it would be beneficial to test some unconventional or new treatments, such as nanoparticle coatings.

→ Guidance on treatment: Where there are voids behind flakes that can receive a fill it is recommended to use a custom-colored mortar such as 400 Series PHLc70 Crack Filler or a Jahn product. This would be appropriate for both the slate and marble markers.

Example of flaked surface where flaking is densely stacked and not treatable. This is designated Severity 1 because it is on the majority of the front surface.

Another example of flaking but it is less densely stacked so presents more potential for loss; also designated Severity 1



Marker 201 is an example of flaking that is treatable.

Example of flaking on marble.

Fragment

A fragment is defined as a piece of stone or a piece of a marker with the remainder of the marker not known. At GLA these are sometimes above ground and leaning against another marker, post, or tree, but more often the fragments are buried. The fragments are at risk of theft, so their burial helps prevent that from occurring. There are some instances where a numbered unit was unearthed, and it appears to be a fieldstone or other random stone piece and not associated with a marker. These were still included in the database and marked as this condition. However, many instances of a fragment were portions of a grave marker that retained the inscription – the most important part of a grave marker. It is these pieces that are considered further below. There are 58 fragments at GLA.

There are a few options for addressing a fragment.

One option is to leave a fragment buried. Burying cultural heritage is a preservation technique if there are a lack of funds for its conservation, restoration and maintenance going forward or if there are philosophical reasons such as too little information to place it in situ, interpret it, compensate for loss, etc. If this approach is taken for fragments that are known to have once been part of a marker than it should be properly documented. This could include ensuring it is on the GLA map and designated as buried, creating other documentation that is shared with stakeholders, or marking it above ground in another way (though these are often ephemeral too).

Another option is to unearth the fragment and archive it indoors somewhere. This can be at a place that has an association with GLA or a historical society, cultural center, etc. that has a vested interest in the history and objects of Newport, RI. The fragment could be kept in storage or placed indoors on display. These options provide an opportunity for interpretation and research.

Lastly, the fragment can be unearthed and mounted in some fashion on site at GLA. This option has the benefit of retaining the marker in situ where possible descendants can view it and providing more history of the place. However, this option exposes it more to agents of deterioration than burying and indoor archiving and again there is the philosophical question of placement and presenting it as it historically never was: a fragment propped as if a museum object. If this option is pursued a decision needs to be made on where it gets placed if there is no historical record indicating its original or recent location and if interpretation of its placement should be done. Some examples found online of markers (not fragments) being mounted or supported are presented below. The mounts would have to be custom designed and fabricated for each fragment to ensure they fit properly, prevent theft, if possible, are made of materials that do not encourage deterioration (such as stainless steel versus steel), and are reversible to some extent.

Another more experimental option to presenting the fragments that retain little of their structural support, is to unearth them and set them in a bed of compatible materials. This entails laying them on their backs which may prevent the water ingress into their delaminated foliate and aid in their preservation. They would in essence become flat tablet grave markers flush with the ground. All edges should be filled as is possible before installation.

However, some of the markers will then be horizontal in position instead of vertical, shifting the stresses that they have previously been under. There are options to minimize these stresses but need further research. In archaeology conservation when re-burial of heritage is pursued geogrids can be used for spreading loads, offering structural support, and providing drainage. The sands and gravels beneath and around the marker should be non-staining and non-compacting to also encourage drainage.

→Guidance on treatment: It should be stated that there is no wrong choice from these options. A recommendation would be to have a consistent approach to how they are treated. For example, all fragments that retain carvings and inscriptions that are over 25 square inches in size get mounted and all other fragments get/stay buried and documented as such. It is also recommended that some fragments that do not have inscriptions or carvings are set aside or their location of burial is documented for potential repair technique tests, color matching, and material testing. There is very little published on the treatment of slate (except for roofing) in the United States and these fragments could help test some experimental techniques and materials and start to build that body of knowledge.

Marker 409 (left) and Marker 300_fs (right) are examples of fragments that can be mounted. There is enough of the inscription remaining to be informative. The fragments should be conserved prior to mounting: this may include stabilizing the edges at their delamination.

Markers Unlisted (G8) and Unlisted (464) could similarly be mounted if there is archival information known about these markers to aid in their interpretation since there is little inscription remaining. They could also be considered for testing treatments and repairs.

Example of a fragment that is believed to be a part of an old post due to tooling mark, but not a marker.

The above two images from CTA Architects website are examples of mounted markers. These are brownstone markers, which depending on the variety of stone is also plagued with delamination. Though the markers were not fragments it provides an idea of mounting options.

