FLOOD MITIGATION DESIGN GUIDANCE FOR HISTORIC COQUINA BUILDINGS

CITY OF ST. AUGUSTINE, FLORIDA

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PISA Preservation Institute: St. Augustine

RESILIENT HERITAGE ST AUGUSTINE

Purpose and Audience

To provide basic information and considerations to owners, property managers, construction professionals, and other interested parties for enhancing the resilience of St. Augustine's historic coquina buildings impacted by rising damp, periodic flooding from tidal and storm surge events, and sea level rise. This document focuses on 31 historic coquina buildings constructed prior to 1821, but many of the recommendations also apply to coquina, coquina block, and other masonry structures built throughout the 19th and early 20th centuries.

For more information, contact the City of St. Augustine
Historic Preservation Officer at 904-209-4326.

Research Team

The research and production of this report were undertaken by Sarah Ryan Architects in collaboration with the University of Florida Historic Preservation Program and its Preservation Institute St. Augustine.

Preservation Institute St. Augustine

The University of Florida Preservation Institute St. Augustine (PISA) is dedicated to helping prepare the next generation of cultural heritage leaders while helping document, conserve, and interpret the history and cultural resources of St. Augustine. PISA is generously supported by University of Florida Historic St. Augustine, Inc.

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Chapter 1

Mitigating the effects of rising water tables, periodic flooding, and storm events for historic coquina structures.

St Augustine faces significant challenges related to sea level rise. High water natural disasters continue to increase in both frequency and in scope as climate change continues to drive global sea level rise. The problem has become increasingly apparent over the last two decades. Within a span of three years, St. Augustine suffered impacts from Hurricanes Matthew (2016) Irma (2017), and Dorian (2019). These storms caused significant physical and economic damage. In addition to major storm events, the city also experiences increasingly frequent nuisance flooding and will continue to have to deal with the effects of rising water tables. These hazards threaten the historic assets that define St. Augustine's 'contributing' structures.

This document is the review and analysis of thirty-one pre-1820 coquina structures located in the St. Augustine Town Plan National Historic Landmark District whose walls are constructed partially or entirely of natural coquina. Coquina, Spanish for "tiny shell" emerged as a building material during Florida's first Spanish period (1513 - 1763) at St. Augustine. Of the thirty - one structures, eight were chosen as “case studies” due to the availability of these sites for more in-depth review and because they represent both unique or exemplary examples of a type of construction or method of preservation**.**

This document is intended for those involved in historic resource management and construction professionals to assist in the adaptation of structures specifically referenced in this document and wider use, for those involved in the management and/or restoration of similar structures from of similar age.

It is the intent of this publication to encourage research, design, conservation, construction, mitigation efforts, and on-going preservation that is in compliance with the Secretary of the Interior Standards for the Rehabilitation of Historic Buildings (Standards). Projects undertaken as a result of this study should meet these Standards. A project meets the Standards when the overall effect of all work is consistent with the property’s historic character. Treatments that might be deemed unacceptable in other rehabilitation contexts because of their impacts on historic character may be acceptable in the context of adapting a property to flooding hazards. Nevertheless, treatments should always minimize changes to a building’s historic character and appearance. In summary, adaptation treatments should increase a building’s resilience to flooding risks as much as possible, but should do so without destroying significant historic materials, features, or spaces.

These guidelines will use the term "flood risk level" to describe the property-specific danger due to the relative height of anticipated floodwater. This measurement is based upon recognized GIS data, past flood events, site-specific reports, and other applicable information and is provided for the 31 structures measured from the Base Flood Elevation. The timeframe

that this document is targeted for is adapting historic coquina buildings to be more resilient to rising damp and tidal and storm flooding is over the next 10 years (2031).

In order to obtain an accurate flood risk assessment, property owners in the historic district need to acquire an Elevation Certificate from a licensed surveyor. An Elevation Certificate will identify the height of the lowest floor relative to the Base Flood Elevation (BFE).

In order to meet the regulatory flood elevations, St. Augustine's historic coquina resources can be made more resilient through actions such as dry flood proofing, wet flood proofing, and site flood proofing. The design guidelines herein outline the various approaches for meeting flood requirements while striving for consistency with the Secretary of the Interior Standards for the Rehabilitation of Historic Buildings.

Flooding Adaptation & Building Elevation Design Guidelines in this document have been developed in accordance with the National Park Service's (NPS) *Guidelines on Flood Adaptation for Rehabilitating Historic Buildings published in 2021*. These standards are referenced throughout this document and provide the basis for resiliency recommendations and outline flood mitigation strategies for historic buildings. As is the case for the Secretary of the Interior's Standards for Rehabilitation, it is up to the St. Augustine Historic Architecture Review Board to interpret the standards. The NPS standards are organized by various treatments and approaches to resiliency. The most common categories of adaptation measures are described using definitions established by the Federal Emergency Management Agency (FEMA). These adaptation categories include:

- Planning and Assessment for Flood Risk Reduction
- Temporary Protective Measures
- Dry Floodproofing
- Wet Floodproofing
- Abandon the Lowest Floor
- Protect Utilities

These approaches and treatments should be reviewed and assessed for their applicability to St. Augustine's historic coquina resources, which are at risk. Planning and assessment for reducing flood risk is the first step that property owners and contractors should take prior to selecting an adaptation treatment. Temporary protective measures are treatments that usually do not have a major affect on a property's appearance. The impacts of the other adaptation treatments to the historic property will vary greatly depending on factors such as location and site conditions, historic significance, flood risk, materials, site and setting and architectural style.

National Park Service Guidelines on Flood Adaptation for Rehabilitating Historic Buildings

1. Identify, retain, and preserve features of the historic site and setting that are important in defining its overall historic character before undertaking site mitigation work or changing the landscape or its features.

2. Protect and maintain buildings, site, and landscape features by providing proper drainage to ensure that water does not erode foundation walls, drain toward the building, or damage or erode the landscape.
3. Design new or improve existing storm water management systems to reduce surface floods and reverse flow flooding (water moving backward through the system to flood through drains).
4. Develop and implement a plan to reduce the risk of damage or destruction to the historic building.
5. Maintain the building, its site, and setting in good repair, and regularly monitor character-defining features.
6. Undertake work to prevent or minimize the loss, damage, or destruction of the historic property while retaining and preserving significant features and the overall historic character of the building, its site, and setting.
7. Use and maintain existing historic and non-historic characteristics, features, and materials of the historic building, its site, setting, and larger environment that may help to avoid or minimize the impacts of flooding.
8. Ensure that, when planning work to adapt for flooding, all feasible alternatives are considered, and that the options requiring the least alteration are considered first.

Chapter 2

Coquina Definition

Coquina, in common usage, is a term applied to many materials as noted below

Glossary of terms related to Coquina

Natural Coquina: A naturally occurring sedimentary rock; a mixture of quartz sand and mollusk shells (calcium carbonate) weakly cemented or indurated with calcite. All naturally occuring Coquina is a "stone", a "limestone", *and* a "shell stone".

Coquina Masonry:

The construction of walls or structures from individual Coquina units most often laid in, and bound together by, cementitious mortar. Coquina Masonry can be constructed of un-dressed or dressed Coquina units.

Dressed Coquina: Quarried or "found" Coquina where TWO OR MORE sides have been cut flat having a regular gometry with respect teach other.

Un-dressed Coquina: Coquina that has fewer than two sides cut or dressed; sometimes referred to as "rubble".

Manufactured Coquina: Manufactured units, poured, and trowel-applied material with a cementitious matrix and shells used as aggregate to approximate the appearance of Coquina. The materials include:

Coquina block: Plant manufactured pre-cast modular units with small shells as aggregate. These usually have some bas-relief detail on the presentation face.

Coquina concrete: Poured-in-place concrete with small shell as aggregate

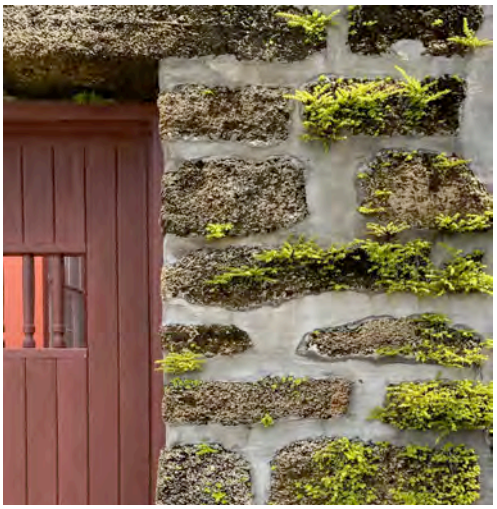
Coquina Stucco: Trowel-applied cementitious parge or stucco with small shells added to approximate the apparence of Coquina.

While common in usage, for the purposes of this report, coquina masonry and manufactured coquina are referred to as "shell-aggregate" materials rather than coquina. This report considers only natural coquina structures.

Coquina Photo Examples

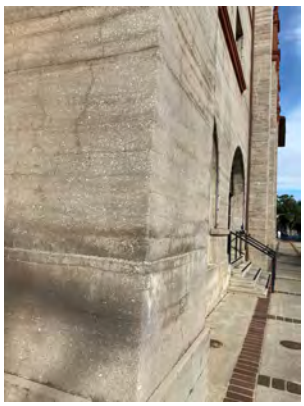
Coquina Masonry

Dressed Coquina



Un-Dressed Coquina

Coquina Block



Coquina Concrete

Coquina Stucco

Chapter 3

FLOOD MITIGATION STRATEGIES

The negative impacts of periodic flooding, storm surge, and sea level rise on historic coquina structures can be reduced and in some cases, mitigated through temporary and /or permanent interventions. The general classifications of these interventions are described below.

Temporary Measures

Temporary or non-permanent protective installations use materials or systems that can be deployed or activated when flooding is predicted, and removed and/ or stored when flood waters have receded. Temporary measures are generally the most affordable options and can have a low to no impact on the historic character of the property because they rarely involve permanent changes. However, temporary measures may not be well suited for areas subject to frequent flooding. Temporary measures require time and people to quickly deploy them, so they are not a good option in locations where flooding may occur without sufficient warning time. Although someone may need to be on site to deploy the system, property owners or tenants themselves should secure the property as best they can and move to a safe location outside the flood zone for the duration of the event. Temporary measures include sandbags, temporary dams, temporary floodgates, and flood-wrapping systems. Sandbags are the most widely recognized tools used to protect a property from flood water, but there are also synthetic products that function in a similar fashion.

Temporary dams are intended to encircle a building or close gaps in floodwalls. Temporary floodgates are removable barriers installed in windows, doorways, and other openings. Depending on the condition of the opening - the temporary barriers can be pressure fit to the opening and avoid permanently installed brackets. This helps maintain the historical integrity of the structures. In some cases permanently installed brackets are appropriate and do not impact the historical integrity. Flood wrapping systems cover the most vulnerable portion of an existing structure to create a temporary impervious barrier. Wrapping systems do not lend additional strength or stability to a structure, therefore any building using such a system must be able to withstand the forces of the flood waters. No temporary system is fail proof. There can be water seepage with these materials and systems, and they should be used in conjunction with pumps and emergency generators. Generators should be elevated above the established design flood elevation. If a temporary measure is breached or overtopped, the deployed system should be immediately removed once flood waters have receded to promote drying. With any of these systems, if custom-sized or special components are needed for certain locations (like a floodgate for a specific-size opening), it is important that they be easy to locate and identify to facilitate timely installation when flooding is predicted.

Summary of Temporary Floodproofing recommendations relevant to coquina structures (from National Park Service Guidelines)

1. Selecting a temporary barrier, system, or equipment that will protect the historic building from the predicted type of flooding and that can be deployed using the labor, equipment, and warning time available.

2. Evaluating and ensuring the ability of masonry walls and temporary flood barriers or other systems covering masonry openings to withstand the forces of flooding. Reinforcing walls as necessary to withstand such forces.

3. Installing fastening devices or stanchions to attach the temporary barrier or system in concealed or secondary locations of the building, and in a manner that does not damage, alter, or otherwise impact the historic character of the property.

