



Flood Resiliency Report & Facilities Capital Expenditure Forecast Plan

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Final Report

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Flood Resiliency Report - Executive Summary

Urgent

- The NHA needs to determine the official Nantucket municipal Base Flood Elevations (BFE) for each of the Museum Complex buildings, The Thomas Macy Warehouse, and #2 Union Street buildings. The BFE is the computed elevation to which floodwater is anticipated to rise during the base flood. Base Flood Elevations (BFEs) are shown on Flood Insurance Rate Maps (FIRMs) and on the flood profiles. The BFE is the regulatory requirement for the elevation or floodproofing of structures. The BFE is the minimum design flood elevation. The NHA Director and Board, as owners of the NHA assets, should next determine an appropriate NHA Flood Protection Level (FPL) for the Museum Complex, Macy Warehouse, and #2 Union Street to use for all future design decisions affecting these buildings. The risk of flooding and the threat rising sea levels should be factored into these decisions.
- Appoint a NHA staff team to review the NHA Emergency Preparedness Plan in light of the lessons learned during and after the January 4th and the following winter 2018 storms. Revise the NHA Emergency Preparedness Plan as necessary and distribute broadly.
- Construct a stone retaining wall along the South Beach Street sidewalk that will allow the exterior courtyard to the north of the Gift Shop Connector and Candle Factory to be re-graded to a higher elevation. Installed new area drains to create positive away from the museum buildings foundation walls. [FY18MC2]
- Dry flood proofing is the recommended flood proofing treatment for the slab on grade Candle Factory. The South Elevation first floor doors should be retrofitted with an emergency drop-in flood barrier. [FY18MC4]

Note: Dry floodproofing is one option for protecting flood-prone property. The technique involves sealing building walls with waterproof compounds (such as the concrete foundation wall outside the stone foundation of the Candle Factory) so that the structure is watertight. This technique can only be used when the walls are strong enough to withstand the hydrostatic force. Sand bags or temporary flood barriers are placed to seal off doors or other openings.

Necessary

- In the future, any plans for any capital improvements in these affected NHA buildings must incorporate flood resiliency measures. This is particularly true for the planned rehabilitation of the interior of the Thomas Macy Warehouse. This report recommends an interior wet-flood proofing strategy for the Macy Warehouse. Install all the new vulnerable building elements such as, accessible bathrooms, mechanical room, utilities

such as fire suppression and HVAC equipment, and permanent exhibits only at the second floor level.

- Complete purchases and pre-position appropriate emergency flood barrier and clean-up materials at both the Museum Complex and the Thomas Macy Warehouse.
- Develop a 2-4 hour training program for NHA staff and docents based on the winter of 2018 lessons-learned. The curriculum of this training event should be emergency response staff training and also cover the deployment and proper use of flood resistance equipment and materials. Repeat this training annually.

Desirable

- Complete the design for the planned construction of a new shed roof addition at the Gift Shop Connector. The design should incorporate installation of a reinforced concrete footing wall that serves as a floodwall and provides a permanent barrier against the Category 3 flood level storm surge that in 2018 penetrated the museum at this point. **[FY18MC1]**
- The NYA should consider elevating the entire Gift Shop at a future date. This wing of the museum complex is in the most exposed location to both storm surge flooding and potential wind driven wave action. **[FY18MC5]**
- This report recommends that the NHA consider sending a representative to attend the *Keeping History Above Water: West*, a pre-conference workshop planned by the California Preservation Foundation for May, 2018 at MacArthur Park | Palo Alto, CA.

Facilities Capital Expenditure Forecast Plan - Executive Summary

Urgent

- Thomas Macy Warehouse - The NHA has already moved forward with removing the existing asphalt shingle roof and installed new roofing underlayment as a temporary stabilization measure to eliminate roof leaks until a new slate roof can be applied in the spring of 2018. It is critical that the task of installing the slate shingles be completed immediately. [FY18MW3]
- Gosnold Center – Inset receiving room barn doors, install Plexiglas transom storm panel, paint the front elevation doors and trim.
- Gosnold Center - Install a drainage channel to carry chiller condensate drainage and fire pump drainage away from the corner of the building. [FY18GC7]
- Hadwen House - All the downspouts along the perimeter of the Hadwen House must be immediately re-connected to the subsurface storm water drains. [2018PM]

Necessary

- Greater Light – It is advisable to complete a major pruning project in this area immediately. [2018 PM]
- Construct Prospect Street entrance steps and retaining wall at the Old Mill site. [FY18OM8]
- The NHA is advised to keep the Old Mill in fully operational condition by restoring a level wheel track completely around the building. [FY20OM9]
- At both the Quaker Meeting House and the Research Library trim all the over-hanging tree limbs above the roofs of both structures. [2018 PM]
- The constant sound produced by the 17-year old condenser unit located above the Research Library at the roof-top is a noise nuisance. This piece of mechanical HVAC equipment has reached the end of its' service life and should be replaced. [FY18RL9]

Desirable

- Consider expanding the existing NHA maintenance programs use of Dude Software's Computerized Maintenance Management System (CMMS) to include the Capital Forecasting module provided by this company.
- A desirable 2018 Preservation Maintenance Tasks at the 1800 House site is to install a clear window well covers at two locations at the adjacent Carriage House. [2018 PM]
- Trim overgrown vegetation at the west side of the Old Mill site.
- Prepare a Condition Assessment of #2 Union Street with accompanying research for a historic data section about this structure.
- Forge a partnership with a university preservation program to develop a set of record drawings for all the NHA historic structures.
- Paint the two cupolas at the Gosnold Center.