Fragmentation

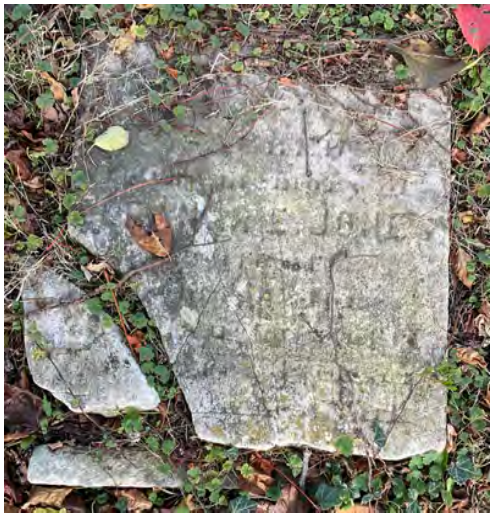
Fragmentation is the complete or partial breaking up of a stone into portions of variable dimensions that are irregular in form, thickness, and volume. This condition was checked if some or all of the broken pieces were extant adjacent to the bulk of the grave stone. This condition is different than a marker that has been designated as a "fragment" which is a lone part of what was once a marker and it is not known where the remainder of the marker is or if it is extant.

The cause of this condition can be from mechanical impact such as landscaping equipment or vandalism or from falling over. In some instances the cause of this condition in a slate grave stone is it has broken off due to delamination. An example is a foliation layer including the face has sheared off but is adjacent to the remainder of the grave stone (markers 303 and Unlisted (437)).

There are 28 grave markers that are fragmented: 12 slate, 14 marble, 1 granite, 1 concrete. In some instances these are also fragments because there are broken pieces but its base or the bulk of the grave marker is also missing.

→ Guidance on treatment: Depending on the configuration, size, and condition of the fragmented pieces they can potentially be pinned back together with appropriately sized and spaced stainless steel pins set in epoxy or mortared/epoxied back together. If there is lacunae after reconstructing those can be filled with a custom-matched mortar patch. If the fragmentation is in slate then the repair for each case needs to be carefully considered. It is not recommended to drill into slate so pinning by conventional methods is not possible. It may be possible to epoxy the pieces back together but it should be done as spot welds and not smeared all over the slate pieces. Ensure the epoxy does not get on the front or back surfaces of the grave stones because it cannot be removed. Once the pieces are secured any voids or cracks can be filled with a custom-matched repair mortar.

Left: Marker 303 (red arrow) may be fragmented from Unlisted (437) (blue arow). If that is confirmed then 303 may be able to be adhered to it with epoxy spot welds and fills around the edges. Unlisted (437) may need to be unearthed and laid on a table set up on site in order to ensure a well-executed repair. If digging is too risky straps and clamps with foam protecting the marker can be used to secure the pieces as the epoxy cures. Right: Marker 303 image provided by the client taken in 2008/9. It is in considerably worse condition today.



Marker 328 and Marker 145 are fragmented; on the left due to the growth of the adjacent tree and on the right likely because it fell over.

Leaning

Leaning is defined as the position of a grave marker that is not plumb and not level as set in the ground or as a fragment that is against another marker, tree, or post. The movement of the marker, much like the buried and fallen markers, can be a result of tree roots growing and dislodging the marker, a high water table, and ground settlement. This condition is very common in cemeteries, particularly those that are centuries old.

In many instances if the lean is a small degree from side to side the marker does not need to be dug and reset to plumb and level, though that is an option if desired. If the lean is forward or backward in its orientation 60 degrees or less relative to the ground it is recommended to reset the marker. In those positions there are stresses placed on the stone where it meets the ground so there is risk of fragmenting. It may also be prudent to reset leaning markers in order to help prevent impact from landscaping equipment, regardless of the angle at which they are leaning.

There are 210 leaning grave markers at GLA. Each was rated for severity: There are 30 Priority 1 including 22 slates, 6 marble and 2 granite. There are 31 Priority 2, including 17 slate, 10 marble, 3 granite and 1 concrete. There are 49 Priority 3, including 37 slate, 11 marble, and 1 granite. Priority 4 included 100 stones, including 55 slate, 34 marble, 10 granite and the one extant metal plaque.

→ Guidance for treatment: The resetting should follow the recommendations made above for the resetting of buried and fallen markers. Excavation of the grave markers should be done with caution.

Marker 0003_fs should be reset.

The marble though thicker warrants resetting due to its angle.

The marble marker being thin, at an acute angle to the ground and leaning towards a post warrants its resetting.

Unlisted (075) is an example of a marker that is leaning to the side at a slight angle so does not need to be reset.

Loss

Loss is missing material located in the place of some formerly existing stone typically in centimetric scale. In slate the loss is often due to delamination in which a part of the stone falls off at a foliation layer. This is found at GLA frequently at the tops of the grave markers where they are most susceptible to weather and have protruding details that are particularly exposed. In the marble grave markers loss typically consisted of chipped edges and occasionally a missing decorative element. The causes are mechanical impact for the former, particularly landscaping equipment and maybe theft or impact for the latter.

There are 446 grave markers that exhibit loss: 309 of the slate, 121 of the marble, 13 granite, 2 concrete, and 1 brownstone. In total, 70% of all grave markers and 83% of all the slate grave markers at GLA exhibit loss.