4. Installing pumps to remove water that breaches the temporary barrier or other system. Ensuring that the water is pumped an adequate distance to avoid seeping back in.

5. Investing in a generator as a backup to operate pumps if there is a power failure during or after a flood. Installing a generator in a flood proof enclosure or above the established flood risk level.

6. Obtaining removable flood barriers for openings in any existing solid masonry perimeter site walls that are strong enough or reinforced to withstand the forces of a flood.

7. Relocating furnishings and valuable collections to higher floors, upper shelves, or off-site to protect them from seepage or possible failure of the temporary barrier or system. Using watertight containers for storage whenever possible.

Dry Floodproofing

Dry floodproofing is an adaptation method designed to keep water out of a building through exterior barriers, door floodgates, window shutters, and other preventive techniques. Strategies include installing a temporary or permanent barrier around the building, creating a watertight seal around the foundation up to the established design flood elevation, and deploying temporary flood barriers at building openings. This adaptation may involve significant alterations that impact historic spaces, features, and materials affecting the building's historic character and appearance.

Any building component, which includes foundations, walls, slab, or sanitary systems, must be able to withstand hydrostatic forces. Walls may need to be reinforced and anchored to withstand flooding forces, including buoyancy and debris impact, and a specially engineered drainage system might need to be installed.

54 St George Street
St Augustine FL
Door Dam Example

The aspect of dry floodproofing that can pose the greatest concern from a technical preservation perspective is waterproofing. There are numerous products and technologies that are available and each product has different performance standards and the potential to negatively impact the historic materials to which it is applied. Waterproof coatings that are vapor impermeable can trap moisture in the wall or on the interior wall surface, which can cause deterioration or damage to historic materials. For this reason, the application of vapor impermeable coatings is not recommended on the surface of historic coquina structures.

Technical limitations:

Dry floodproofing has limitations. Because of the strength of the flood forces, dry floodproofing is generally not recommended where the anticipated flood or high water level is more than three feet, particularly for unreinforced masonry. In addition, dry floodproofing requires a high frequency of maintenance when exposed to frequent flooding.

Designing temporary or permanent floodgates for all openings (i.e. windows and doors) that are below the established design flood elevation is a key component of dry floodproofing. This is best achieved by installing stanchions, fasteners, or tracks for floodgates in concealed or secondary locations, and in a manner that does not damage, alter, or otherwise impact the historic character of the property. As mentioned above, depending on the condition of the opening - temporary floodgates can be pressure fit to the opening and avoid permanently installed brackets.

Many properties have crawl spaces with vents that allow air circulation in the crawl space. The vents can be protected from flood waters with low protective walls.

The low walls surrounding the vent still allow for air circulation but in some circumstances, the installation of a fan to provide additional air circulation in the crawl space is recommended.

The low walls should be compatible with the historic building. If crawl space vents have been previously sealed, investigation should be undertaken to determine if the vent closures are watertight and, if not, they should be sealed.

71 Marine Street, St Augustine FL
Low Protective Walls at Crawl Spaces

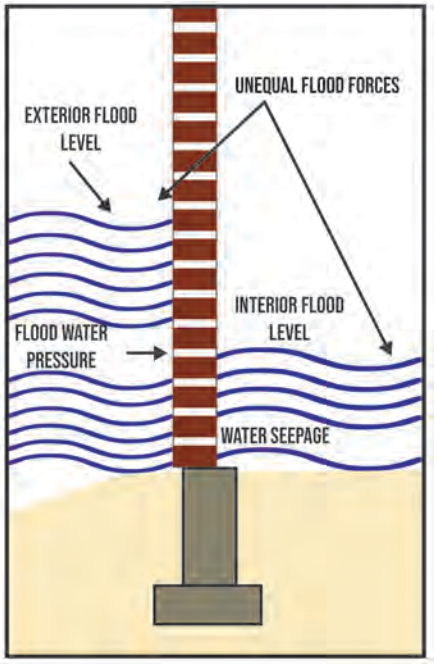
Wrapping the walls with a temporary, removable waterproof membrane is an option if there is a likelihood of flood waters seeping through the wall material itself.

If a dry floodproofing measure is breached or overtopped, the deployed system should be immediately removed once flood waters have receded to promote drying.

22 St Francis Street, St Augustine FL -
Example of walls wrapped with a temporary waterproof membrane

Summary of Dry Floodproofing recommendations relevant to coquina structures
(from National Park Service Guidelines)

1. Evaluate the strength of masonry walls and footings of historic buildings to ensure that they have the capacity to withstand floodwater pressure and debris if the floodwaters are likely to be moving. (see diagram to right)



2. Install a drainage system around the foundation and footings of the historic building to avoid undermining the building and to allow for proper site drainage.

3. Design temporary or permanent closures for all openings (i.e. windows, doors, crawl space vents) that are below or extend into the established design flood elevation while maintaining the historic character of the building.

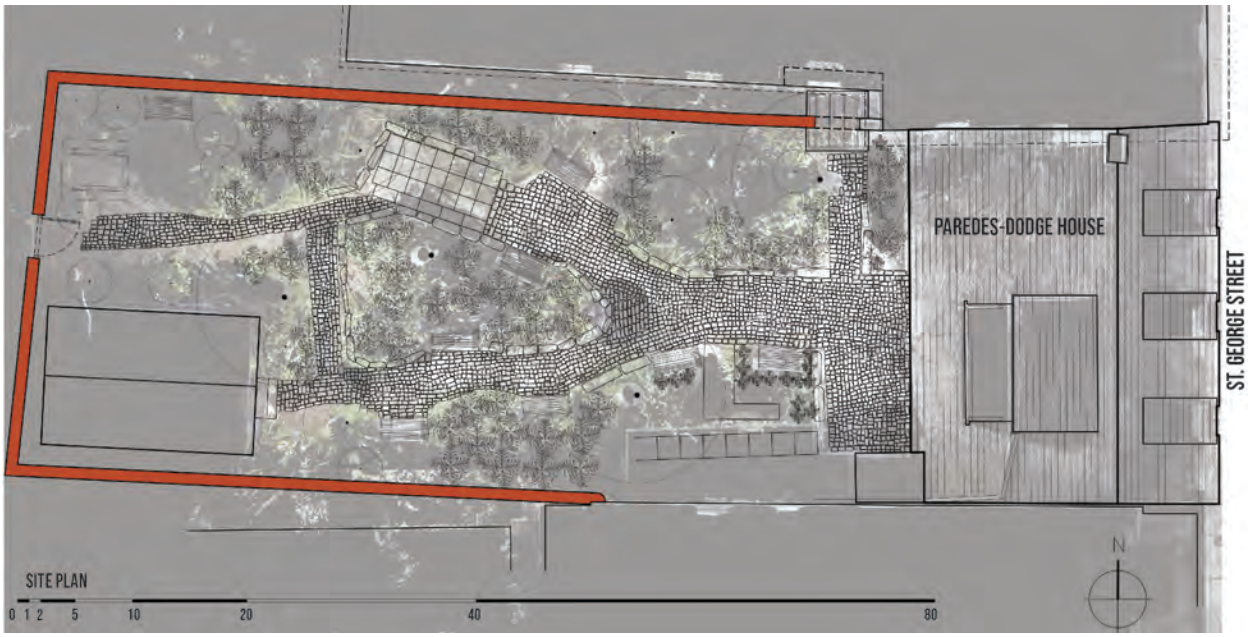
4. Block character-defining window or door openings that extend into the flood protection zone with temporary floodgates.

5. Install fasteners or tracks for floodgates in concealed locations, and in a manner that does not damage, alter, or otherwise impact the historic character of the property.

<u>Site Floodproofing</u>

In some cases, properties that are enclosed by a perimeter wall can take advantage of site floodproofing that will protect the entire site from inundation. This is a highly advantageous solution in St. Augustine where many sites are walled. In the case of Site Floodproofing, walls are assessed in terms of height and structural ability to resist hydrostatic pressure. Temporary or permanent operating flood doors are prepared or installed and one or more sump pumps

are recommended, if needed, to effectively control water on the site and reduce hydrostatic pressure as floodwaters recede.



54 St George Street, St Augustine FL - Site Floodproofing example (walls shown in red)

Dry floodproofing the building or site also requires the control of any utility related penetrations through the flood barrier. Yard drains, floor drains, electrical service entrances, foundation vents, and other physical connections through or around the flood barrier can provide an entrance pathway for floodwater. Installing check valves to prevent infiltration though sewer, waste, and drain systems, grouting around utility service entrances, and walling around vents can provide protection for these systems.

Technical Limitations:
This adaptation method is only appropriate for load-bearing masonry buildings or frame buildings with masonry foundations, where the established Design Flood Elevation is below the top of the wall, since masonry walls can be made to withstand flooding forces.
The treatment requires regular maintenance, monitoring, and repair to perform effectively in repetitive flood events, as system components such as sealants and membranes can degrade or become damaged.

Summary of Site Floodproofing recommendations relevant to Coquina Structures (from National Park Service guidelines)

1. Identifying, retaining, and preserving features of the historic site and setting that are important in defining its overall historic character before undertaking site mitigation work or changing the landscape or its features.

2. Altering the site or setting in locations that are not critical to the significance of the historic character of the property.

3. Protecting and maintaining buildings, site, and landscape features by providing proper drainage to ensure that water does not erode foundation walls, drain toward the building, or damage or erode the landscape.

4. Surveying and documenting areas where the terrain will be altered or new features constructed to determine the potential impact to important landscape features, archeological resources, other cultural or religious features, or burial grounds.

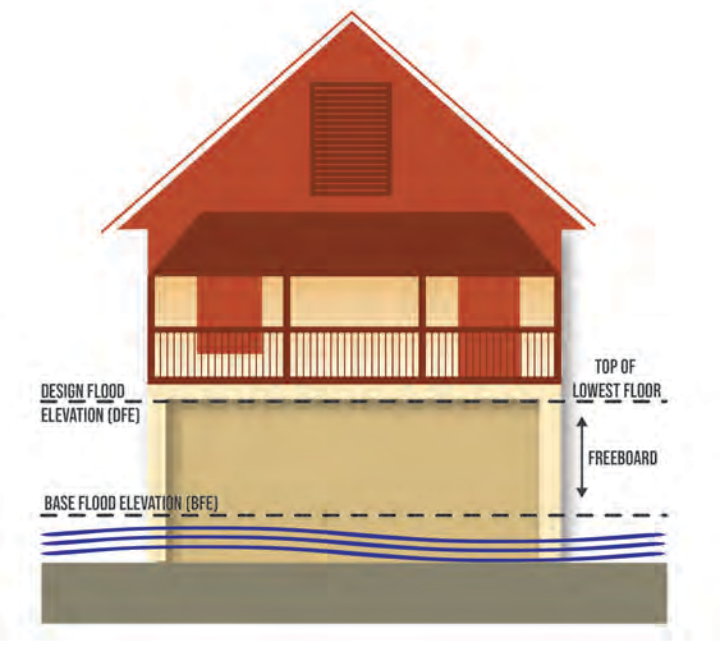
5. Constructing a levee, berm, or embankment on adjacent or nearby land outside the historic site or district to minimize impacts to the character of the historic property and increase the area of protection for the historic site or district. Designing a new floodwall or berm or improving an existing barrier to provide flooding protection to a historic site.

7. Ensuring that the new or modified floodwall or berm is compatible with the historic character of the property.

8. Where the building wall forms part of the site enclosure, compatible dry flood proofing measure need to be employed.

Wet Floodproofing

Wet floodproofing allows water to flow through the building with no or minimal damage during a flood event. It is a method to reduce damage that typically involves three elements - allowing floodwaters to enter and exit to minimize structural damage, using flood damage-resistant materials, and elevating utility services, and equipment. When a building is retrofitted to be wet flood proofed, non-flood damage-resistant materials that are below the Base Flood Elevation (BFE) should be removed and replaced with appropriate flood damage-resistant materials. It may be appropriate to fill in all or portions of crawl spaces and improve the grading around the building.



Wet floodproofing is not recommended where flooding is expected to exceed 24 hours in duration. Because this approach allows flood waters to enter the building, which will likely cause damage to historic materials, features, and finishes. It is best to limit this treatment to buildings where the area of inundation is an unfinished space or where materials are of a flood damage-resistant quality.