Introduction

The information presented in this Report & Plan was gathered during a three day site visit to Nantucket Island on February 8-10, 2018. This report also incorporates recommendations and observations taken from my visit on July 6-8, 2017 for the purpose of the preparation of a Conservation Assessment Program (CAP) Report for the Nantucket Historical Association (NHA) and from my subsequent Nantucket Island site visit to prepare a Condition Assessment of the exterior envelope of the Thomas Macy Warehouse that was made by the me on August 15-18, 2017. Therefore, the cumulative findings of this report are informed by several days of intensive building assessments completed over the course of the last six months. The research to prepare this Report & Plan began with a Thursday morning project scoping discussion at the Peter Folger Museum Building with Ed Rudd, Maintenance and Program Manager, and myself.

Flood Resiliency Report

Our initial on-site scoping discussion centered on a re-cap of the two tasks identified in my February 1, 2018 Proposal Letter to the NHA. After confirming our work objectives, we proceeded to an immediate survey of the January 4th winter storm surge flooding at the Gift Shop Connector and the historic Hadwen & Barney Oil and Candle Factory.

Fortunately, the outcome of this flood event was limited to a clean-up of the storm surge flood waters that entered the Connector connecting the Gift Shop to the Candle Factory. Rapid emergency mitigation measures by the NHA maintenance staff resulted in the erection of temporary flood barriers at the Connector exit doors, gift shop entrance and candle factory south elevation exit doors. Flood seepage during and subsequent to the event necessitated the removal of small amount of flood water which remained on the Connector and Candle Factory floors.



Photo flood clean-up: An “all-hands-on deck” event for the museum staff.

Two more storm-surge flood events have occurred since the January storm. The most recent bomb cyclone nor’easter hit Nantucket on March 3-4, 2018. There were three abnormally high tides that caused flooding along the Nantucket Harbor with the third high tide on Saturday March 3rd measuring approximately 4-ft above the mean high tide level as measured at NOAA’s tide gauge at Steamboat Wharf. The lessons-learned from responding to the dual emergencies caused by prolonged 5°F degree freezing temperatures and three powerful Nor’easter storm surges required the NHA staff react by installing emergency sand-bag barriers to protect the museum buildings from significant storm surge flooding and at the same time to clean-up to a

fuel oil spill in the mechanical room caused by the failure of one of the two oil storage tank valves. Evidently, the last major flooding of the Nantucket Whaling Museum was during the “Perfect Storm” of 1991. The experience gained from these multiple winter of 2018 flooding events has been taken to heart by the NHA Director, Mr. Rudd and staff. Flood response kits have now been assembled and have been prepositioned in the museum building for any future flood emergency. Additional flood mitigation equipment such as, FloodSaxs© (sand-less sand bags), a variety of absorbent pads for water clean-up, neoprene sheets, duct tape and other flood emergency tools and equipment had also been ordered and was immediately available for the March storm.

Certainly the flooding in the Houston Area from Hurricane Harvey in late August and the extensive damage to the Florida Keys from Hurricane Irma in mid-September of 2017 has impacted most cultural institutions awareness of the importance of emergency preparedness planning for historic facilities located in flood plains or in coastal areas. Actions over the remainder of 2018 by the NHA must demonstrate to the Board, Nantucket Community and museum stakeholders that the museum has taken action and is now actively planning to implement future flood resilience and appropriate sea level rise mitigation measures for those facilities located in the town of Nantucket storm flood zone. In the future, any plans for any capital improvements in these affected NHA buildings must incorporate flood resiliency measures.

Several of these measures were considered and discussed by Mr. Rudd and I during our post-January 4th event assessment of the flood resistance at the east end of the NHA Museum complex and the Thomas Macy Warehouse. Additionally, it is worth noting for the reader, that the author completed a CAP architectural assessment for the Key West Art & Historical Society in November 2017. This post-Irma assessment provided a very recent the opportunity to gain first-hand knowledge from the experiences shared by the Director and Curator of the KWA&HS on how effective their emergency preparedness planning and storm resilience measures were in the face of the 100+mph winds that Irma brought to Key West. The importance of having an adequate supply of storm resistance materials and equipment, such as wet/dry vacuums, on-hand was critical in protecting their facilities against substantial storm damage. Fortunately, there was very little storm surge flooding in Key West, so the basement of their museum was spared that from the threat of flooding.

Also this past fall, I had the opportunity to attend the second *Keeping History Above Water, an International Multi-Disciplinary Conference on Saving Historic Structures & Neighborhoods in the Face of Rising Tides*, held October 29-November 1, 2017 in Annapolis, Maryland. A *Keeping History Above Water* pre-conference workshop is planned for Palo Alto, California in May 2018 and I recommend that the NHA consider sending a representative to attend this outstanding

event. The workshop is an opportunity to gather information concerning recently completed flood resilience best practices, learn about Federal Emergency Management Agency (FEMA), National Oceanographic and Atmospheric Administration (NOAA) and state and community flood resilience planning, and obtain information from material vendors.

Our project scoping conversation and preliminary flood damage inspection at the museum ended by noon on Thursday, February 8th, 2018. The short time I was on Nantucket, limited the scope of this flood resiliency assessment report to the Museum Gift Shop and Connector, the adjacent Candle Factory and the Thomas Macy Warehouse.

Facilities Capital Expenditure Forecast Plan

Over the course of the next day and a half, Ed and I visited all NHA sites to conduct visual assessments of the existing building conditions. I also compiled a photographic record of the inspected building elevations and features. The assessment methodology utilized for the preparation of this report did not include researching the collection of existing NHA building plans or drawings. The only building documents we reviewed were those that were located within Mr. Rudd's office. Our site assessments did not include any materials analysis, utilize investigative probes, and we did not conduct any air/water infiltration tests or thermal imaging. I did compile extensive observation notes during our walk through visual inspections. These notes form the basis of all the identified projects that we have compiled in our forecasted five year capital replacement cycle schedule that is presented in this report.