There are two options for addressing loss: compensation or doing nothing. Compensation includes recreating the piece that was lost in the same or other compatible material and attaching it to the historic material. The issues with this approach are the fact that often it is not known what to recreate because evidence of what was there is missing, there is a lack of authenticity in the recreation, and most critically with slate it is difficult to attach the newly created piece with a sound technique or one that is long term. It is risky to drill into slate through its presentation surfaces and it is often difficult and also risky to drill into its foliation layers to set pins. Though epoxying the new piece onto the old is an option.

→ Guidance on treatment: If the decision is to leave the loss as is, it is recommended to stabilize the edges of the stone where there is loss. In slate the loss is often the breaking of material due to delamination so what remains exposed are the ragged edges and gaps of the foliation layers.

An example of loss typical of the majority of the slate grave markers: parts are missing in their entirety such as the very top of this marker and/or a significant layer of the slate is missing.

This marker though largely intact exhibits a small loss (red outline) so would still be documented as such in the database.

Examples of loss on marble grave markers: the top decorative element is missing (this is known because a pin is revealed) and there is loss on the right edge of the middle of the marker where it has been chipped.

This marble marker exhibits several losses on its edges. Because it is low to the ground it is likely landscaping equipment has repeatedly impacted the marker. The appearance of the loss suggests it is older as it is weathered and soft at the edges.

Open Joint

An open joint is missing or failing mortar in a joint between stones. At GLA the joints are found between base stones and the markers. This concentrates the condition in the marble and granite grave markers. This construction of grave markers is limited to some of the marble and granite ones; there are no slate markers of this construction. The mortar in these instances aids in adhering the stones together (typically paired with pins) and helps limit moisture from getting between the stones.

There are 33 markers with partially or completely open joints.

→ Guidance on treatment: To address the open joint the failing mortar should be removed with a 5-in-1 tool or fine masonry chisels, or Dremel bits until only sound mortar remains. A lime- and cement-based mortar custom colored to match the adjacent mortar or stone can be used to repoint the units.

Example of an open joint in marble.

Example of an open joint in granite.

Previous Repair

Previous repairs are past interventions executed on the grave markers which aim to repair and treat conditions or prevent future deterioration. These can include patching, cleaning, tooling, and other non-visible treatments. There is evidence of at least three repair campaigns throughout GLA's 300-year history though there could certainly have been others that were not documented or there is no longer any evidence remaining. There was a 2017-2019 and a 2020 restoration campaign that consisted in part of patching which is readily visible at GLA. Documentation provided by the client suggests a clear, non-visible consolidation or water repellent treatment was potentially applied to select grave markers, but it is not known which ones, if any. An earlier repair campaign is likely as seen in the tooling of some of the tops of the slate grave markers. It appears as if someone tried to arrest the delamination by tooling it to sound stone. The date of this work is unknown and while it is an aggressive intervention it may have helped prevent some larger material loss.

The more recent repair campaigns capped the grave markers' delamination with patching mortar. While this is a typical technique the approach was very heavy-handed in some instances where large fills were done to partially compensate for the lacuna. This resulted in a disfigurement of the grave marker: the fills did not recreate what was lost but also were not limited to filling voids and gaps. Hence, those grave markers now take a form that is not indicative or sensitive to what they once were nor is the slate presented in a more natural stabilized state.

Several of the fills exhibit hairline cracks and separation from the slate. This can be from the patching mortar having been mixed too wet, the fills being too large so the shrinkage was increased, or the patching mortar and slate having different coefficients of thermal expansion (both being dark colors means they can heat up more dramatically than say a white marble).

Additionally, many of the fills are visually incompatible with the grave markers. They may have matched the slate better shortly after implementation, but the weathering alters and typically lightens patching mortar over time. The patching mortar used also appears to have some component in it that has been exposed due to weathering and makes the fills look very dissimilar from the slate. The fills have a mica-like appearance which is not observed in the slate which creates a distinctive contrast to the adjacent stone.

Despite these concerns regarding the previous repairs, it is currently not recommended to remove them. The removal of mortar can often remove stone with it and because of the nature of the decay it is not known where the slate is extant within the mortar and how to avoid it during tooling. To remove the patching usually involves chisels and other hand-held tools that can do damage if care is not taken. Acid can also aid in the removal of mortar and slate is acid resistant, but it should not be relied on as the sole method for removal because used improperly can still harm the stone.

In the conditions mapping of the slate markers the cracks and separations were drawn in red within the patch outline which is light blue.

There are 106 grave markers with observed previous repairs - this includes repairs implemented before the more recent 2019-2020 campaign. Of these, 55% are failing to some degree (58 markers): cracks in the repair mortar and separation of the patch from the substrate are the two most common reasons. And 60% of the previous repairs are considered visually incompatible (65 markers): this is typically due to the mismatched color of the patching mortar, the mica-like aggregate/inclusions of the mortar, and the misshaping of the grave markers from the excessive application of the mortar.