Water must also be able to move through the interior spaces of the flooded portions of the building, such as through door and other openings in order to prevent the build up of

hydrostatic pressure on one side of a wall or the other. The building may require structural reinforcement and anchoring to the foundation to allow it to withstand the force of floodwaters. In a noted example in St. Augustine at 172 Avenida Menendez, rapidly receding floodwaters caused a wall to topple outwards from the force of water receding during Hurricane Matthew in 2016. The site wall was then reinforced and heightened and withstood hydrostatic force nine months later during Hurricane Irma.

All mechanical, electrical, and plumbing systems must be elevated above the established design flood elevation or otherwise designed to withstand floodwaters. Where the floodwater may not drain naturally from the lowest levels of the property, a new mechanical drainage system should be designed and installed to help remove the water from the building.

Interior spaces must be altered to allow for inundation, potential contamination, draining, cleaning, and drying, which can require removal and replacement of historic materials. Materials that will be in contact with the water may need to be replaced with more water-resistant and impervious materials. For example, gypsum wall board will need to be completely removed and replaced with a more flood-damage resistant substitute material such as marine-grade wood or vapor permeable non paper-backed, gypsum board to avoid moisture and mold issues. Any wall cavities will need to be opened and accessed after each flood to clean and dry. If the wall is solid coquina with vapor permeable stucco and plaster the wall will need to be lightly cleaned after water inundation - please reference the appendix for cyclical or post-flood event maintenance and repairs. Additionally, all interior furnishings and personal effects must be moved from the area prior to the flooding event to protect them from damage of the floodwaters. Be aware that drying and cleaning can take extended periods of time, and the building may not be habitable during this process. The drying process can be moderately accelerated by using dehumidifiers and fans. Heated air systems are not recommended.

The primary preservation concern about this adaptation method is the potential loss of historic materials. It is crucial to identify and document the condition of the historic materials, features, and finishes before selecting this treatment. Some traditional materials perform as well as modern flood-damage resistant materials. Many historic buildings have been altered over time and may no longer retain a high degree of historic interior materials (e.g., plaster has been replaced with drywall). In these instances, it may be possible to replace these with flood-damage resistant materials without impacting the historic character of the building. Flood-damage resistant substitute materials may be used to replace deteriorated or damaged historic materials and features below the established design flood elevation.

This adaptation method is generally not appropriate for a historic building that still retains a high level of historic materials, features, finishes, and spaces at or below the established design flood elevation because it could result in their loss.

Technical Limitations:
This adaptation is not viable for buildings where flooding will likely exceed 24 hours due in part to the potential for damage, contamination, and biological growth possible over longer exposures to floodwater. Any building component, which includes foundations, walls, slab, or sanitary systems, must be able to withstand hydrostatic forces. The building has to dry out after

a flood, so this method is not suitable if there is inadequate ventilation. This adaptation requires a lengthy cleaning process and drying time, and, therefore, is best applied when flood waters will be limited to non-living spaces (i.e. crawlspaces, garages, etc.) or for non-residential properties.

It is recommended that all utilities be relocated above the established design flood elevation or to protect them in place with a watertight or impermeable enclosure. Likewise, it is recommended that electrical outlets and panels are relocated above the established design flood elevation in a manner compatible with the historic character of the building by placing them in less visible locations and possibly concealing them with existing features such as a door frame or chair rail.

Summary of Wet Floodproofing recommendations relevant to Coquina Structures
(from National Park Service guidelines)

1. Evaluating the strength of walls and footings of historic buildings to ensure that they are strong enough to withstand floodwater pressure and flood-borne debris.

2. Anchoring the structure, where necessary, to prevent movement or collapse of the historic building.

3. Relocating all utilities above the established flood risk level or protecting them in place with a watertight or impermeable enclosure.

4. Installing a Ground Fault Circuit Interrupter (GFCI) to protect the electrical system of the historic building and prevent possible fires.

5. Following the recommended structural engineering guidance for the number, size, and placement of hydrostatic flood vents, as well as any other ventilation requirements.

6. Designing a system for draining the building as floodwaters recede outside the building.

7. Retaining historic materials, features, and finishes that are flood-damage resistant. Removing non-historic finishes and furnishings that absorb and trap moisture, such as carpets.

8. Using substitute materials that are more flood-damage resistant when replacing deteriorated or destroyed historic materials and features that are compatible with the historic character of the building. Replacing character-defining features with a substitute material that matches the design and appearance of the historic component.

9. Relocating furnishings and possessions to higher floors, upper shelves, or off-site to protect them from floodwaters.

<u>Abandon the First Story during a Food Event</u>
This adaptation method requires modifying a multi-story building to relocate all living spaces to upper floors above the established design flood elevation. The abandoned first story must be altered and adapted into a utilitarian wet or dry flood proofed space. This option is best suited for multi-story masonry buildings. Historic buildings with unfinished interior spaces that are constructed of durable materials are also likely candidates. While permanently abandoning the

first floor is an option, an alternative is to occupy the first floor but be prepared to move furniture and artifacts to a second floor when a storm is approaching. First floor spaces can be lightly washed and dried after they have been inundated.

The abandoned first story can also be used for storage or for items that can be easily moved and for building access. The abandoned story can be wet or dry floodproofed (see sections above). The application of dry floodproofing when abandoning the first story may impact the exterior due to the treatments necessary to resist water infiltration. In addition, dry floodproofing the first story requires a sump pump to remove water that may penetrate the space. Masonry walls may still require air venting that can be closed in the event of a flood.

Elevate the Building on a New Foundation

This adaptation method involves raising the height of a building by lifting the building from the existing foundation, constructing a new, higher foundation, and resetting the building on the new foundation. This is one of the most common solutions for wood frame residential buildings at risk from flooding and is often the most effective approach to protecting historic buildings and therefore from flooding. This approach, however, is impractical and potentially destructive, to the soft and heavy coquina structures in St. Augustine, its application should only be undertaken in the most dire of circumstances.

Technical Limitations:

The historic building must be structurally stable and/or repaired or temporarily reinforced in order to be raised onto a new foundation. There must be a structural system that can support the building on temporary cribbing while a new foundation is constructed. For example, buildings in which a structural slab also functions as the floor or subfloor do not have a platform that would support the walls when lifted. The building must be physically separated from neighboring buildings, although attached buildings that are essentially one structure can be elevated together.

Protect Utilities

Utilities and mechanical systems for historic buildings are often placed in side and back yards to conceal them from sight. Any part of these systems in such flood-vulnerable locations should be elevated or relocated above the established design flood elevation. Utilities and mechanical systems should be relocated to utilitarian or other secondary spaces in historic buildings that are unlikely to flood. Exterior utilities and mechanical systems should similarly be elevated to protect them from flooding, and placed in locations that minimize, as much as possible their visibility and impact on the historic character and appearance of the building. Consider relocating HVAC equipment to rear roof lines not readily visible from the street. When planning a project involving mechanical, electrical, plumbing, or fire suppression systems, it is helpful to be aware of the service life of the various features of the systems involved.

172 Avenida Menendez
St Augustine FL
Example of raising electrical outlets

Example of raising utilities

Technical Limitations:
It may be necessary to keep the systems, in whole or in part, in the existing location even though it is a known flood risk area of the property. This part of the system will need to be placed within a watertight enclosure or be sacrificial and replaced after a flood. Depending on the frequency of expected flooding, the cost of that part of the system, and its expected service life, this approach may be economically reasonable.

Summary of protecting and elevating utilities

1. Elevate HVAC units or any other exterior equipment as inconspicuously as possible.
2. Secondary elements such as electrical outlets, switches, junction boxes, meters, and wiring should also be raised above the base flood elevation.
3. HVAC units should be screened with landscaping, wood lattice or slats or other screening elements per HARB guidelines.
4. Consider ladders and moveable screen panels for access and servicing raised utilities.
5. All utilities, which are placed on elevated platforms, should be securely anchored to meet wind-resistant requirements.
6. Similarly, propane and other fuel tanks should be screened and anchored so they do not float and become a hazard during a flood

<u>Property Clean- Up Post Flooding</u>
Once a storm or flood event has passed it is important to evaluate the building for safety and cleanup. Clean up includes using the gentlest means possible for removing surface grime and killing flood-borne bacteria. This can include low-pressure water wash and appropriate cleaners. Identifying and assessing the flood-damaged building to determine the impacts to the historic materials will be necessary to determine which materials and features can be cleaned, dried and repair and which materials must be replaced. All materials that were submerged or in contact with the flood waters need to properly dry using dehumidifies and fans before repairing or occupying the building.

Chapter 4

Specific flood mitigation strategies and recommendations

This document is the review and analysis of thirty-one pre-1820 coquina structures located in the St. Augustine Town Plan National Historic Landmark District whose walls are constructed partially or entirely of natural coquina. Of the 31 structures, eight were chosen as "case studies" due to the availability of these sites for more in-depth review and because they represent both unique and exemplary case studies of a type of construction or method of preservation**.** The case studies are noted on the resources specific analysis.

The recommendations for individual recourses are meant as guideline to address the most pressing needs related to anticipated future weather - related events. Property owners should consult professional architects and building contractors if there are questions regarding these recommendations.

Listed below are the specific resources:

1) Arrivas House - 46 St George Street *
2) Avero House - 41 St George Street
3) Cathedral of St Augustine - 38 Cathedral Place
4) Demesa-Sanchez House - 43 St. George Street*
5) Don Manuel Solana House - 21 Aviles Street
6) Dummet House - St Francis Inn - 279 St. George Street
7) Espinosa-Sanchez House - 110 Charlotte
8) Gaspar Papy House - 36 Aviles Street
9) Gonzales - Alvarez House - 14 St Francis Street*
10) Gonzales - Jones House - 56 Marine Street
11) Joaneda House - 57 Treasury Street
12) Kings Bakery - 99 Marine Street
13) Lindsley (Horruytiner) House - 214 St George Street
14) Llambias House - 31 St Francis Street
15) Long Sanchez House - 7 Bridge Street*
16) Marin House - 47 Marine Street
17) O'Reilly House - 32 Aviles Street*
18) Padres - Dodge House - 54 St George Street*
19) Parades-Ortega-McMillan House - 224 St George Street
20) Pena-Peck House - 143 St George Street
21) Poujoud-Burt House - 105 St George Street
22) Prince Murat House - 250 St George Street
23) Puello House - 53 Marine Street
24) Rodriquez Avero Sanchez House - 52 St George Street
25) Rovira-DeWhurst House - 71 Marine Street
26) Roira - Hernandez House - 172 Avenida Menendez

27) Segui House - 12 Aviles Street
28) St. Francis Barracks - 82 Marine Street
29) Tovar House - 22 St Francis Street*
30) Triay House - 42 Spanish Street
31) Ximenez Fatio House - 20 Aviles Street*

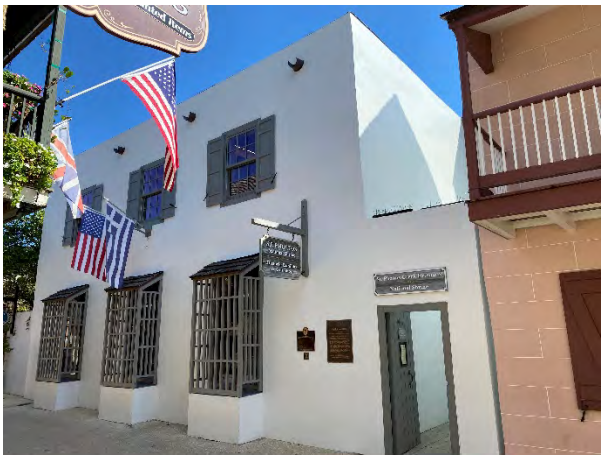
Address:	46 St. George Street
Name:	**Arrivas House**
Ownership:	University of Florida
Construction Date:	1740
Additions/alterations:	1926, 1937
Restoration Date:	1962
Exterior walls:	Stucco / exposed coquina
First Floor Elevation (FFE):	
Flood Risk Level:	Low. Flood zone “X” BFE 7’
Window Sill Height (abv FFE):	24” (min)
Case Study (y/n):	Yes
Site Walls (y/n):	Yes

Summary
This resource is only one of three buildings included in the study that has exposed coquina on the entirety of the public façade. The north, south, and west facades are painted stucco over coquina. All exterior walls are coquina masonry with painted plaster on the interior. This resource has not been inundated in a named storm event however heavy localized rain poses a periodic concern in the rear yard. The building is air-conditioned but limited visual access prevents observation of rising damp or potential condensation issues. From our limited observations of the interior (displays were covering most of the walls) the first floor suffers slight rising damp issues due largely to the higher elevation and extensive roof and porch overhangs around the building.