The goal of our Capital Expenditure Forecast Plan (Forecast Plan) was to start the process by which the NHA identifies the elements, format, and costs of included in a five year cyclic maintenance schedule for 13 sites and structures. The initial draft of this report cannot be considered comprehensive; only after NHA management, staff, stakeholders, the Board have had an opportunity to comment and expand/reduce or modify the schedule of project packages can the Forecast Plan be considered a final product.

Capital or cyclical repairs and/or replacements are performed on a schedule just like planned maintenance, except in this instance, the NHA will be repairing, updating or replacing the equipment as it reaches the end of its useful life before it completely fails. For the purpose of this report Capital/Cyclical repairs occur on a set schedule, including every five, 10 and 15 years. Some replacements may even happen every 20 years. Examples of NHA cyclical repairs include, painting exteriors, replacing wood siding or shingles, replacing roofs and gutters, repairing wood windows, steps, and doors, or replacing HVAC systems. This report plans a schedule that extends into the future up to 2023. Developing a schedule that forecasts types of building upgrades and replacements necessary, should allow the NHA Director the Board time to budget for the costs of the identified project packages. During our site assessments we also identified

2018 Preservation Maintenance (PM) projects for several buildings and we have included these 2018 tasks in our report to give the reader a sense of the scope of the NHA annual maintenance workload.

At the start of our process, Facility Manager Rudd and I outlined a walk-through procedure for developing and recording the data necessary to develop our envisioned plan that would be based on the building assessments. Our methodology would rely heavily on Ed's extensive knowledge of the thirteen NHA properties we would assess and my expertise in preparing Cyclic Maintenance/Capital Improvements plans for parks and historic structures throughout the National Park System and for dozens of state and local historic sites and museums.

The objective of the two and one-half days available to us was to gather enough repair/renewal/capital improvement information from our site visits, combined with Mr. Rudd's knowledge of the maintenance history and identified deficiencies or deferred maintenance actions, for every listed NHA building. This information would form the data for a draft plan.

We had hoped, and NHA Director James Russel confirmed during a conference call with us on 2/13/2017, that the plan should project an initial 10 year horizon. However, we later determined a five year plan to be a more realistic outcome. The structures we planned to survey are (listed in the order presented in the NHA Building Site Information packet): #1- Bartholemw Gosnold Museum Support Center (Gosnold Center); #2 the Whaling Museum Complex [consisting of the Museum Center (Center): Peter Folger Museum Building (Museum), Hadwen & Barney Oil & Candle Factory (Candle Factory) Museum Gift Shop (Gift Shop, note includes the Connector to the Candle factory); #3 Hadwen House (Hadwen); #4 Thomas Macy House; #5 Greater Light; #6 Fire Cart House; #7 Old Mill; Jethro Coffin House (Oldest House); #9 Old Goal; #10 Quaker Meeting House; ; #11 Research Library, #12 Thomas Macy Warehouse; #13 the 1800 House; #14 No. 2 Union Street; #15 Foley/Vaughn Building. The Forecast Plan Spreadsheet is included as an attachment to this report. This contains every project package recommended in this document. Projects are grouped by the year they are to be initiated. Every project described in this report has been assigned a package (number shown in red type) that begins with the commencement year followed by a two letter site identifier and the project package number.

Lastly, I want to thank Ed Rudd for his 100% dedication to our assessment effort during my short visit. Particularly, Ed went "Above and Beyond" when working with me on Saturday morning to complete our visits to the last four NHA sites. Again on this visit to the Island, I was extremely grateful again for the privilege of being a guest at the NHA guest facilities at the historic Thomas Macy House. Although we have never met, I want to extend my profound gratitude for the services provided by the 99 Main Housekeeper, Ms. Patti Kepenash, she does

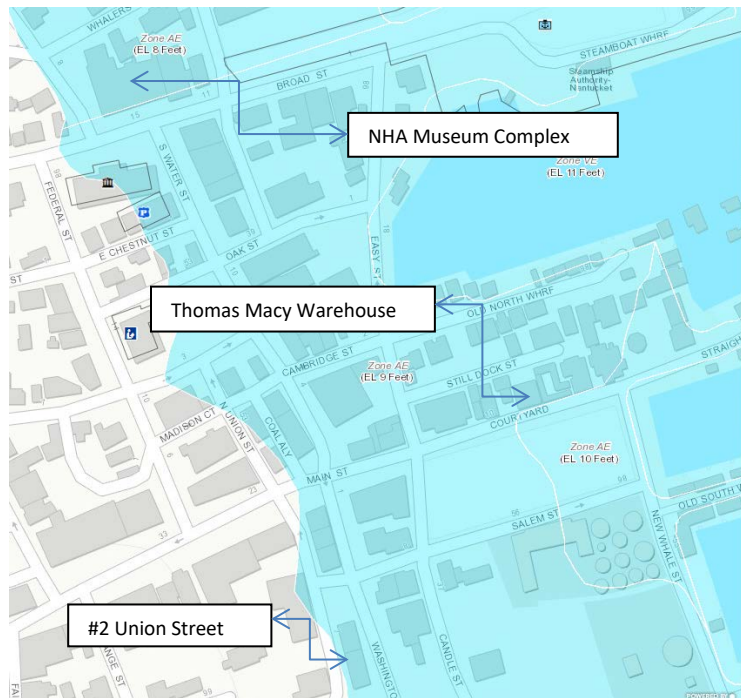
an outstanding job of both preservation stewardship and providing excellent guest services at this Landmark Home, thank you Patti!