An example of the visually incompatible patching mortar (Marker 72). Looking at images soon after patching (see) it appears as if the mortar never matched the stone well. The fill of the delamination crack at the lower portion of the image represents a good technique for repairing that condition but it should have also been employed in the delamination voids at the edges of the grave marker that instead consist of large areas of fills which are visually jarring and detract from the grave marker and inscription. Right: Marker 72 in 2008.


Left: marker 72 in 2020 prior to restoration. Right: a detail of the condition at the top right of the marker confirming the needlessly large unsightly patch that was implemented.

Marker 72 in 2020 shortly after its restoration: the patching mortar was visually jarring then as well. The color then somewhat matched the stone but the inclusions or aggregate of the patching mortar were already unsatisfactory.

Evidence of another repair campaign on two different markers. This repair campaign does not have any associated documentation so the dates of execution are unknown. The delaminated tops of select markers have been tooled to relatively sound stone. It is an aggressive intervention but appears to have arrested the delamination.

Scrape

Scrapes on grave markers are manmade damage, a sign of accidental percussion on the surface by a hard material such as metal, wood or stone. These condition issues appear with random placement as bright lines or gouges that indicate a fresh disruption of the surface material and patina. In a cemetery, scrapes on grave markers are largely due to negligence during the maintenance of the grounds, as evidenced by the location of scrapes.

At GLA, seventeen percent of the markers had scrapes, including 78 slates and 30 marbles and one granite. Twenty-six slates experienced Severity 1 or 2 scrapes. While this amount may seem minor, each scrape was avoidable. Action should be taken to prevent further such damage.

The main action to take for scrapes is in management of lawn maintenance to reduce future accidents. Diagnosing the source of scrapes and decreasing the periodicity of lawn maintenance can help mitigate future risk of damage. However, ceasing lawn maintenance and cultivating long grass creates problems of its own in covering inscriptions and entire markers as found at GLA. Therefore careful and vigilant management of landscaping is needed. Communication with and training of grounds maintenance crews can raise awareness and influence a routine of best practices. Landscaping strategies that reduce the need for mowing such as surrounding grave markers with gravel beds in close proximity, can be effective if feasible. Considering the historic importance of GLA, exploration of this approach should be coupled with any movement or resetting of stones.

A scrape indicates removal of original material and can only be camouflaged by treatment. If aesthetic correction is desired, mineral pigments can be applied to reduce the visual disruption caused by fresh scrapes. Pigmented mortar fills can be applied to larger or deeper losses. Usually this sort of fine cosmetic treatment is not applied to works with continued exposure. If these stones were on exhibition in a museum, perhaps such treatments would be warranted.

→Guidance on treatment: No treatment for scrapes is recommended at this time. A strategic plan for management of landscape maintenance needs to be designed and implemented. As markers are reset, increasing the berth of gravel around the base of stones to 12 inches, will aide in reducing risk of impact by lawn equipment.

Marker 288.

Marker395

Marker 150 has multiple losses and fresh scrapes due to mechanical abrasion presumably from lawn equipment.

Soiling

Soiling of exterior stone is a gradual process of the collection of particulate in the porous texture of surfaces, most evident on light colored stones like the white marbles at GLA. Source of particulate may be from atmospheric pollution or from elements washed over a surface from adjacent areas, for instance corrosion products washing from a metal element. Exposure to precipitation has a washing effect, thus soiling patterns may highlight the sheltered and unsheltered relief of surfaces as water flows. Coatings or treatments to surfaces may influence the rate of deposition and removal.

At GLA, 23 percent of stones had noticeable soiling. The most severe soiling was found on marble fragments that were buried. A number of granites (11) and marbles (35) had mild accumulated atmospheric soiling.

Marker 269 is a granite with Soiling of a Severity of 1.

Markers 317 and 355 are typical examples of atmospheric soiling.

Of the slates, 105 had marked soiling. A recurring black soiling pattern localized in the tympanum was observed on some slates concentrated around the winged faces. Evidence is noted in the "Notes" section of forms since it was not an expected condition, and became clear only after days of surveying. Forty-five markers exhibited this. As these blackened surfaces appeared and felt waxy to the touch, it's possible that a previous wax coating or other soapy surface treatment had been applied, as part of a historic maintenance or cleaning routine. A treated surface may have collected and held particulate, or alternatively a black pigment may have been applied within the waxy binding medium as decoration. Solvent tests and extractions from microscopic sampling of the surface coupled with analyses by Fourier Transform Infrared Spectroscopy (FTIR) and/or Gas Chromatography-Mass Spectrometry (GC-MS) could reveal more information about the nature of this blackened surface.

Markers 333 (top left), 321 (top right), 201 (lower left) and 422 (lower right) show different manifestations of the black soiling found concentrated in the tympanums of 45 markers.