The site is not walled. Of the four ground-level doorway openings, two have been permanently closed and sealed shut but not reinforced to support hydrostatic pressure. The two open doorways have a threshold height of 5 ½”.

Recommendations:
This resource can be protected by temporary measures including improvements to the water resistance of the two sealed doorways and temporary floodgates at the two open doorways. Protecting the exposed coquina could be undertaken through the use of sheet waterproofing to avoid staining and subsequent cleaning although any trapped moisture that can damage coquina if not removed quickly after a storm.

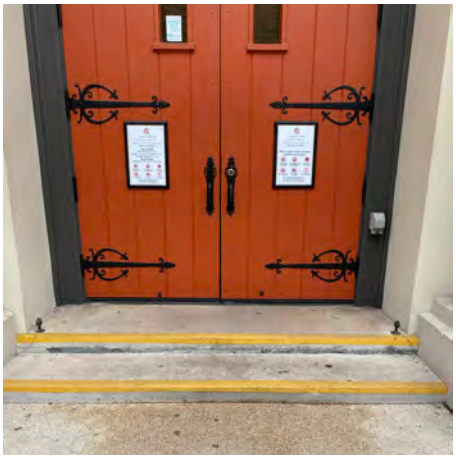
Address:	41 St. George Street
Name:	**Avero House**
Ownership:	Greek Orthodox Archdiocese
Construction Date:	1743
Additions/alterations:	
Restoration Date:	1970
Exterior walls:	Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	Low. Flood zone “X” BFE 7’
Window Sill Height (abv FFE):	24”
Case Study (y/n):	No
Site Walls (y/n):	Yes



Summary
All of the exterior walls of this resource are coquina masonry with painted stucco in excellent condition on the exterior and painted plaster on the interior. This resource has not been inundated in a named storm event and heavy localized rain seems not to pose a concern as the enclosed courtyard drains through the main entry into St. George Street.

Recommendations:
While site flood proofing measures could be applied to this property, sealing the door facing St George Street would eliminate the means by which the water in the courtyard could escape. The building alone could be protected by temporary measures including removable pressure fit floodgates.

Address:	38 Cathedral Place
Name:	**Cathedral of St. Augustine**
Ownership:	Catholic Diocese
Construction Date:	1797
Additions/alterations:	1894
Restoration Date:	1966
Exterior walls:	Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	Moderate. Zone "AE" BFE 7' (29% in Zone "X")
Window Sill Height (abv FFE):	60"
Case Study (y/n):	No
Site Walls (y/n):	Yes



Summary

This resource "fronts" on Cathedral Place but has significant exposure to St. George Street. Exterior walls are thick coquina masonry with stucco in excellent condition on the exterior and stone veneer and plaster on the interior. The site is separated from the streets by a 36" (min) concrete wall with significant gates and gaps along the perimeter. Doorways are raised less than 5" from the street and all windows sills are very high. Through-wall air conditioning units at floor level pose the greatest opportunity for water infiltration.

Recommendations:

This resource is a good candidate for dry floodproofing. Two alternatives for dry floodproofing are site floodproofing the property at the surrounding wall or floodproofing the building. Although the garden wall has significant openings, the largest (separating the property from the Pena-Peck house) could be narrowed (with a floodgate installed) or in-filled completely to remove the opening. Installing permanent brackets for floodgates could protect the other site wall openings. The brackets would not significantly impact the existing historic fabric and would block flooding through these openings. A generator could be installed with a sump pump to remove water accumulating in the yard. Alternatively, the building alone can be flood proofed with removable pressure fit floodgates at the doors that do not require permanent brackets. In the event of a significant flood event, the air conditioning units will need to be removed and the openings covered with flood barriers. In either method, door dams will be required on Cathedral Place.

Address:	43 St. George Street
Name:	**Demesa-Sanchez House**
Ownership:	University of Florida
Construction Date:	1764
Additions/alterations:	c. 1791, 1857
Restoration Date:	1959, 1980
Exterior walls:	Stucco, wood siding
First Floor Elevation (FFE):	
Flood Risk Level:	Moderate. Zone "AE" BFE 7' (74%) BFE 8' (14%)
Window Sill Height (abv FFE):	18" – kitchen windows above main floor elev.
Case Study (y/n):	Yes
Site Walls (y/n):	No

Summary

The majority of the first floor exterior walls are coquina masonry with painted stucco on the exterior and painted plaster on the interior. Floors are wood in areas and concrete in the rear 1821 kitchen addition (recessed 4" from the main house level). This resource had minor flooding in a recent named storm event however heavy localized rain poses a periodic concern. The building is air conditioned but apparently not enough to cause vapor drive or condensation problems. However, the air conditioning's unique under floor distribution system provides a potential pathway for water infiltration.

The site is not walled and is open to adjacent properties. Of the three ground-level doorway openings, the one in on St. George Street has the highest threshold height with the others being almost at grade level. The first floor suffers rising damp issues in areas where the roof overhangs are minimal and at the kitchen addition that is at grade level.

Recommendations:

Although not significantly inundated, this resource should be carefully protected against future water damage. Protection by temporary measures including removable pressure fit floodgates at the three doorways is recommended. Installing a sump and pump to remove water that infiltrates the air conditioning system would be useful if the underground floor distribution system is inundated in future flooding events.

Address:	21 Aviles Street
Name:	**Don Manuel Solana House**
Ownership:	Private
Construction Date:	1803
Additions/alterations:	c. 1880, c.1970
Restoration Date:	
Exterior walls:	Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	Low. Zone "X" (70%) BFE 7' Zone "AE" (30%) BFE 7'
Window Sill Height (abv FFE):	24"
Case Study (y/n):	No
Site Walls (y/n):	No

Summary

The first floor is historic coquina masonry with painted stucco on the exterior. Access to the interior was limited. This resource has not been inundated in a recent named storm. The nuisance flooding concern is reduced largely due to the fact that the site rises as much as 20" above Charlotte Street. The site is not walled and is open to adjacent properties. The two ground-level doorway openings facing Aviles Street are almost at grade level and the one door facing Charlotte Street threshold height is 22".

Recommendations:

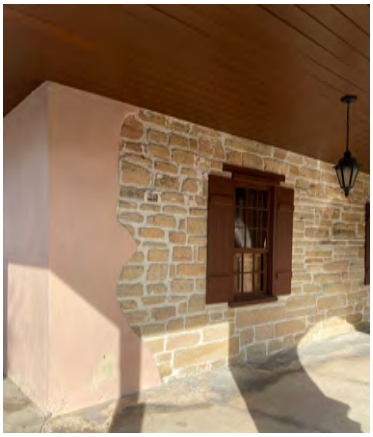
Although not recently inundated, future-flooding events may impact this resource. Protection by temporary measures including removable pressure fit door floodgates is recommended.

Address:	279 St. George Street
Name:	**Dummet House – St. Francis Inn**
Ownership:	Private
Construction Date:	1791
Additions/alterations:	c. 1888, c. 1903, c. 1976
Restoration Date:	
Exterior walls:	Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	High. Zone "AE" BFE 8'
Window Sill Height (abv FFE):	36"
Case Study (y/n):	No
Site Walls (y/n):	Yes

Summary
The first floor exterior walls are coquina masonry with painted stucco in fair condition on the exterior and painted plaster on the interior. This resource was inundated in a recent named storm to a depth of 24" but localized storms or nuisance flooding does not pose a concern largely due to the fact that the floor level is approximately 8" above street level. The door on St. Francis Street has been sealed shut. The site is walled with a low coquina garden wall on St. George and CMU / coquina walls encompassing the rest of the site. The wall has significant openings but appears sound.

Recommendations:
This resource is a good candidate for dry floodproofing. Two alternatives for flood protection are site floodproofing the property at the surrounding wall or floodproofing the building. Although the garden wall has significant openings, installing permanent brackets for floodgates at the site wall would not significantly impact existing historic fabric and would block flooding through these openings. A generator could be installed with a sump pump to remove water accumulating in the yard. Alternatively, the building alone can be floodproofed with the doors closed and removable pressure fit door floodgates. The existing doorway on St. Francis should be reinforced against hydrostatic pressure.

Address:	110 Charlotte Street
Name:	**Espinosa-Sanchez House**
Ownership:	Private
Construction Date:	1756
Additions/alterations:	1790s, 1920s
Restoration Date:	1965
Exterior walls:	Coquina, Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	Severe. Zone “AE” BFE 8’
Window Sill Height (abv FFE):	27”
Case Study (y/n):	No
Site Walls (y/n):	No



Summary
This resource is one of three buildings in this study that has exposed coquina on an entire public façade. The north, south, and west facades are painted stucco over coquina in good condition with “windows” into the coquina substrate. All exterior walls are coquina masonry. There are three ground-level doorway openings - the threshold height for the door facing west at Charlotte Street is 12", the door facing east towards Avenida Menendez threshold height is 4" and the threshold height for the door facing north to the alley is 6". The site is not walled.

Recommendations:
This resource can be protected by temporary measures including removable pressure fit door floodgates at the two recessed openings and a surface applied dam facing east towards Avenida Menendez.

Address:	36 Aviles Street
Name:	**Gaspar Papy House**
Ownership:	Sisters of St. Joseph
Construction Date:	1810
Additions/alterations:	1944
Restoration Date:	
Exterior walls:	Stucco, coquina
First Floor Elevation (FFE):	
Flood Risk Level:	Moderate. Zone "AE" BFE 7'
Window Sill Height (abv FFE):	17"
Case Study (y/n):	No
Site Walls (y/n):	Yes

Summary:
Perimeter walls are painted stucco on the exterior in excellent condition and unknown material on the interior. According to the owners, the interior of this building has been extensively re-built with little remaining historic fabric. Recent named storm events have inundated this resource to a reported depth of several inches. There are three doors into the building, one from Aviles Street with a 6" curb and two within the courtyard at grade. The site is walled but has numerous large openings. Window sills are low and the natural grade rises above the interior floor elevation on the south side.

Recommendations:
This resource is a good candidate for dry floodproofing of the building. The building alone can be floodproofed with temporary measures including removable pressure fit door floodgates set in between the door jambs and without the use of permanently installed brackets. Window floodgates would also be recommended because the sills are low.

Address:	14 St. Francis Street
Name:	**Gonzalez-Alvarez House (Oldest House)**
Ownership:	St. Augustine Historical Society
Construction Date:	1723
Additions/alterations:	1791
Restoration Date:	1960
Exterior walls:	Stucco, wood siding, coquina
First Floor Elevation (FFE):	
Flood Risk Level:	Severe. Zone "AE" BFE 8'
Window Sill Height (abv FFE):	26"
Case Study (y/n):	Yes
Site Walls (y/n):	Yes

Summary:
Perimeter walls are painted stucco on the exterior in fair condition and a patchwork of various plaster-type materials on the interior. Recent named storm events have inundated this resource to a reported depth of several inches. There are multiple doors into the building and only one with a 6" curb; the others open into the courtyard at grade. There is a site wall it but includes several buildings including numerous large openings.

Recommendations:
The natural and unadorned state of the interior of this resource suggests that it is a good candidate for wet floodproofing. For storm events, the furniture and artifacts on the first floor can be removed to the second floor and the spaces lightly washed and dried after they have been inundated. Alternatively, the building alone could be temporarily floodproofed with the doors closed and removable pressure fit door floodgates without the use of permanently installed brackets.