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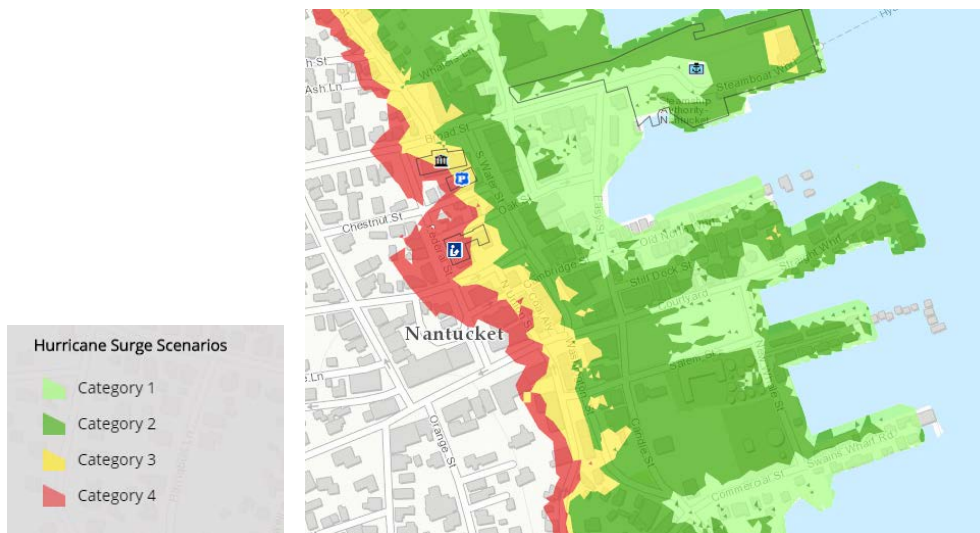
Flood Resiliency Report

The January 4, 2018 winter storm that pummeled Nantucket with rain and wind resulted in significant downtown flooding. Flood waters began to rise along the downtown waterfront more than an hour before the 1:42 p.m. afternoon high tide, with more than a foot of water in places along Washington, Easy and Broad streets. The January nor'easter was the most severe of the three flood events in the winter of 2018 and the only occasion when water actually penetrated into the museum's buildings. This event was a very unpleasant reminder that three NHA properties lie within the Massachusetts Office of Coastal Zone Management designated AE flood zone. The "E" in AE indicates that a predicted elevation of water has been determined and is designated on the FEMA Flood Information Rate Maps (FIRM). A Zones in coastal areas are likely to be subject to moving water, over wash, breaking waves (with heights less than 3 feet), storm surge, and wave run-up (with depths less than 3 feet)—all of which may cause erosion and scour and are capable of damaging or destroying buildings.



The above map is from the Massachusetts Sea Level Rise and Coastal Flooding Viewer found at the Massachusetts Office of Coastal Zone Management (CZM) website. Flood Insurance Rate Maps - FIRMs are official maps that depict the predicted extent of the 1%-annual-chance flood (also called the 100-year flood), which is the area that would be flooded in a storm having a 1% chance of occurring in a given year. These high-risk flood zones are determined by the Federal Emergency Management Agency (FEMA) using models and historical data for storm tides and frequency. **This map does not account for sea level rise.** There is a plethora of maps, graphs, and charts that relate to coastal flooding and projected levels of sea level rise at FEMA, NOAA, and the CZM websites. This CZM map was selected for this report because it clearly shows the 100 year flood area of the Nantucket town water front. NHA affected properties are identified.

The noteworthy fact about the January 4th event was the extent of storm surge flooding. The extent of the waterfront flooding had not been witnessed on Nantucket in the recent past. The storm was a very dramatic reminder that the predicted coastal flooding from government agencies is a very real and present threat and can happen at any time in the future. The reach of the flood waters from this storm was almost identical to the yellow Category 3 storm flooding boundary seen in the CZM map below. If one looks carefully at the Category 3 boundary one can see the exact flood pathway into the museum Connector building at the north elevation. The time for the NJA to implement flood resiliency measures is now. The NHA needs to determine the official Nantucket municipal Base Flood Elevation (BFE) for the Museum, Thomas Macy Warehouse, and #2 Union Street buildings. The BFE is the minimum design flood elevation. The NHA Director and Board as owners of the NHA assets then should determine the NHA flood protection level to use for all future design decisions affecting their buildings at risk.



Above is another

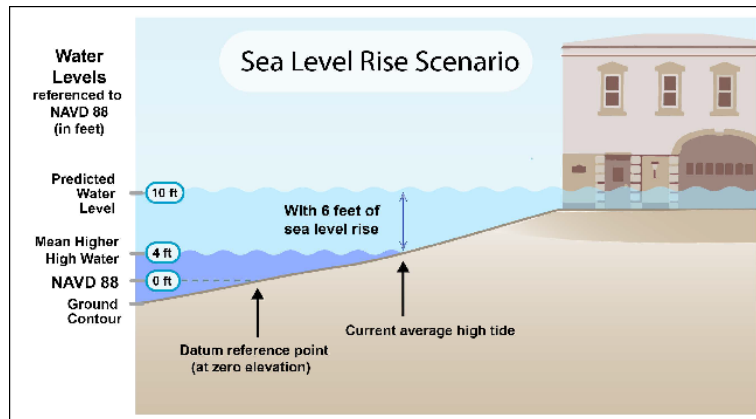
Massachusetts CZM interactive map includes that includes four worst-case scenarios of storm surge based on thousands of modeled combinations of hurricane intensity (Category 1-4), forward speed, track or direction, and other factors **not including sea level rise**. What this CZM maps reveals for the NHA is that a category 1 storm should have not reach the museum complex and would have little impact on the Macy Warehouse. Category 2-4 storms will cause flooding at the museum complex that will require storm resiliency measures. The Thomas Macy ground floor elevation is approximately 1 foot higher than the Base Flood Elevation of the museum Gift Shop and Candle Factory and should only be impacted by a category 4 storm surges. According to this map #2 Union Street could be subject to flooding as well in either at category 3 or 4 storm event.

Ed Rudd described the events of the 2018 storm surge floods as follows: *“The first storm came up and over the back yard area and fill the area between the gift shop and candle factory with water, so the only place for the water to go was through the double wooden doors in that area, which in turn had water leaking into the candle factory floor. We used wet dry vacuums to suck up the water as it migrated through the doors and what water was not caught by vacuums, followed the slope of the cement floor. After 5 hours, we were able to get all water out of the building. We did sand bag the Gift Shop front door*

The second big 2018 storm came with flooding but with the berm that we built prevented water from entering to the back area by the double doors, between the Gift shop and Candle Factory.