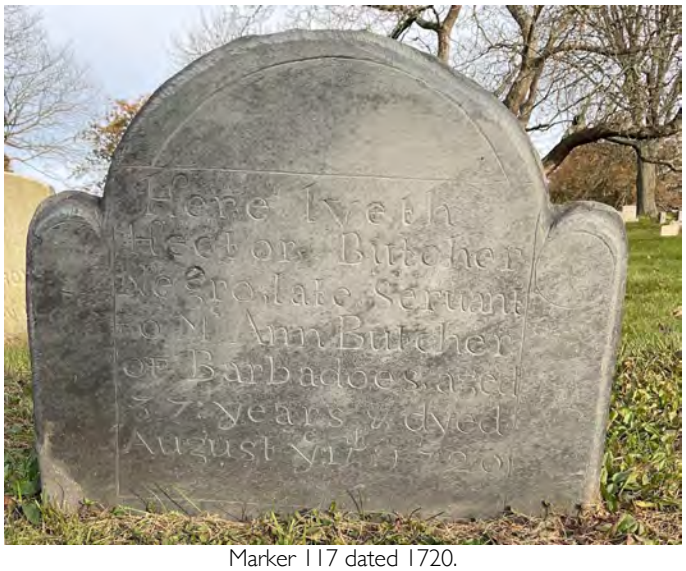
Scientific and historic research may help support the hypothesis that a mid 20th century fire of a storage shed at GLA might have caused this sort of damage. Although the black soiling is not localized only to this section of GLA, it is possible that the atmospheric presence of sooty particulate was attracted to these surfaces due to a past treatment of the figurative areas that had left them absorptive. Selective cleaning over the centuries may also account for the darker upper tympanums, if the figurative parts of the markers received less aggressive mechanical cleaning than the inscriptions.

→ Guidance on treatment: Overall the soiling of the GLA markers of all types does not pose a material risk and is not visually disruptive, save for the black patches described above. Research and investigation into the composition of the black surfaces and the histories of the group of slates, may yield information that leads to an understanding of this soiling typology, its potential for removal, and/or importance for retention. At this time no cleaning treatment is recommended.

IV. Findings

Summary

The survey revealed a site and collection of markers that have changed over time, with tree roots dislodging markers, footstones out of position, markers leaning at all angles, some disappeared buried into the ground, fragments of stones leaning against others, and repairs that have been poorly executed. More than two-thirds of all the stones (446/641) had losses, including over eighty percent of slates (309/370). The majority of twentieth century marble and granite stone markers are in stable condition, while the historic slates, vary across a spectrum of stability, associated with their mineral composition. Conditions of markers were not related to their location on the site or directly correlated with their age, for instance Marker 117, one of the oldest markers at GLA.



Marker 117 dated 1720.

While marbles exhibited erosion, it was not associated with active sugaring or spalling. The slates exhibited a spectrum of erosion, with some inscriptions still crisp as if tooled yesterday and others more compromised by the loss of detail. Likewise, extent of delamination varied.

The slate markers are, in general, the highest priority for treatment. Of the 370 markers, 314 exhibited delamination, 187 are in need of filling. Ninety-five slates have evidence of previous repairs and of these 54 are failing. The previous repairs that are failing can be considered for removal once testing proves it is safe to do so. The remainder need to be monitored for further changes.

The slate markers provide a valuable corpus in their similarities and differences. Similar but not standardized sizes and shapes, reflect the practical influence of varied mineral deposits and different hands of carvers. Patterns of tool marks hint at a regular stone cutting practice for gravestone slabs. A recurring pattern of tool marks across the backs of 31 stones indicates a common preparation technique, likely used to affect the proper thickness of a slab. The tool marks are found in parallel striations that are orthogonal with the edges of the markers, perpendicular to the height. Thirty stones exhibited this horizontal pattern of lines. One marker (343) had a less regular vertical pattern of tool marks, which may be related, but is likely later tooling to remove damaged stone.

A sampling of the markers with horizontal tooling on their backs, likely from manufacture.

Marker 343 has a vertical pattern of tooling on its back.

Different stone composition hints at a diverse quarry and trade industry. Variations on the theme of the skull and winged effigies or faces (Luti, p. 9) in the tympanum show a common cultural tradition followed by different artists. Different narratives described in epitaphs reflect the social framework of the community and its burial practices. A black surface appearance associated with the carved faces may indicate a past decorative or maintenance approach.

Priority 1

Markers with a Priority 1 for treatment are those for which immediate action is recommended to mitigate risk for loss of material. Aesthetic needs do not qualify for Priority 1. P1 indicates active decay or high risk.

There are 69 markers designated as P1. They include one concrete marker with a crack and three marble headstones that are either buried or fallen. To reduce the risk of further fragmentation or loss, the structural instabilities of these markers should be addressed through repair and resetting. Sixty-five slates have P1, twelve of which have a Priority/Severity of 1 due to their Leaning, 2 have cracks, 2 are buried or fallen. For this set of slates, it is critical that structural and positioning issues be addressed. Fifty-nine stones possess Delamination with a Severity 1 indicating a campaign of capping with mortar fills is critical to reduce risks of delamination.

One slate marker, #333 has a previous failing treatment, which seems a much older treatment- it should be removed and replaced.