Address:	56 Marine Street
Name:	**Gonzalez-Jones House**
Ownership:	Private
Construction Date:	1763
Additions/alterations:	Early 20c., 1980s
Restoration Date:	
Exterior walls:	Stucco, siding
First Floor Elevation (FFE):	
Flood Risk Level:	Severe. Zone "AE" BFE 8'
Window Sill Height (abv FFE):	42" from curb. 49" from street
Case Study (y/n):	No
Site Walls (y/n):	Yes

Summary:
First floor perimeter walls are painted stucco on the exterior in excellent condition and unknown material on the interior. Flooding history is unavailable but its elevation suggests that it is likely the property would have been inundated during recent named storm events. The one door into the building from Aviles Street has a sill 18" up from the Marine Street. Access to the rear of the house and interior was not available. The entire site appears to be enclosed with a tall and structurally sound wall containing two large openings, which includes a large vehicular opening.

Recommendations:
This resource is an excellent candidate for site floodproofing with only the two openings in the site wall and the main door of the house needing temporary floodgate protection. The building alone may be floodproofed but openings to the side and rear were not observable.

Address:	57 Treasury Street
Name:	**Joaneda House**
Ownership:	University of Florida
Construction Date:	1806
Additions/alterations:	c. 1920, c. 1986
Restoration Date:	1976
Exterior walls:	Stucco, wood siding
First Floor Elevation (FFE):	
Flood Risk Level:	High. Zone "AE" BFE 7'
Window Sill Height (abv FFE):	28" (at street) 23" interior
Case Study (y/n):	Yes
Site Walls (y/n):	No

Summary
This resource is a valuable example of Second Spanish Period colonial architecture and the "St. Augustine plan" with the original fabric intact. Perimeter walls are painted stucco on the exterior and painted plaster on the interior. This resource was severely inundated in both recent named storm events with water levels reportedly reaching 36" deep in the main room on the first floor. Heavy localized rain also flowed into the building (the floor is at grade in the rear) until the owner installed a trench drain. The site is not walled and is open to adjacent properties. The one main entry door is at grade as is the one to the kitchen addition. The first floor appears not to have any rising damp issues despite its low elevation and short overhangs.

Recommendations:
Two options exist for addressing future inundation. Wet floodproofing - removing or elevating furniture and materials to the upper floor and allow the water to enter and exit the building and then cleaning and drying the interior. Dry floodproofing – protect the first floor against flooding by temporary measures including removable pressure fit floodgates at the two doorways. The fairly straightforward nature of the shutters suggests the possibly of altering the existing shutters with gaskets to act as flood protection in the closed position rather than installing dam brackets. The integrity of the shutters should be evaluated prior to installing a gasket and using them as a temporary floodproofing measure. Installing a sump and pump on the interior of the structure is recommended to remove any water inundation.

Address:	99 Marine Street
Name:	**Kings Bakery**
Ownership:	US Parade Grounds
Construction Date:	1796
Additions/alterations:	
Restoration Date:	
Exterior walls:	Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	Severe. Zone "AE" BFE 8'
Window Sill Height (abv FFE):	26"
Case Study (y/n):	No
Site Walls (y/n):	No

Summary:
The perimeter walls are painted stucco on the exterior in excellent condition and painted plaster on the interior. This resource was inundated severely in both recent named storm events and is unique in that the entire eastern façade has been removed and the first floor is used for parking.

Recommendations:
The current flood mitigation strategy is a combination of wet floodproofing and abandonment of the first floor. Given its location and severity of flooding, these are sound strategies.

Address:	214 St. George Street
Name:	**Lindsley (Horruytiner) House**
Ownership:	Private
Construction Date:	1763
Additions/alterations:	1889, 1915, 1977
Restoration Date:	
Exterior walls:	Stucco, wood
First Floor Elevation (FFE):	
Flood Risk Level:	Low. Zone "X" BFE 7'
Window Sill Height (abv FFE):	23" above sidewalk
Case Study (y/n):	No
Site Walls (y/n):	Yes

Summary
Perimeter walls are painted stucco in excellent condition on the exterior. The interior was not accessible. The site is walled and is completely closed to the neighboring properties.

Recommendations:
Protection by temporary measures, including removable pressure fit door and window floodgates, should be considered. This resource is also a good candidate for site floodproofing. Temporary door floodgates can be installed at the narrow site wall opening and the vehicle gates can be made watertight, provided the wall is capable of supporting the hydrostatic forces. A check valve should be installed on the yard drain if one exists and a sump pump to remove water that enters around the protection measures would be helpful.

Address:	31 St. Francis Street
Name:	**Llambias House**
Ownership:	City of St. Augustine
Construction Date:	1763
Additions/alterations:	1780s
Restoration Date:	1954
Exterior walls:	Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	High. Zone "AE" BFE 8'
Window Sill Height (abv FFE):	19" from sidewalk
Case Study (y/n):	Yes
Site Walls (y/n):	No (see * below)

Summary
This resource is a valuable example of Second Spanish Period colonial architecture with the original fabric intact. Perimeter walls are painted stucco in good condition on the exterior and plaster on the interior. The site is partially walled and also open to adjacent properties; however there is considerable site area for mitigation design.

Recommendations:
Two options exist for addressing future inundation. Wet floodproofing - removing or elevating furniture and materials to the upper floor and allowing the water to enter and exit the building and then cleaning and drying the interior. Dry floodproofing – protect the first floor against flooding by temporary measures including removable pressure fit floodgates at the two doorways. *This property was also the study of *RESILIENT HERITAGE In the Nation's Oldest City* project report August 2020, which suggested sheet waterproofing and berms around the site.

Address:	7 Bridge Street
Name:	**Long Sanchez House**
Ownership:	Private
Construction Date:	1793
Additions/alterations:	
Restoration Date:	
Exterior walls:	Stucco
First Floor Elevation (FFE):	Flush at east courtyard.
Flood Risk Level:	Severe. Zone AE BFE 8'
Window Sill Height (abv FFE):	15 ½" in courtyard, 26" (min) at street
Case Study (y/n):	Yes
Site Walls (y/n):	Yes

Summary
This resource "fronts" on Marine Street, Bridge Street, and Avenida Menendez; a fact that makes it highly susceptible to storm damage and flooding. Inundated in both recent named storm events, this resource has a high risk of damage from flooding and rising water table issues. All exterior walls are coquina masonry with stucco on the exterior and painted plaster on the interior. The site is walled with a very low concrete wall abutting Avenida Menendez and a taller mixed material garden wall on both sides. The short wall is too low to form an effective barrier to storm events and the taller wall is in very poor condition and is incapable of resisting hydrostatic pressure from a significant flood event.

The first floor suffers from severe rising damp issues due in part from the application of modern vapor impermeable latex paint. The doorway facing Avenida Menendez is level with grade and the doorway facing Bridge Street is slightly elevated with a threshold height of approximately seven inches.

Recommendations:
Two options for this resource are site floodproofing the property at the garden wall or dry floodproofing the building using floodgates. For site floodproofing - The garden wall is currently structurally inadequate, improvements could be made to its condition and two gates equipped with permanent brackets that allow for installation of floodgates at the openings. For dry floodproofing the building - removable pressure fit floodgates could be installed and the two doors. Damage related to rising damp should be addressed as outlined in the main report.

Address:	47 Marine Street
Name:	**Marin House**
Ownership:	Private
Construction Date:	1791
Additions/alterations:	
Restoration Date:	
Exterior walls:	Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	Severe. Zone “AE” BFE 8’
Window Sill Height (abv FFE):	28” from curb, 34” from street
Case Study (y/n):	No
Site Walls (y/n):	No

Summary
This waterfront resource fronts on Marine Street and Avenida Menendez and is adjacent to the Long Sanchez house. Three of the perimeter walls are painted stucco in poor condition on the exterior and there are modern materials such as drywall on the interior. The site is not walled and is open to adjacent properties; and the east-building wall is open to a large frame addition that has many openings. The main entry door is at grade and many other openings in the addition are susceptible to flooding. Inundated in both recent named storm events, this resource is likely to be subject to recurring flooding.

Recommendations:
There is no practical method to protect this resource from inundation. Given the modern materials on the interior and the frame sections, wet floodproofing is not recommended. The only remediation scenario is site floodproofing with an adequately high and strong wall around the entire site, which may not be practical.

Address:	32 Aviles Street
Name:	**O'Reilly House**
Ownership:	Sisters of St. Joseph
Construction Date:	1702
Additions/alterations:	1910
Restoration Date:	1940s
Exterior walls:	Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	Moderate. Zone "AE" BFE 7'
Window Sill Height (abv FFE):	19 ½" minimum
Case Study (y/n):	Yes
Site Walls (y/n):	Yes

Summary:
Perimeter walls are painted stucco on the exterior in excellent condition and painted plaster on the interior. The interior of the walls are a combination of dressed and rubble coquina with some tabby. There are four doors into the building, two from Aviles Street and two within the courtyard. The site is walled, but the wall encompasses the majority of the block and has numerous large openings.

The first floor suffers from severe rising damp issues due in part from the application of modern vapor impermeable latex paint. The doorways have a threshold height of approximately seven inches.

Recommendations:
This resource is a good candidate for dry floodproofing of the building. The building can be floodproofed with removable pressure fit floodgates set in between the door jambs and without the use of permanently installed brackets. Site flood proofing is not recommended because of the large openings in the site walls.

Address:	54 St. George Street
Name:	**Paradres-Dodge House**
Ownership:	University of Florida
Construction Date:	1813
Additions/alterations:	1822 – 1860, c. 1890, 1948
Restoration Date:	
Exterior walls:	Stucco, coquina
First Floor Elevation (FFE):	
Flood Risk Level:	Low. Zone "AE" BFE 7'
Window Sill Height (abv FFE):	21"
Case Study (y/n):	Yes
Site Walls (y/n):	Yes

Summary
All exterior walls are coquina masonry with stucco exterior and painted plaster on the interior. One interior wall is exposed coquina and a few other details are exposed. This resource has not been inundated in a named storm event, however heavy localized rain poses a periodic concern in the rear.

The site is walled. The two open doorways fronting St. George Street have a threshold height of 12 ½". The rear door is at grade.

The first floor exterior exhibits severe rising damp and spalling issues on the east facade due at least in part to very short overhangs and vapor impermeable paint materials. Interior walls have a much smaller incidence of rising damp.

Recommendations:
This resource can be protected with minimal site floodproofing measures by installing permanent brackets for short floodgates at the site wall and removable pressure fit floodgates at the three doorways.

Address:	224 St. George Street
Name:	**Parades-Ortega-McMillan House**
Ownership:	Private
Construction Date:	1763
Additions/alterations:	1820s, 1884, 1899, 1970
Restoration Date:	1964
Exterior walls:	Stucco, coquina, wood siding
First Floor Elevation (FFE):	
Flood Risk Level:	Moderate. Zone "X" BFE 7'
Window Sill Height (abv FFE):	28"
Case Study (y/n):	No
Site Walls (y/n):	Yes

Summary
Perimeter walls are painted stucco on the exterior; the interior was not accessible. The site is walled and is completely closed to the neighboring properties. The coquina site wall section is not historic and is buttressed with steel. The one main entry to St. George has been sealed shut. The owner installed a yard drain that is piped through the curb. This property was not inundated in a named storm event.

Recommendations:
This resource is a very good candidate for site waterproofing. Temporary floodgates can be installed at both narrow site wall openings and the vehicle gates can be made watertight. The site wall appears capable of supporting significant hydrostatic forces. A check valve should be installed on the yard drain and a sump and pump to remove water that enters around the protection measures would be helpful. The building can be floodproofed with removable pressure fit floodgates set in between the door jambs and without the use of permanently installed brackets.

Address:	143 St George Street
Name:	**Pena Peck House**
Ownership:	City of St. Augustine
Construction Date:	1750
Additions/alterations:	1930s, 1960s
Restoration Date:	1969
Exterior walls:	Stucco, wood siding
First Floor Elevation (FFE):	
Flood Risk Level:	High. Zone AE BFE 7’
Window Sill Height (abv FFE):	24” on two major streets
Case Study (y/n):	No
Site Walls (y/n):	Partial

Summary
Perimeter walls are painted stucco on the exterior in excellent condition and painted plaster on the interior. Door openings are up 5” from St. George Street and 11” up from Treasury Street.