This storm was not as bad as the first storm, no water got into the building.

Again, on March 3rd-4th there was a big storm, lots of wind and flooding. The streets and sidewalks were under water, up to the Gift Shops back step, but the berm that we built at the back of the Gift Shop held the water back, so no water got in to the building. We had sand bags around all the doors, with the help of the DPW dropping off more sand bags for us to use on Saturday night.”



Previous page, a SLR diagram. It is beyond the scope of this report to make a prediction about the rate and level of expected Sea Level Rise for the Nantucket Harbor over the course of this century. However, SLR is a scientific fact and the NA would be well advised to allow for an appropriate estimation of SLR when determining their FPL and when creating plans for any capital expenditures on the Museum Complex, Thomas Macy Warehouse or #2 Union Street. All three of the above illustrations can be found by visiting:

<https://mass-eoeaa.maps.arcgis.com/apps/MapSeries/index.html?appid=6f2797652f8f48eaa09759ea6b2c4a95> can be

Findings: Recommended Flood Proofing Strategy – Immediate Flood Resiliency Actions

Museum Complex – Gift Shop & Connector, Candle Factory

The good news for the NHA is that the response to storm flooding over the near future (not accounting for SLR) concerns the relatively short period of time of a tidal event or storm duration as opposed to the long term immersion seen as a result of Katrina in New Orleans or Irma in Houston. Therefore, several Dry Flood Proofing measures should prove effective over relatively short period of time. Dry Flood proofing systems require human intervention which can only be implemented if there is adequate warning time. This report recommends the following flood resiliency actions and measures for the Museum Complex and the Thomas Macy Warehouse:

- The NHA should designate a staff team to review the NHA Emergency Preparedness Plan in light of the lessons learned during and after the January 4th storm event. Revise the plan as necessary and distribute broadly.
- Purchase and store appropriate emergency flood barrier and clean up materials at both the museum complex and the Thomas Macy Warehouse. Conduct annual staff training in the deployment and proper use of these flood resistance materials.
- The exterior courtyard to the north of the Connector and Candle Factory also should be re-graded to a higher elevation. Regrading will provide positive drainage away from the museum complex footprint along the north elevation. Exiting area drainage lines also must be reconfigured, a stone retaining wall built along the S. Beach Street sidewalk and the area behind the retaining wall re-bricked or replanted with turf.
- Employ selective Dry Flood Proofing tactics at the Museum complex. Complete the design and if funding permits construct a new shed roof for the 145 sq. ft. expansion of the Gift Shop Connector at the north elevation. The draft design incorporates installation of a reinforced concrete footing wall that will in effect become a floodwall and provide a permanent barrier against the Category 3 flood level storm surge that penetrated the museum at this point. The new enclosed area by the Connector expansion should provide some additional storage space for the museum. Incorporate removable drop-in flood barriers into the design of the new exit doors at the relocated north Connector wall.



Gift Shop & Connector north Elevation. Photos taken during the flood illustrate the major pathway of the January 4th flood waters into the building were through the Connector exit doors seen in the photo on the left. The photo of the open area to the north of the Gift Shop illustrates the concurrent need to regrade this area to provide positive drainage to the east. Photo credit: Ed Rudd

- The NYA should consider elevating the entire Gift Shop at a future date. This wing of the museum complex is in the most exposed location to both storm surge flooding and potential wind driven wave action. The gift Shop is a wood-frame on a brick/concrete foundation structure and elevation would be relatively straight forward. During our assessment my measurement of the floor elevation using the app *My Elevation* indicated a reading of 3 ft.



Gift Shop South Elevation. Installing temporary emergency flood barriers at the south elevation entrance to the gift shop may be effective in flooding slightly above the level of the door threshold, however, flood waters will most likely over time penetrate through the clapboard siding and enter the Gift Shop wing. The wood shingle siding of the Connector at the south elevation also will not provide a very effective barrier against any potential storm surge that rises above the brick foundation wall. The long term flood proofing solution for this building is elevation.

- Dry flood proofing is an appropriate treatment for the slab on grade Candle Factory with its solid masonry walls. There are no apparent portals of entry along the north elevation of the Candle factory. The South Elevation first floor doors are used for emergency exiting and would also be suitable to retrofitting an emergency drop-in flood barrier.



Candle Factory interior views. Top left, the entrance alcove of the Candle Factory could be easily adapted to accommodate two discrete slots for an emergency flood gate. Top right the concrete flooring and masonry walls make clean-up of any internal flood water that penetrates into the Candle Factory floor, the lowest elevation finished floor in the museum, a straight forward task. Bottom left and right, however, should a severe storm surge overwhelm the exterior flood barriers and enter into the Candle Factory low level display cases, electrical outlets and mechanical equipment might then be subject to immersion.

Thomas Macy Warehouse



Photo Credit- Nantucket Inquirer & Mirror

Photo of January 4th flooding on Main Street looking towards Straight Wharf to the east. The corner of the Thomas Macy warehouse is just visible on the left. Fortunately, the height of this storm surge did not penetrate to the first floor.

The January 4th flood waters did not reach the ground floor level of the historic Thomas Macy Warehouse. Our measurement from the *My Elevation* app indicated the Warehouse floor level was 4 ft., a foot above the Gift shop floor level.

- A dry-flood proofing strategy is not appropriate for this structure. The reason for this is straightforward; the Warehouse structure is built upon a perimeter foundation sill set on piles with wood floor joist running several inches above the permeable fill material. Any storm surge flooding will flow through the sandy fill and percolate up through the flooring into the first floor. Fortunately, the masonry brick walls and wood flooring are fairly resilient to short periods of flooding and should not suffer permanent damage if flooded. Post flood clean-up can be significant but will not cause damage if new building features at this level are constructed of flood resistant materials and all displays are elevated above the Design Flood Level.