Priority 2

Markers with Priority 2 should be treated in the short term, in the next campaign after the highest priority needs. They have condition issues such as delamination that would benefit from the protection of fills, but are not urgent because delaminating areas are not to a degree that they are at high risk for immediate loss at this time. Priority 2 may have severe flaking on the surface, and so monitoring for whether this is progressing to dimensional loss, is important. Priority 2 also includes past treatments that should be revisited due to their obvious material failure indicated by cracking and separation and/or poor appearances.

There are 98 markers designated as P2. Almost all of them, 89 are slates, 25 with a Delamination Severity 1. Of the others, six have previous failing repairs, and one has extreme leaning. Marker 458_fs has Delamination Severity 2 but has no legible inscription to save. The marble markers with P2 are structurally unstable, currently either buried, fallen, cracked or at risk due to their lean. The highest priority granite marker is P2 due to its precarious leaning with an open joint that should be corrected to mitigate risk. Addressing all of these issues is needed but can be completed after the most critical P1 markers are secured.

Priority 3

Priority 3 markers are a set of 208 stones that have minor issues that may need future treatment. Monitoring their status for changes and planning for their future treatment is recommended. Reviewing their condition in 5 years is recommended. P3 markers include the one brownstone (Unlisted (510), one concrete, two granite, 63 marble and 141 Slate. In this group, 30 marble, the brownstone and eight slate are buried or fallen. Eighteen marble are leaning and the remainder of marbles have various incipient issues including cracks, delamination and previous repairs. When Priority 1 and 2 stones have been stabilized, addressing these needs may be more urgent and will be appropriate.

Slates of Priority 3 generally have lower Severity Delamination of P3 or P4. There are ten exceptions to this where the overall priority of the marker is lower either because it is in generally good condition or there is no inscription that is threatened by loss, but the delamination is a high priority to address when conservation of these markers commences. These are: #427, 426, 267, 180, 183fs, 91, 10, 92fs, unlisted (464), and unlisted (001). In P3, there are 44 slates that have previous repairs. Of these, only four slates need their repairs revisited or redone. However in the future, when resources allow for P3 treatments to be made, this number may have increased.

Priority 4

The largest group of markers, 266 have a treatment priority of P4. These markers are stable and are not at risk for accelerated deterioration. No treatment at this time is needed. Treatment may be desired solely for aesthetic issues such as cleaning. The majority are granite and marble markers of the 19th and 20th Centuries, which are more common and physically less vulnerable. Of the 75 slates in Priority 4, 37 are stable due to previous treatment, and 57 exhibit minor delamination that should be monitored for future changes.

While the FormConnectPro+ database was an effective tool for collecting the data in an organized manner, it has its limitations. The search ability can only search by Gravestone ID# or text in a field placing extreme limitations on quickly referencing a condition or priority. It is also not possible to conduct queries in the database. For example, a query of all Priority 1 slate markers cannot be done in this application. It was always the intention that the data would be exported by others to the ArcGIS software that exists for GLA and this data would augment the collection of data in that platform and can be queried there. Thus, the data has been exported as an Excel file and a PDF of every form page as an associated deliverable with this report.

V. Treatment Recommendations

The treatment recommendations below are for general guidance and are only to be considered potential options for repair and treatment. The consulting conservator on the implementation project for conservation and restoration of the markers should decide which repair to implement based on the discussions outlined within each condition above, testing as necessary, and feasibility.

Biogrowth

- Monitor every few years to determine if cleaning is required.
- Clean with D/2: if the marker is slate or marble it should be spray applied on a dry surface and not scrubbed or rinsed. If it is a granite marker it can be scrubbed and rinsed.
- Leaving the biogrowth on the markers is also an option.

Buried/Fallen

- Carefully excavate the marker and reset it only if there is sufficient amount of stone to support being reset. If there is not enough stone to support it a new base can be designed and fabricated.
- Another option is to leave the marker buried. The location of the buried marker should be well-documented.
- A fallen marker can be lifted carefully either by hand or with a gantry and reset.
- When reset place 4" of gravel in the hole before placing in the grave markers and packing loam soil in the remainder of the hole. Create a foot of gravel 4" deep around the perimeter of the marker as berth to prevent damage from landscaping and to aid in drainage.

Crack

- Monitor cracks for progression.
- Fill with compatible crack filler if wide enough to receive it. The filler to use will be dependent on the width of the crack. Each product will have a Technical Data Sheet to accompany it that should outline those parameters. Possible fillers to use are VoidSpan's 400 Series PHLc70 Crack Filler colored to match the stone. If cracks are deep, they can be injected with a compatible grout, such as VoidSpan 600 Series PHLc70 Injection Grout.