The site is partially walled and appears structurally sound enough to resist some hydrostatic forces.

Recommendations:
This resource is a good candidate for dry floodproofing. At a minimum, the building could be floodproofed with removable pressure fit floodgates set in between the four doorways and without the use of permanently installed brackets. In addition, the property could be site floodproofed by installing permanent brackets for floodgates to protect the openings at the south and east site walls.

Address:	105 St. George Street
Name:	**Poujoud-Burt House**
Ownership:	Private
Construction Date:	1816
Additions/alterations:	1968
Restoration Date:	
Exterior walls:	Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	Low. Zone "X" BFE 7'
Window Sill Height (abv FFE):	36"
Case Study (y/n):	No
Site Walls (y/n):	Yes

Summary
Perimeter walls are painted stucco in excellent condition on the exterior and painted plaster on the interior. The site is walled and not open to adjacent properties. There are closed-off vents that appear to have ventilated joist space below the floor. This resource was not inundated in the two recent named storm events.

From our limited observations of the interior (displays were covering most of the walls) the first floor does not suffer from rising damp issues perhaps due to the slightly higher elevation.

Recommendations:
This resource is a good candidate for dry floodproofing. Protection by temporary measures around the perimeter of the site and removable pressure fit floodgates at the two doorways should be considered. Door dams should be removable and not require permanent brackets. Floodgates in openings in the site wall can protect the rear of the building. Investigation should be undertaken to determine if the vent closures are watertight and, if not, sealing these openings should be a priority.

Address:	250 St. George Street
Name:	**Prince Murat House**
Ownership:	Private
Construction Date:	1815
Additions/alterations:	c. 1880, c. 1940
Restoration Date:	
Exterior walls:	Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	Moderate. Zone "AE" BFE 7'
Window Sill Height (abv FFE):	30"
Case Study (y/n):	No
Site Walls (y/n):	No

Summary
This resource is a valuable example of Second Spanish Period colonial architecture and the "St. Augustine plan" with the original fabric intact. Perimeter walls are painted stucco in excellent condition on the exterior and painted drywall on furring strips on the interior. The site is not entirely walled and is open to adjacent properties. The one main entry door is 10" above the sidewalk as is the one to the rear. There are closed-off vents that appear to have ventilated joist space below the floor.

Recommendations:
The first floor should be carefully protected against future water damage using the least intrusive methods possible. Protection by temporary measures including removable pressure fit floodgates at the two doorways should be considered at a minimum. Floodgates should be removable and not require permanent brackets. Investigation should be undertaken to determine if the vent closures are watertight and, if not, they should be sealed.

Address:	53 Marine Street
Name:	**Puello House**
Ownership:	Private
Construction Date:	1812
Additions/alterations:	1987
Restoration Date:	
Exterior walls:	Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	Severe. Zone "AE" BFE 8'
Window Sill Height (abv FFE):	26" from curb, 30" from street
Case Study (y/n):	No
Site Walls (y/n):	Minimal

Summary

This resource fronts on Marine Street and Avenida Menendez with direct exposure to the water. Walls are painted stucco in good condition on the exterior and indeterminate materials on the interior. The site is walled with a low (24") wall and is open to adjacent properties. The one main entry door is at grade and many other openings are low. The flooding history for the property is unknown but its elevation suggests inundation in recent named storm events. This resource is extremely likely to be subject to recurring flooding.

Recommendations:

This resource is a good candidate for dry floodproofing of the building. Site flood proofing could be employed however the site wall would need to be raised, strengthened, and floodgates provided at the openings. The building alone can be floodproofed with the doors closed with removable floodgates set in between the door jambs with or without the use of permanently installed brackets. The low window sill elevation may need to be addressed with removable floodgates on permanent brackets that allow for installation of floodgates on the outside of the reja (window grille).

Address:	52 St. George Street
Name:	**Rodriquez Avero Sanchez House**
Ownership:	Private
Construction Date:	1763
Additions/alterations:	1791-1802, 1833-1869, 1960s, 1966
Restoration Date:	1962
Exterior walls:	Stucco, coquina
First Floor Elevation (FFE):	
Flood Risk Level:	Low. Zone "AE" BFE 7'
Window Sill Height (abv FFE):	26"
Case Study (y/n):	No
Site Walls (y/n):	No

Summary
This resource is one of three buildings included in the study that has exposed coquina on the entirety of the public facade. The north, south, and west facades are painted stucco over coquina. All exterior walls are coquina masonry. The flood history of this resource is unknown however its elevation suggests that it has not been inundated in a named storm event. The grade behind the building suggests heavy localized rain may pose a periodic concern.

The site is not walled. The main doorway has a threshold height of 11". Interior access was unavailable.

Recommendations:
This resource can be protected by temporary measures including removable pressure fit floodgates within the door openings and without permanent attachment. Protecting the exposed coquina could be undertaken through the use of sheet waterproofing to avoid staining and subsequent cleaning of the stone although any trapped moisture can damage coquina if not removed quickly after water has receded.

Address:	71 Marine Street
Name:	**Rovira-DeWhurst House**
Ownership:	Private
Construction Date:	1798
Additions/alterations:	1910-1914
Restoration Date:	
Exterior walls:	Stucco, wood shingles
First Floor Elevation (FFE):	
Flood Risk Level:	Severe. Zone "AE" BFE 8'
Window Sill Height (abv FFE):	21"
Case Study (y/n):	No
Site Walls (y/n):	Yes

Summary
This waterfront resource fronts on Marine Street and Avenida Menendez. Walls are painted stucco in excellent condition on the exterior and indeterminate materials on the interior. The site is walled with a window through to the property on the north. Foundation or crawl space is vented but vents have 26" tall protective walls surrounding them. Flood history on this property is unavailable however it is very likely that it was inundated in both recent named storm events and is extremely likely to be subject to recurring flooding. There is a large garage door with indeterminate strength or conditions within the garage.

Recommendations:
This resource is a good candidate for site floodproofing due to the strong and tall nature of the surrounding wall. The main entry to the west can be floodproofed with a removable floodgate set in between the door jambs with or without the use of permanently installed brackets. The garage door may withstand hydrostatic pressure and could be floodproofed or, alternatively, allow water into the garage with the flood barrier taking place within. The gate on Avenida Menendez is easily floodproofed with a removable floodgate and the large windows in neighbor's perimeter wall can be closed with a removable floodgate mounted to permanent tracks. Coordination with the neighbor to close a small gap and flood proof the windows is required.

Address:	172 Avenida Menendez
Name:	**Rovira -Hernandez House**
Ownership:	Private
Construction Date:	1803
Additions/alterations:	c. 1888
Restoration Date:	
Exterior walls:	Stucco, coquina
First Floor Elevation (FFE):	
Flood Risk Level:	Severe. Zone "AE" BFE 8'
Window Sill Height (abv FFE):	30.5" from Marine Street
Case Study (y/n):	No
Site Walls (y/n):	Yes

Summary
This resource fronts on Marine Street and Avenida Menendez with direct exposure to the water. Walls are painted stucco in good condition on the exterior and varying materials on the interior. The site is walled with only two gates. Foundation or crawl space is vented but vents have protective walls surrounding them. Inundated in both recent named storm events, this resource is extremely likely to be subject to recurring flooding. The owner has installed a sump and pump to evacuate water from the site.

Recommendations:
The owner is proactive and has implemented strategies for dry and site floodproofing. The owner has already has improved site wall integrity and opening protection measures. The gates in the site wall are easily floodproofed with removable dams. The foundation or crawl space is vented but have protective walls surrounding them

Address:	12 Aviles Street
Name:	**Segui House**
Ownership:	Public Library
Construction Date:	1790
Additions/alterations:	1888-1895
Restoration Date:	
Exterior walls:	Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	Low. Zone "X" BFE 7'
Window Sill Height (abv FFE):	26"
Case Study (y/n):	No
Site Walls (y/n):	No

Summary
Perimeter walls are painted stucco on the exterior in excellent condition and painted plaster on the interior. There are six doors into the building from within the compound and door openings are up at least 6" from St. Aviles Street. The rear of the site is walled with the garden accessed through a large gate and archway through the building. There is an obvious low spot in the garden at the entry arch and no visible yard drainage.

Recommendations:
This resource is a good candidate for dry floodproofing. Two alternatives for flood protection are site floodproofing of the property at the surrounding wall or floodproofing the building. Although the garden wall has significant openings, these openings can be protected with removable door floodgates and permanent brackets would not significantly impact existing historic fabric. A generator could be installed with a sump pump to remove water accumulating in the yard. Alternatively, the building alone can be floodproofed with the doors closed with removable floodgates.

Address:	82 Marine Street
Name:	**St. Francis Barracks**
Ownership:	State of Florida
Construction Date:	1767
Additions/alterations:	
Restoration Date:	
Exterior walls:	Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	Severe. Zone "AE" BFE 8'
Window Sill Height (abv FFE):	24"
Case Study (y/n):	No
Site Walls (y/n):	Yes

Summary
This resource fronts on Avenida Menendez and St. Francis Street with direct exposure to the water. Walls are painted stucco in excellent condition on the exterior although decades of coating with vapor impermeable treatments has likely entrapped moisture within the walls. The interior walls vary in materials interior including drywall and exposed coquina. Although in a precarious location, the building is elevated on a plinth with additional elevation to the interior. The site is walled with a large vehicular gate and an adjacent building completing the enclosure. Foundation or crawl space is vented above the plinth. The crawl space was inundated in both recent named storm events. This resource is extremely likely to be subject to recurring flooding.

Recommendations:
This resource is a good candidate for site floodproofing to the rear and easily protected on the east facade with removable floodgates set in between the door jambs with or without the use of permanently installed brackets. The large gate in the perimeter wall can be made to withstand hydrostatic forces and sealed to the adjacent walls. Foundation vents will need to be protected with removable covers.

Address:	22 St. Francis Street
Name:	**Tovar "Cannonball" House**
Ownership:	St. Augustine Historical Society
Construction Date:	1791
Additions/alterations:	
Restoration Date:	
Exterior walls:	Stucco, wood siding
First Floor Elevation (FFE):	
Flood Risk Level:	Severe. Zone "AE" BFE 8'
Window Sill Height (abv FFE):	17"
Case Study (y/n):	Yes
Site Walls (y/n):	No

Summary:

Perimeter walls are painted stucco on the exterior in fair condition and a patchwork of various plaster-type materials on the interior. Recent named storm events have significantly inundated this resource up to 24". There are three doors into the building and all are at sidewalk level, which in this instance is slightly below natural grade. There is a site wall it but includes several buildings and has numerous large openings. The floor elevation is one of the lowest in the city.

Recommendations:

The natural and unadorned state of the interior of this resource suggests that it is a good candidate for wet floodproofing. For storm events, the furniture and artifacts on the first floor can be removed to the second floor and the spaces lightly washed and dried after they have been inundated.

Address:	42 Spanish Street
Name:	**Triay House**
Ownership:	Private
Construction Date:	1806
Additions/alterations:	
Restoration Date:	1951
Exterior walls:	Stucco
First Floor Elevation (FFE):	
Flood Risk Level:	Moderate. Zone “AE” BFE 7’
Window Sill Height (abv FFE):	28" sill window / 11.5" door sill
Case Study (y/n):	No
Site Walls (y/n):	Yes

Summary:

Perimeter walls are painted stucco on the exterior in fair condition and unknown material on the interior. There are three doors into the building with sills approximately 11 ½” from the Spanish Street. The front door has been sealed shut but is not watertight or structurally sound. The site is walled with only a few openings and appears sound.

Recommendations:

This resource is a good candidate for dry floodproofing of the building and/or site floodproofing. The building alone can be floodproofed with the sealing of the Spanish Street door improved and the other doors closed with removable floodgates with permanent or temporary brackets. Similar floodgates would be necessary at site wall openings if site floodproofed.