Front (south) Elevation of the Thomas Macy Warehouse.

Currently, the NHA is in the preliminary planning stage for a major preservation treatment of the exterior of the Warehouse that includes installing a new wind-resilient historically appropriate slate roof and gutters, exterior brick repointing and parge coating, and a comprehensive wood window preservation program.

- The recommended interior wet-flood proofing strategy for this building is to install all the new vulnerable building elements such as, accessible bathrooms, mechanical room, utilities such as fire suppression and HVAC equipment, and permanent exhibits only at the second floor level. Flood damage resistant materials should be used where necessary at the first floor level. Automatic shut-off valves must be installed on any sewer and fuel lines. FEMA has recently released an outstanding publication: FEMA P-348, Edition 2/February 2017 that provides profusely illustrated guidance in section 5.0 Mitigation Measures for Non-Residential Buildings, see: <https://www.fema.gov/media-library/assets/documents/3729>

Note: Wet floodproofing uses a variety of techniques to reduce the damage to a building and its contents while allowing the structure to flood. Vulnerable items such as utilities, appliances, and contents are relocated pto higher parts of the building above the design flood high.

#2 Union Street

This fine historic building is located within the 100 year Nantucket town floodplain. An assessment of flood proofing alternatives for this building was not in the scope of this report.



Photo of the West Elevation of #2 Union Street. Note the very poor condition of the asphalt roofing shingles. The roof hatch and chimney will also require repair. This work must be scheduled in the very near future.

Facilities Capital Expenditure Forecast Plan

NHA Buildings Assessment Findings

Building #1 – The Bartholomew Gosnold Museum Support Center

The Support Center was built in 1993 and the Annex in 1996. The July 2017 Foundation for Institute of American Conservation Collections Assessment Program (CAP) Report recommended the NHA create more storage space at the Gosnold Center by completing a major rehabilitation and several of the capital expenditure packages listed below directly support this critical NHA goal. The storage area climate control dates to the original construction when it was a state-of-the-art unit; however, there have been substantial incremental repairs recently that have enhanced the systems performance. Wholesale replacement of the storage space climate control system is not recommended. The roof and exterior shingles will require replacement in the next decade. There are several necessary improvements and capital expenditures that are recommended in the CAP report. These components included:

- Recessing the large swinging barn doors leading into the receiving area and installing a Plexiglas storm panel to cover the transom window above. [FY18GC6]
- Adding large diameter gutters at the Gosnold Center to collect and direct rainwater runoff away from the building perimeter. [FY19GC10]
- Relocate the woodworking shop to a rehabilitated Annex Building. Install windows and doors, insulate, install new electrical system and heat pump heating system, install new flooring and drywall, paint, and install a new dust collection system. [FY19GC11]
- Increasing storage space for the small craft collection in the former two-story receiving room by installing a pre-fabricated mezzanine storage structure with a lift. [FY20GC12]

In the past six months many improvements have been completed at the Support Center. These improvements include: extensive clean-up of the Annex and existing woodworking shop, installation of a new emergency generator, installing a new air handling unit compressor for the second floor museum storage climate control system, and installing new coils in the first floor air-handling unit and rebuilding the mixing box ductwork at the first floor level.



Gosnold Center Photo: A new 5KW emergency generator and a new condenser unit have recently been installed at the center

Additional Gosnold rehabilitation tasks developed during our Forecast Plan assessment include:

- Add the additional HVAC zones to the curatorial staff office area, the new small craft storage area created in the former receiving room, and the new receiving room in the former shop space by installing Mitsubishi zoned HVAC equipment. [FY19GC13]
- Add new UV system to storage area climate control system. Add Upgrade storage area lighting controls. Add network climate control module to allow local or remote graphic operating control and monitoring by the Facility Manager of the climate control, HVAC, Fire, and Security systems at the Support Center. [FY19GC14]
- Rehabilitate former shop space into a new collections receiving area. Install new flooring and wall covering, paint. [FY19GC15]
- Upgrade existing fire suppression system, install new heads, convert to a pre-action fire suppression system. [FY19GC16]
- Purchase additional shipping containers for maintenance storage. [FY19GC17]



Photo Gosnold center Annex Building – left existing south Elevation, right existing west elevation. Rehabilitating this existing shell storage building into usable heated space will be a major project.

Lastly, two critical 2018 Gosnold Capital Improvement Tasks have been identified from this assessment for immediate completion at the Support Center. These two tasks are illustrated below:



Gosnold Support Center: 2018 Task #1 Inset receiving room barn doors, install Plexiglas transom storm window, paint the front elevation doors and trim; Task #2 Install a drainage channel to carry chiller condensate drainage and fire pump drainage away from the corner of the building.

Building #2 - Whaling Museum Complex

The Museum Center buildings were rehabilitated and expanded 13 years ago and as a result the entire complex is in generally good condition. Also, ongoing preventative and cyclic maintenance have been effective. 2018 Flood Resiliency projects already discussed in this document are the highest priority task items for the complex. Additional 2018 and beyond planned capital expenditures include:

- Complete the Candle factory 2nd floor expansion by 320 sq. ft. and install ceiling fans in the Candle Factory. [FY18MC18]
- Install glass doors between the Candle Factory first floor level and the Gosnold Gallery (?). The objective of this project is to provide acoustical and environment separation between these two spaces. Environment separation will enhance the control of each of these separate climate control zones. [FY18MC19]
- Install glass doors between at the Second Floor level between the entry vestibule and the Candle Factory. The objective of this project is to provide acoustical and environment separation between these two spaces. Environment separation will enhance the control of each of these separate climate control zones. [FY19MC20]
- Replace the 16-year old museum complex heating boiler and the left-hand side Chilled Boiler Starter (CBS). The right-hand side CBS was replaced in 2013. [FY20MC21]
- Restore rotating mechanism and install a more durable and historically accurate steel brace to support of the 2nd order Fresnel Lenses. [FY20MC22]
- Expand museum parking area at the west side by adding 6-8 spaces. [FY19MC23]
- Rehabilitate the Foley-Vaughn Building. [FY22MC24]
- Upgrade boiler burners and controls. Repair boiler back plates. [FY20MC25]
- Upgrade Fire Suppression system and controls. [FY20MC26]
- Install shingle siding at the rear of the museum. [FY20MC27]

Building #3 - Hadwen House

During our CAP visit last July to the Hadwen House we learned that the NHA is planning to expand the current presentation of the Hadwen beyond the current docent-led house museum theme. Work is currently underway to improve Hadwen by upgrading the existing HVAC system to a climate control system that will serve potential exhibit and event space in the public areas of this historic home.

The recent clean-up of the Hadwen basement responded to our CAP recommendation to remove collections and material from the Hadwen Basement. Our February 2018 assessment resulted in the identification of several immediate and future capital expenditure project packages for Hadwen House. They are:

- Enhance existing hot-water boiler and HVAC system by adding climate control features: install new air-handler coils, new insulated ductwork, additional vents, and a new network climate control module to allow local or remote graphic operating control and monitoring by the Facility Manager. Install new wiring and a secondary electric panel. [FY18HH28]
- Install an ADA compliant elevator and access ramp to the rear deck of the Hadwen House. [FY20HH29]
- Complete Hadwen Landscape rehabilitation/restoration. [FY21HH30]
- Rehabilitate staff bedrooms at the basement level of Hadwen House. [FY21HH31]
- Rehabilitate the Hadwen kitchen [FY21HH32]
- Rehabilitate the Hadwen 2nd floor bathroom [FY21HH33]
- Preserve Hadwen cupola, repair chimney caps, and upgrade Hadwen gutters and downspouts. [FY22HH34]



Photo Rear Elevation of the Hadwen House – Developing an appropriate architectural plan for the addition of an elevator and ADA accessible ramp to the rear deck (first floor) level of the Hadwen house for this character defining exterior elevation will be a challenge. The accessibility enhancement must be designed so that the exterior appearance of this NHL home is not diminished.

One critical 2018 Preservation Maintenance Tasks at Hadwen house was identified during the February assessment is illustrated below:



Photo East Elevation of the Hadwen House – all the downspouts along the perimeter of the Hadwen house must be immediately checked and re-connected to the subsurface storm water drains.

Building #4 – Thomas Macy House –

Maintenance and capital expenditures for this site are provided by an endowment. No capital expenditure forecast assessment was performed for this structure.

Building #5 - Greater Light

An exterior rehabilitation completed in 2012 by the Nantucket firm of Twig-Perkins has resulted in overall good condition assessment for this historic home. One project was identified as a future capital expenditure:

- Replace the pergola at the rear elevation. [FY22GL35]

Our assessment also identified a necessary 2018 Preservation Maintenance task that is illustrated below:



Photo Rear Elevation of Greater Light – It is advisable to instigate a major pruning project in this area in 2018.

Building #6 – Fire Cart Hose House

Restored in 2012 the condition of the Hose House is good. The following are the identified Capital Expenditure projects for this site:

- Move existing interpretive panels and install new railings with Plexiglas barriers to allow visitors to access the Cart house without a docent present. [FY18CH36]



Photo of the interior of the Fire Cart Hose House – this picture shows the existing railing and exhibit panels now on the interior of the Cart House. Relocating these railings and adding Plexiglas barriers should allow visitors to view the interior fire-fighting equipment, interactive displays, and video presentation without a docent providing security.

Building #7 – Old Mill

The Old Mill is distinguished from all the other magnificent NHA National Landmark structures by the fact that it is a functioning building and a complex machine. The Old Mill, thought to be the oldest operating mill in the United States, is also an engineering treasure and it is the obligation of the NHA to keep this structure in operational condition. The Old Mill was last restored in 2006. The following capital expenditure packages are recommended:

- Design/Build a Prospect Street pedestrian access stairway up to the wheel track elevation. The recommended design would utilize large granite treads that are woven into a random coursed, dry-laid field-stone retaining wall to the east where there has been extensive erosion of the existing turf slope. [FY18OM8]
- Design/Build an ADA compliant entry and access path from the main Old Mill site entrance to the mill entrance threshold. [FY20OM37]
- Remove existing cobblestones, regrade a level crushed stone base and relay cobble stones along the entire circumference of the wheel track. [FT22OM38]
- Re-shingle the mill structure. [FT22OM38]

One critical 2018 Preservation Maintenance Tasks at the Old Mill is to trim overgrown vegetation at the west side of the site.



Three Old Mill photos from the south: The photo on the left shows the existing access from Prospect Street, the center photo gives a clear indication of severe erosion that now is a safety hazard, and photo on the right shows the area where it will be necessary to construct a stone retaining wall.

Building #8 – The Jethro Coffin House or the Oldest House

John Milner Architects oversaw a 1987 restoration and the roof structure was reinforced in 1989. The entire exterior envelope of the building should be renewed in the near future.

- Install new roof shingles, clean chimney brick, repoint as necessary, inspect repair/replace roof gutter system. [FY21OH40]
- Re-shingle all four elevations of the Oldest House. Inspect repair/replace window trim. . [FY21OH41]



Photo of the Front Elevation of the Oldest House. The roof and siding shingles are now more than three-quarters of their way through the expected service life of these materials.

Building #9 – The Old Goal

There have been several previous campaigns of repair and restoration of the Old Goal, the most recent was a comprehensive phased group preservation and repair tasks completed in 2014-2016 which included the reconstruction of the exterior stairway. The outcome of this work is the 2018 assessment determination that this structure is in Good Condition. There are no recommended future capital expenditures for the Old Goal.