Delamination

- If treatable, fill with pigmented and possibly stone dust/sand bulked elastomeric crack filler suitable for masonry and exterior environments. One product to consider is Sto Flexible Crack Filler. Call product manufacturer for pigmenting and bulking discussion. Regardless of recommendations by product manufacturer this repair mix can be made by the conservator to match individual markers and tested in situ to assess performance.
- If treatable, fill with a lime- and cement-based filler such as those recommended under Crack repairs by VoidSpan or Jahn products are also an option.
- Metal sheathing custom made for each specific grave marker. This is less aesthetically obtrusive if the top of the marker is largely intact. This repair option could also be considered as a preventive conservation measure for P3 and P4 designated markers with delamination that is not treatable.
- An experimental preventive treatment could be tested which entails an elastomeric or mineral silicate coating applied to the tops of markers that are not, or less, intact. Coatings should be custom mixed to each individual stone due to the extreme variability between the appearance of the slates. Research would need to be conducted on products and the technique should be tested on a few markers to help determine efficacy, visual impact, and long-term performance after environmental exposure.

Disaggregation

- It is not recommended to treat the disaggregation at this time. None of the marble grave markers exhibited severe sugaring requiring treatment.
- If future treatment is warranted for the marble a treatment program employing Prosoco's Conservare products is an option. They should be tested for efficacy and to confirm they do not visually alter the appearance of the stone. The products for calcium carbonate stones require a conversion treatment consisting of HCT and HCT Finishing Rinse followed by OH100 for consolidation and acid resistance or H100 for water repellency.

Efflorescence

- Only two markers exhibit efflorescence at this time. If removal is pursued a conservator should do the work using a variety of methods such as mechanical removal ad careful dissolution with acid. The patching mortar is very sensitive to acid so care in avoiding the edge of the patch is recommended.

Erosion

- It is not recommended to treatment eroded markers t this time.
- Monitoring may determine if treatments such as those listed under Disaggregation are necessary.

Flaking

- Most of the flaking is not treatable so it is not recommended to do anything at this time.
- Research and testing by conservators could be pursued to determine if there is an effective long-term treatment for the flaking.
- If the flaking is fillable the crack fillers mentioned under Crack can be used. They should be custom matched to the specific stone requiring repair.

Fragment

- As mentioned, there is not necessarily a wrong choice for the treatment of the fragments.
- A strategy can be developed on to how to treat the fragments depending on size, inscription, whether they help tell the story of GLA, whether there are descendants interested and involved, etc.
- Options for treatment are:
    - Burying them and recording their location.
    - Mounting them in a sensitively designed and fabricated mount that won't cause damage to the marker.
    - Laying them flat, similar to a tablet-style marker, in a bed of gravel as discussed under this section in the report.
    - Placing them in storage in the event additional information is found on them.
    - Placing them indoors or buried in a select location to use for future testing of treatments and repairs and for use in custom color matching, etc.

Fragmentation

- The fragmented pieces should be carefully removed if entwined with tree roots or buried and carefully cleaned with water.
- If the marker is marble stainless steel pins and/or epoxy welds can be used to adhere the fragments together. Once the pieces are adhered and stable the remaining seams/cracks can be filled with a custom matched crack filler.
- If the marker is slate drilling is not recommended, however, epoxy may suffice. The remaining cracks/seams can be filled with custom matched crack fillers.

Leaning

- It is recommended to reset markers that are leaning at acute angles forward or backward and side to side.
- Follow the recommendations for resetting as outlined under Buried/Fallen, taking care to excavate the marker that is out of alignment in the ground.

Loss

- It is not recommended to compensate for the loss.
- It is recommended to stabilize the edges of the loss if necessary. In many instances the loss exposed delamination so those resulting gaps and voids should be filled following the recommendations under Delamination (cementitious and/or elastomeric crack fillers).

Open Joint
- If mortar is failing carefully remove it until sound mortar is reached. Custom match a mortar to the adjacent mortar or stone using a Type O mortar mix (consisting of approximately 2 parts lime to 1 part cement to proper proportions of sand).

Previous Repair
- It is recommended to test the removal of a failing previous repair. This will determine the ease of its removal and whether it removes stone with it. Gaining this knowledge will allow for a plan on how to proceed with the failing repairs.
- It is recommended for the sound previous repairs even if they are visually incompatible that they are not removed due to the invasive procedure of removal. They should be monitored for their condition in two years and if a safe method of removal is determined be removed then.

Scrape
- It is not recommended to treat the scrapes.

Soiling
- It is recommended for a conservator to extract a few samples from various markers of the waxy black soiling and submit it for FTIR or GC/MS to composition identification. This could help understand possible source of the discoloration and treatment options if necessary.
- A cleaning treatment is not recommended at this time.

VI. Discussion

This comprehensive baseline survey of God's Little Acre has provided a snapshot of the current state of conservation of its 641 markers. It has made evident both the challenges and potential for the preservation of this important and unique cultural heritage of Newport, RI. The record provided by the inscriptions provide an unparalleled window into American history, therefore the physical preservation of these markers is tantamount. By assessing and prioritizing the markers for treatment, it provides a scaffolding on which a strategic plan for the site and the GLA Preservation Project can develop. The sheer quantity of markers, and the limits of working days in a calendar year demand that a stepped approach is plotted. This effort is a keystone of the foundation on which future conservation, research and engagement with GLA as an extraordinary resource for the greater community can continue.