Address:	20 Aviles Street
Name:	**Ximenez Fatio House**
Ownership:	Society of Colonial Dames
Construction Date:	1797
Additions/alterations:	
Restoration Date:	1979
Exterior walls:	Stucco, coquina, wood siding
First Floor Elevation (FFE):	
Flood Risk Level:	Low. Zone "X" BFE 7'
Window Sill Height (abv FFE):	
Case Study (y/n):	Yes
Site Walls (y/n):	Yes

Summary
The first floor exterior walls are coquina masonry with painted stucco on the exterior and painted plaster on the interior. Floors are wood in areas and concrete in a few places. There are many exterior doors on the first floor. This resource has not been inundated in a recent named storm event however heavy localized rain poses a periodic concern. There is a French drain along the courtyard facade and a sump and pump in the former well location to evacuate rain accumulation in the courtyard.

The site is walled but has several very large openings that would be difficult to close. The first floor shows evidence of rising damp in areas evidenced by exterior discoloration. The discoloration is important because this is how the stone behaves naturally and attempting to change this process becomes problematic. Unlike most buildings in this study, the stucco, plaster, and paint used on this property are all vapor permeable.

Recommendations:
Site floodproofing is impractical and, given the number and nature of the openings, a preferred strategy may be wet floodproofing - removing or elevating furniture and materials to the upper floor and allowing the water to enter and exit the building and then gently cleaning and drying the interior. The resource could also be dry floodproofing with temporary pressure fit floodgates at the main house doorways.

Appendix

Condition of Existing Natural Coquina

The single greatest cause for concern among owners of historic coquina structures is rising damp and the rising water table contributes to the severity of rising damp. Rising damp and flood events are likely to occur in concert in the future. Understanding the condition of natural coquina structures is essential to implementing any strategy for flooding and rising water table mitigation. It is important that planned mitigation measures are compatible with the stone itself. In fact, most of the damage done to historic coquina structures is by property owners trying to combat rising damp by using incompatible materials and systems. This concern, as well as causes and treatment strategies, are described below.

Rising Damp

Coquina is a very porous "stone" with a high rate of absorption. When coquina is placed in damp, wet earth, moisture rises through small gaps in the stone structure through capillary action to dryer regions of the stone. This active process occurs in all coquina structures that are exposed to moisture. It is important to note that this is how the stone behaves naturally and attempting to change this process is problematic. For centuries coquina wicked moisture from the ground to the dryer stone above and the stone would "breathe" the moisture into the environment.

Vapor Impermeable Materials

Modern vapor-impermeable materials including high-strength portland cement based mortar and stucco, single coat plasters, and latex and oil based paints are commonly applied to coquina structures. The effect of applying these coatings traps moisture and it's associated salts within the wall. This subsequently results in pressure from capillary action, which can cause the failure of the vapor impervious coating or, if the coating remains in place, salts are deposited in the moist area behind the coating while the moisture rises ever higher seeking a place to escape. The continued rise of moisture can result in peeling paint, delaminating and failing plaster, damp and rotting wood window sills, and structural failure of stucco coverings. Salts in the moisture are concentrated and deposited on the surface of the coquina eventually breaking down the calcium carbonate that binds the stone together. This problem is being exacerbated by steadily rising water tables.

Recommendations to Restore the Natural Cycle of Coquina

Listed below are long term strategies for restoring the natural cycle of vapor migration in historic coquina buildings. (Interior and Exterior)

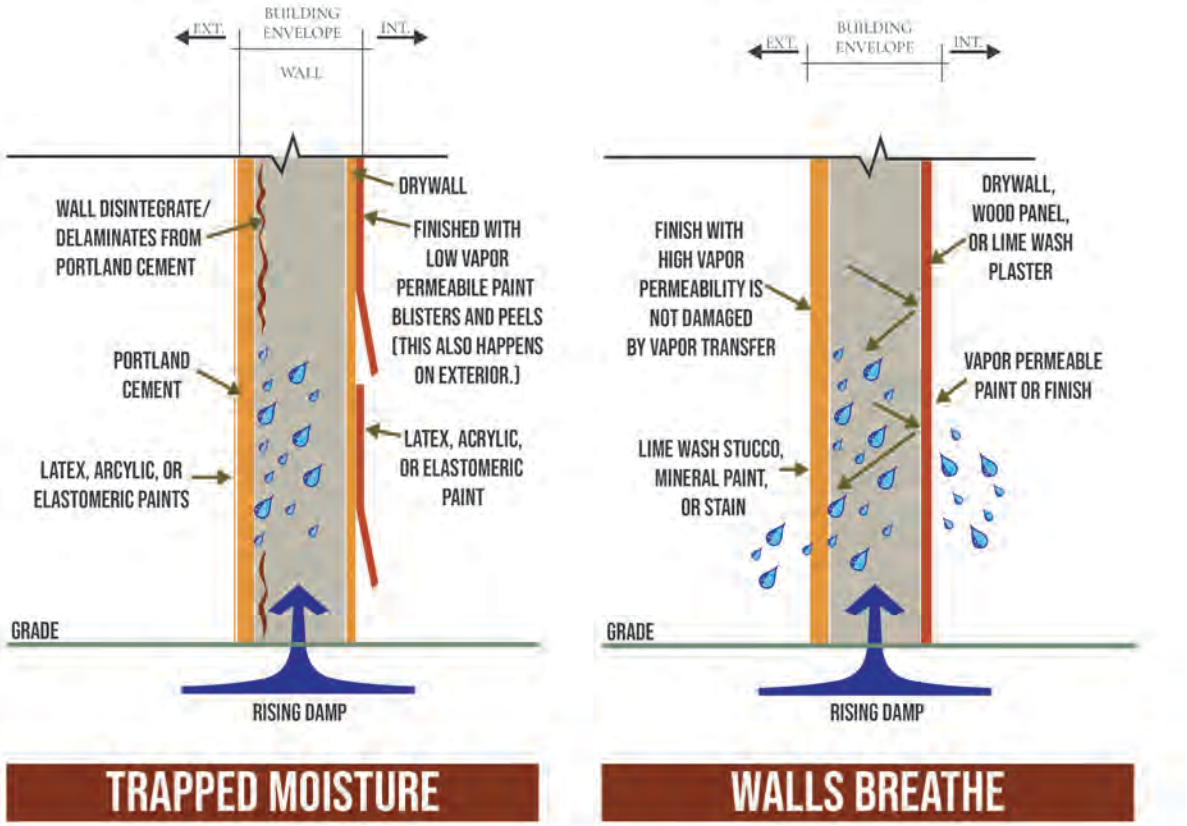
- Evaluate moisture content and migration in the existing coquina walls. Obvious signs of moisture within walls include peeling paints, delaminating and failing plaster or stucco, condensation on the wall surface, damp and rotting window-sills, fungal growth around

doors and windows, and weeping. Hidden moisture can be detected with both infrared and probe-type moisture meters.

- At a minimum, vapor impermeable coatings such as latex paints should be removed from the surface of the plaster and stucco applied to coquina walls. These coatings should be replaced with vapor permeable coatings including pigmented lime wash and mineral silicate paint coatings. There are manufacturers that supply lime based coatings, stuccos and mortars appropriate for coquina structures.
- Complete restoration of the natural moisture cycle can be accomplished by removing all moisture impervious materials (i.e. portland cement) from the surface of coquina walls. Since removing impermeable coatings on an entire building can be cost prohibitive, one option may be to remove vapor impermeable coatings to a height of approximately 30 inches above grade and then re-coating with a lime-based or other vapor permeable stucco. This process allows rising moisture that enters coquina an opportunity to escape and restores the coquina wall to its natural cycle. It is recommended to provide a thin control joint between the new pervious surface and impervious surface to remain. Using a simple tool joint, this will control future cracking. Additionally, the entire building (permeable and impermeable) should be painted with a mineral coating to provide a consistent appearance.
- Walls previously covered with impermeable coatings will need to dry. Even after that drying process it is likely that dissolved salts that were deposited behind the coating will remain on the surface of the stone. If a lime wash is applied after the impermeable material is removed the salts may be drawn out through the lime wash and require its re-application.
- Historic stucco, plaster, paints, and coatings such as lime wash were vapor permeable and, as a result, the water vapor escapes and takes with it soluble salts and other minerals. Escaping moisture leaves a small amount of condensation on wall surfaces that provide a medium for mildew growth and may evaporate some of the coatings. To hide the discoloration from mildew, a tinted coating or 'zocalo' is applied to the bottom 30” or so of historic buildings. The 'zocalo' is a historic treatment that not only disguised dirt and mud splatters from unpaved roads but also hid the discoloration of rising damp on coquina structures. See example photos before and after a 'zocalo' treatment below.

54 St George Street, St Augustine FL
Example of rising damp approx. 30 inches above grade

Rising Damp - After 'zocalo' treatment



Detail Section Example of trapping moisture in a wall using vapor impermeable finishes and paints versus allowing the walls to breath using vapor permeable finishes and paints


82 Marine Street, St Augustine FL
Vapor impermeable finish on the exterior


31 St Francis Street, St Augustine FL
Vapor permeable finish on the exterior

Interior treatments - Coquina

There are different treatments and aesthetic preferences for interior spaces of Coquina Buildings. Several interior options and recommendations are listed below.

1) Exposed Coquina - It may be desirable to leave the coquina exposed on the interior as a decorative feature. As described above the coquina on the interior needs to be able to "breath" and allow moisture to escape. While leaving the exposed coquina in it's natural uncoated natural state is recommended it may 'dust' and leave a fine powder on interior

flooring and furniture. Applying a vapor permeable clear coating may be acceptable in addressing this issue.

2) Plaster over Coquina - The historic interior finish application is a hydraulic lime render plaster over the natural coquina. This finish is applied in many structures such as the Ximenez Fatio (interior photo to the right) and Llambias house. The lime-based plaster protects the natural coquina and allows it to "breath". Rising damp evidence (salts collecting) may be visible on the lower portion of the walls and this can be repaired over time with additional coats of the lime-based plaster. While plaster over coquina is the historic application the wall finish can appear textured and mottled. This is the wall "breathing" and in it's natural state. It is important to note that vapor permeable plaster will need to be lightly cleaned after water inundation.

3) The "most pristine" wall aesthetic is to remove any evidence of the coquina by installing a flood-damage resistant material over furring strips attached to the mortar joints in the coquina wall. The covering needs to be a vapor permeable non-paper, backed gypsum or marine grade wood to avoid moisture and mold issues. Any wall cavities will need to be opened and accessed after each flood to clean and dry. In a noted example at the Prince Murat house the coquina wall is hidden behind plastic furring strips and vapor permeable non-paper, backed gypsum. An important detail in this method is to allow vents in the wall so that the coquina can release moisture. If it is not allowed to "breath" the moisture can build up in the cavity and disintegrate the coquina wall. Post flooding the non-paper, backed gypsum can be allowed to dry out and then gently cleaned.

Conditioning the Interior

It may be desirable or necessary to condition the interior of coquina structures. Because air conditioning dries the air in a structure it can disrupt the natural flow of moisture through the coquina wall by encouraging moisture migration to the interior. It is recommended to provide positive air pressure to conditioned spaces with a dedicated duct that allows air into the structure from the exterior. If the airflow is not properly balanced, it can disrupt the moisture balance and compromise the wall integrity.

Vapor Permeable Materials

With very few exceptions, historic coquina building walls have been covered with a protective covering. Listed below are appropriate materials to use on Coquina that have been used historically and are recommended today. When using stucco, plaster, or mortar, it is important to match the compressive strength of the coquina to the coating. Each coquina building is unique; mortars and coatings can be custom mixed by specialty companies from stone samples provided by the owner.

STUCCO / PLASTER

Lime-based, multi coat stucco and plaster is the preferred solid coating.

RESTORATION MORTAR

Mortar should have the same or lesser compressive strength than the coquina itself and approximate vapor permeability of the stone as well. Lime-based mortar is the preferred mortar. If commercially available mortar is used, the strength must be decreased by adding more aggregate (sand) to allow for an appropriate compressive strength and provide some degree of vapor permeability and softer mortar.