Examination of the grave markers and interaction with the landscape and site over the course of the survey, sparked many questions. Why are some parts of the landscape devoid of grave markers? As some stone fragments are known to be currently buried, might there be more buried? Are these slate markers so historically important and unique that they should be sheltered indoors? Analysis of the grounds by Ground Penetrating Radar (GPR) could help answer questions of what lies under the surface. Whether to move markers indoors has no simple answer. Such a decision would require the consultation and agreement of multiple stakeholders, including communities most closely-tied to those who are buried at GLA. Since the tangible inscriptions are of principal importance, perhaps advanced documentation of these by three-dimensional photography and/ or laser scanning should be given precedence in the future.

There are numerous historic and scientific areas of research for which GLA's stone markers could provide a rich resource for investigation. Many have been mentioned in this report: research on the colonial quarry and stone trade; mineralogical and materials research into degradation and conservation techniques for American slate varieties; and sociological, anthropological and cultural studies into colonial communities and burial practices.

There are a multitude of subjects and stories recorded within GLA's grave markers. Conserving the stones preserves the legacy of these stories so they can be shared. Ultimately, the return on investment into the conservation of GLA will be the value these stories bring in education and engagement with the general public.

Appendix 1: Conditions Survey Form and Key

Conditions Mapping Key:

Symbol	Condition
	Crack or Delamination Crack
	Delamination
	Flaking
	Loss
	Erosion / Surface Loss
	Previous Repair
	Redo Previous Repair
	Failed Previous Repair
	Scrape

Marker 117 annotated for conditions.

GLA Conditions Survey

Gravestone ID#: Date: Surveyor:

Material: — Height: Width: Depth:

Secondary Material: —

☐ Footstone ☐ Fragment Overall Priority : ☒ 1 ☐ 2 ☐ 3 ☐ 4

Conditions

☐ Crack	Priority:	☒ 1	☐ 2	☐ 3	☐ 4	☐ Fill
☐ Delamination	Priority:	☒ 1	☐ 2	☐ 3	☐ 4	☐ Fill
☐ Disaggregation	Priority:	☒ 1	☐ 2	☐ 3	☐ 4	
☐ Leaning	Priority:	☒ 1	☐ 2	☐ 3	☐ 4	
☐ Erosion	Severity:	☒ 1	☐ 2	☐ 3	☐ 4	
☐ Flaking	Severity:	☒ 1	☐ 2	☐ 3	☐ 4	
☐ Fragmentation	Severity:	☒ 1	☐ 2	☐ 3	☐ 4	
☐ Loss	Severity:	☒ 1	☐ 2	☐ 3	☐ 4	
☐ Scrape	Severity:	☒ 1	☐ 2	☐ 3	☐ 4	
☐ Soiling	Severity:	☒ 1	☐ 2	☐ 3	☐ 4	

☐ Previous Repair ☐ Failing ☐ Visually incompatible

☐ Biogrowth

☐ Buried/Fallen

☐ Efflorescence

☐ Open joint

Notes:

Appendix 2: Resources and Archival Information

Site Map, ArcGIS with Search
https://glapp.maps.arcgis.com/apps/webappviewer/index.html?id=6665b8fca43a48d6aba11d553a5cb450

Prior treatments:
https://www.dropbox.com/sh/xpkddlg7778tlnn/AACi49KPNnvow8_3BFdZoWULa?dl=0

Book, Mallet and Chisel, by Vincent Luti, 2002 on Newport gravestone carvers
https://www.dropbox.com/s/ivm9t2mgndcz9d2/Mallet%20%26%20Chisel%2C%20Vincent%20Luti%2C%202002.pdf?dl=0

http://rihistoriccemeteries.org/newgravedetails.aspx?ID=155125

www.colonialcemetery.com

GLA RESOURCES/ARCHIVE:

- Bluestone Carver:
  - RI-NT003Langley,CatherineGreene1765hf.jpg
  - RI-NT003Stearnes,Hannah1761.jpg
  - Screenshot 2021-11-21 121523.jpg
  - Screenshot 2021-11-04 143113 fire location.jpg
  - site map_05.jpg
- Info in Correspondence:
  - email update on #303 Jubaafford Greenhill_ Hart stone
- Fire
  - site map_04.jpg
  - Screenshot 2021-11-04 143113 fire location

Preserving Archaeological Remains – Material for Use in the Reburial of Sites
https://historicengland.org.uk/images-books/publications/preserving-archaeological-remains/heag100f-appendix5-materials-for-use-in-reburial-of-sites/

Appendix 3: Links to Potential Products

Hydroxylating Conversion Treatment and Consolidation
https://prosoco.com/product/hct/
&
https://prosoco.com/product/oh100-consolidation-treatment/

Jahn Mortars
https://www.cathedralstone.com/Mortars-and-Grouts/

Sto Flexible Crack Filler
https://www.stocorp.com/sto_products/sto-flexible-crack-filler-2/

VoidSpan
https://www.voidspan.com/phl-products/