HYDRAULIC LIMEWASH

This traditional coating provides a breathable, decorative finish that soaks into the underlying material to which it is applied. The material is primarily composed of slaked lime (calcium hydroxide) usually with a low proportion of an organic binder. The calcium hydroxide sets slowly by combining with carbon dioxide to form calcium carbonate, the principal component of limestone and marble. As a coating for lime-based render and stucco, and limestone in particular, limewash is in many ways comparable in nature to that of the underlying material, with similar porosity, alkalinity (pH value) and coefficient of thermal expansion.

20 Aviles Street, St Augustine FL
Hydraulic limewash finish on exterior

In the past, periodic redecoration of building facades with limewashes every few years was very much the norm and specific compositions varied almost on a building by building basis, relying heavily on past experience, local availability of raw materials and what had previously proved successful. Lime wash can be tinted with natural pigments and needs to be reapplied on a regular basis.

MINERAL SILICATE PAINT SYSTEMS

As with limewashes, silicate paints soak into the underlying material, but in addition the potassium silicate binder chemically reacts with the mineral underlying material to form a microcrystalline silicate bond, which is insoluble. Secondary chemical crystallizations also take place between the binder, the color pigment and carbon dioxide in the atmosphere. The resultant microcrystalline structure has a pore size that allows the free passage of vapor, but the pores or 'holes' are small enough to prevent the ingress of driven rain. The inherent nature of silicate paint is that of a semi-permeable membrane. Combined with this basic structure, silicate paints employ inorganic fillers and earth oxide color pigments that are unaffected by the action of UV degradation. The microcrystalline structure is comparable to that of the mineral structure to which it is applied and it has a comparable coefficient of thermal expansion. The insoluble silicates formed in the chemical reaction are resistant to strong acid and alkali attack in the same way that silica sand is a highly resistant product.

As a highly porous protective coating, silicate paints offer a valuable alternative to a limewash, and can provide for much longer life expectancies. There are documented examples of such paint systems performing satisfactorily on lime based render facades in Germany, Switzerland and Norway for periods in excess of 100 years.

Interior mineral paint is available in a variety of colors. It has a photo-catalytic agent that gives the paint a self-cleaning property, and it remains bright and colorful for many years. There are several types of stains and glazes that are available as well.

Damage Due to Maintenance and Repairs

Almost all of the historic coquina buildings included in this study and the vast majority of buildings dating from the nineteenth century have had significant changes made to them through purposeful modification, or ad hoc repair. Repairs tend to have been constructed in a way that was not identical to, and sometimes not in harmony with, the historic coquina masonry wall structure. In addition to rising damp and using incompatible materials there are other significant causes of deterioration to historic coquina listed below and suggestions for their treatment.

Weathering and Erosion

For exposed coquina, weathering or surface erosion is due principally to exposure to the elements. Contributing factors include: wind driven particles, water (e.g., scupper wash and splash-back), acid rain, and evaporation of moisture containing ionized salts. Many garden walls, gateways, and, for more recent (post-1820) structures, exposed coquina masonry. Other causes of loss of stone surface include: application of an inappropriate surface consolidating treatment, surface repair coating (e.g., portland cement stucco), and repointing with cement-based mortar that is harder than the stone (see example of photo to right). Water impermeable mortar traps water in the coquina face and it erodes the coquina eventually leaving a ledge of mortar that traps even more water and worsens the condition.

Repairing Damaged Coquina

In-kind replacement of severely deteriorated coquina can be accomplished for a permanent repair that is fully compatible in appearance and physical performance with the surrounding historic masonry. In lieu of replacing a full width piece of stone, a veneer or Dutchman can be inserted after the spalling stone is chiseled back to stable material. The Dutchman can be adhered to the existing stone on five sides with mortar matching the physical properties of the original mortar.

When re-pointing, as noted above there are manufacturers that supply lime-based mortars that can match the appearance, compressive strength and porosity of the original mortar. The use of high strength Portland cement based mortar should be avoided. Portland cement is vapor impermeable, has a compressive strength several times higher than coquina, and bonds tightly to the stone. The high strength and vapor impermeability requires that the sacrificial element in the system is the stone itself. As the stone erodes the mortar will protrude. Careful consideration should be given to removing portland cement based mortars because the bond with the stone can be so great that the removal of the mortar will significantly damage the original material. If using a commercially available mortar, the strength must be decreased by

adding more aggregate (sand) to allow for a more appropriate compressive strength and provide some degree of vapor permeability and softer mortar.

When repointing, hand chisel rather than mechanical tools, should be used without damaging the coquina. Joints should be finished to match the original work.

Drainage

Prevention strategies for reducing capillary rise in coquina building materials are to reduce the amount of water in contact with the historic material. Strategies are listed below:

- Install a drainage system around the foundation and footings of the historic building to avoid undermining the building and to allow for proper site drainage. An interior or exterior pumping system may need to be installed to drain the building or yard.
- Yard drains, floor drains, electrical service entrances, foundation vents, and other physical connections through or around the flood barrier can provide an entrance pathway for floodwater. Installing a backflow valve to prevent infiltration though sewer and drain systems, grouting around utility service entrances, and walling around vents can provide protection for these systems.
- Another approach is minor re-grading to ensure adequate drainage of storm and irrigation water away from the building. Please note that regrading can adversely affect archaeological resources and should be monitored with the City of St Augustine archaeological department.
- For a landscape / nature-based approach - refer to the "Resilient Heritage" study / and report and the Llambias house landscape project.

Cleaning

Cleaning techniques must be the most effective, least invasive approach. Cleaning techniques should be carefully tested to ensure that they cause no harm to either the coquina or mortar. All cleaning treatments should utilize gentle, hand application or low-pressure spray application and rinses to avoid possible erosion of coquina. Landscape buffer zones, which require no mowing or trimming should be established at the base of historic masonry walls. It is important that these buffers are not so constructed as to retain moisture or cause water to stand against the masonry. Ensure that herbicides used to control plant growth do not react chemically with the coquina or otherwise change its appearance or physical properties.

Use of Metal Anchors

Any mechanical ties or anchors used in repair of coquina construction should be of corrosion resistant material (e.g., stainless steel or of an appropriate plastic material). Masonry damaged by expansion of exfoliated metal features should be repaired following removal of all ferrous material. These repairs may make use of specially formulated epoxies and, when the damage is visible, coquina aggregate. Causes of structural cracks in masonry should be identified and addressed, otherwise, the use of metal ties (staples) or epoxy repair materials may be simply transfer the damaging shear forces to an adjacent portion of the wall.

Appendix - Clarification of Terms used in Report

Above Finished Floor Elevation - A distance measured vertically from the finished interior floor level of a structure.

Base Flood Elevation (BFE) - Elevation of a 100-year flood. The BFE is determined by statistical analysis for each local area and is designated on the FIRMs. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Design Flood Elevation (DFE) – Regulatory flood elevation adopted by a local community. If a community regulates to minimum NFIP requirements, the DFE is identical to the BFE. Typically, the DFE is the BFE plus any freeboard adopted by the community. (FEMA).

Door Dam - The watertight structure or device put in place to resist the intrusion of water into a structure though a doorway. These devices have some seal around the edges that prevent water from bypassing through gaps and posess structural integrity to resist hydrostatic forces (pressure) from water depth. Door dams typically block less than half the height of the door.

Elevation Certificate – NFIP form used to provide elevation information to ensure compliance with floodplain regulations and to aid in determining the insurance rate for a specific property.

Flood Damage Resistant Materials — Materials identified by FEMA as flood resistant. Flood Elevation = Determination– A determination by the Administrator of the water surface elevations of the base flood, that is, the flood level that has a one percent or greater chance of occurrence in any given year.

Floodplain or Flood-prone Area – Any land area susceptible to being inundated by water from any source (see definition of ``flooding'').

Floodproofing — Any combination of structural and nonstructural additions, changes, or adjustments to structures, which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures, and their contents.

Floodproofing Certificate — A certification, in the form and containing the information required by FEMA, that a structure has been designed and constructed to be dry floodproofed to the flood protection elevation. A floodproofing certificate may only be prepared and certified by a licensed professional engineer or professional architect.

Floodproofing, Dry — The floodproofing method that is used to render a structure's envelope substantially impermeable to the entrance of floodwaters.

Floodproofing, Wet — The floodproofing method that relies on flood damage-resistant materials and construction techniques to minimize flood damage to areas below the design-flood elevation of a structure.

Freeboard — A factor of safety usually expressed in feet above a flood level for purposes of flood plain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed.

Resilience, Flood — The ability to withstand, respond to, and recover from a flooding or storm event

Sheet Waterproofing - Plastic sheeting material that is placed against the exterior wall of a building from the ground surface up a certain distance to prevent the intrusion of water through openings or porous wall construction. Sheet waterproofing is continuous across door and window openings and some attempt is made to seal the sheet to building or grade at the bottom.

Threshold height - A vertical measurement between the floor level or door threshold and the horizontal plane of the sidewalk or street on the exterior. This is generally the depth of water required to surmount the threshold.

Window Dam - Similar to a Door Dam, window dams are generally very short because they rest on an alreay-elevated sill.

Appendix - **References for Flood adaptation strategies**

NATIONAL PARK SERVICE PRESERVATION BRIEFS
1 - Cleaning and Water-Repellent Treatments for Historic Masonry Buildings
2 - Repointing Mortar Joints in Historic Masonry Buildings
6 - Dangers of Abrasive Cleaning to Historic Buildings
15 - Preservation of Historic Concrete
16 - The Use of Substitute Materials on Historic Building Exteriors
17 - Architectural Character—Identifying the Visual Aspects of Historic Buildings as an Aid to Preserving their Character
18 - Rehabilitating Interiors in Historic Buildings—Identifying Character-Defining Elements
21 - Repairing Historic Flat Plaster—Walls and Ceilings
22 - The Preservation and Repair of Historic Stucco
24 - Heating, Ventilating, and Cooling Historic Buildings: Problems and Recommended Approaches
39 - Holding the Line: Controlling Unwanted Moisture in Historic Buildings
42 - The Maintenance, Repair and Replacement of Historic Cast Stone
47 - Maintaining the Exterior of Small and Medium Size Historic Buildings

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- Technical Bulletin 0: User's Guide to Technical Bulletins (July 2019)
- Technical Bulletin 1: Openings in Foundation Walls and Walls Of Enclosures (2008)
- Technical Bulletin 2: Flood Damage-Resistant Materials Requirements (August 2008)
- Technical Bulletin 3: Non-Residential Floodproofing - Requirements and Certification (1993)
- Technical Bulletin 4: Elevator Installation (November 2010)
- Technical Bulletin 5: Free-Of-Obstruction Requirements (August 2008)
- Technical Bulletin 6: Below-Grade Parking Requirements (1993)
- Technical Bulletin 7: Wet Floodproofing Requirements (1993)
- Technical Bulletin 8: Corrosion Protection for Metal Connectors in Coastal Areas (1996)
- Technical Bulletin 9: Design and Construction Guidance for Breakaway Walls (June 2019)
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- Technical Bulletin 11: Crawlspace Construction (November 2001)
- Floodproofing Non-Residential Buildings, FEMA P-936 (July 2013)
- Integrating Historic Property and Cultural Resource Considerations Into Hazard Mitigation
- Planning, State and Local Mitigation How-To Guide, FEMA 386-6 (May, 2005)
- Protecting Building Utility Systems from Flood Damage, FEMA P-348, Edition 2 (February 2017)

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- Community Rating System (June 30, 2017)
- Historic Structures and The Biggert-Waters Flood Insurance Reform Act of 2012
- Historic Preservation and Cultural Resources: Protecting Our Heritage (July 2016)
- Technical Fact Sheet 1.2: Summary of Coastal Construction Requirements and Recommendations

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The Conservation and Preservation of Coquina: A Symposium on Historic Building Material in the Coastal Southeast, Historic Buildings Design Guide. City of St. Augustine. 2000

Disaster Mitigation for Historic Structures: Protection Strategies. Florida Department of State, Division of Historical Resources.

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Guidelines on Flood Adaptation for Rehabilitating Historic Buildings. National Park Service.

Guidelines for Rehabilitating Historic Buildings. National Park Service.

St. Augustine Resilient Heritage Report. City of St. Augustine. 2020