Photo of the Front Elevation of the Old Goal – The front door of the Old Goal is a significant character defining feature of this historic structure and previous restoration efforts have respected the historic integrity of this feature by avoiding “heavy-handed” and unnecessary replacement of worn or rusted elements.

Building #10 – The Quaker Meeting House

This important religious structure underwent a comprehensive preservation and rehabilitation effort in 2016 and is consequently categorized as in Good condition. Recommended future capital expenditures for the Research Library are as follows:

A critical 2018 Preservation Maintenance Task, illustrated below, at both the Quaker Meeting House and the Research Library is to trim all the over-hanging tree limbs above the roofs of both structures.



Photo of the Front Elevation of the Quaker Meeting House – Overhanging tree branches can damage a roof or gutters in a wind storm and leaf debris will clog gutters and downspouts.

Building #11 - The Research Library

A major construction project completed in 2001 by the NHA retrofitted, restored, and enlarged the Research Library and the structure remains in good condition now. The library space is climate controlled and there is an archival, climate controlled storage vault beneath the attached Quaker Meeting House. Work to upgrade parts of the library climate control system was completed in 2017 and included replacing the two boiler units and installing two new two scroll compressor. Recommended future capital expenditures for the Research library are as follows:

- Install a new rooftop mounted Condenser Unit to supply the Research Library climate-control system. The entire unit must be isolated on an acoustically isolated pad and be completely surrounded by a sound attenuating barrier. **[FY18RL9]**



Photo of the existing condenser unit now above the Research Library. Adjacent neighbors have complained about the constant noise this 17-year old unit produces while running during the summer months. The unit is at the end of its' service life and should be replaced.

Building #12 – The Thomas Macy Warehouse

An Exterior Condition Assessment Report dated August 23, 2017 was completed for the NHA by this author. This report recommended the NHA initiate a complete exterior preservation treatment program within 18 months. There were three major tasks identified with exterior preservation, reroofing with slate and installing new copper flashing and gutters, repointing and parge coating the exterior brick masonry, and a complete program of wood window repairs that include paint removal, re-glazing, installing weather-stripping, caulking and painting.

Following receipt of the Warehouse Condition Assessment Report the NHA developed a three phase rehabilitation plan for the Thomas Macy Warehouse. Phase I consists of the Exterior Preservation tasks. The report advised that the entire exterior roof system: shingles and underlayment, roof hatch, east parapet wall parge coating on faces, flashings and roof cricket, and all gutters, collection boxes, and downspouts should be replaced immediately with a historically correct slate roof. The NHA has already moved forward with removing the existing asphalt shingle roof and installed new roofing underlayment as a temporary stabilization measure to eliminate roof leaks until a new slate roof can be applied in the spring of 2018. It is critical that the re-roofing task be completed immediately. At the same time the NHA has applied for preservation grant funding to help offset costs for all the above described exterior preservation treatments. The current estimate for all the exterior work is \$183,225.

Thomas Macy Warehouse Phase II tasks address upgrading essential electrical & plumbing systems, ADA accessibility improvements, and installing new fire suppression and building security systems. The estimated cost for completing the Macy Warehouse Phase II projects is \$191,570.

The Phase III projects include: Installing a climate-control system, installing an ADA compliant elevator, and replacing deteriorated fencing at the rear elevation. The NHA estimated cost for all the Phase III tasks is \$271,500.

Recommended future capital expenditures for the Thomas Macy Warehouse are as follows:

- Complete Phase I Exterior Preservation tasks. [FY18MW3]
- Complete Phase II Systems Upgrades. [FY19MW42]
- Complete Phase III Interior Rehabilitation tasks. [FY19MW43]



Photos of the Thomas Macy Warehouse Attic before, and after, the thorough 2017 “housekeeping” effort. The first step in rehabilitating the Macy Warehouse was cleaning out the attic space. The photo on the left shows the attic space in August 2017; the photo on the right shows the same space in February 2018.

Building #13 – The 1800 House

The 1800 House is the NHA's restored nineteenth-century dwelling located at 4 Mill Street that contains classroom space for NHA programs teaching the decorative arts. The most recent preservation construction work was completed at this structure in 2008. The overall exterior roofing and shingle condition is rated at Fair Condition. Recommended future capital expenditures for the 1800 House are as follows:

- Install new roof shingles, clean chimney brick, repoint as necessary, Inspect repair/replace roof gutter system. [FY21EH44]
- Re-shingle all four elevations of the 1800 House. Inspect repair/replace window trim. [FY21EH45]



Photo of the Front Elevation of the 1800 House. The exterior storm windows do not detract from the historic appearance of this structure and significantly reduce the effects of weathering on the wood double hung sash windows. The wood shingle roof and exterior shingle siding appear to be more than halfway through their respective service life.

A desirable 2018 Preservation Maintenance Tasks at the 1800s House site is to install a clear window well cover at side elevation at the adjacent Carriage House.



Photo of the new window well at the Carriage House. This well should be covered with a custom transparent Plexiglas cover.

Building #14 – #2 Union Street


#2 Union Street is a historic brick Nantucket Row House now leased for office use by commercial tenants. The existing asphalt shingle roof is in failing condition and should be replaced in the next year. The original roof appears to have been slate. The remainder of the building exterior is in Fair Condition. All the wood windows require preservation treatment, as does the exterior brick masonry.

Recommended future capital expenditures for the #2 Union Street are as follows:

- Install new roof shingles, clean chimney brick, repoint as necessary, Inspect repair/replace roof gutter system. [FY19TU46]
- Repair cracks in brick masonry gable wall; repoint all the exterior brick walls as required. [FY19TU47]
- Complete a comprehensive window preservation treatment project for all the historic wood windows on all three elevations of this building. [FY20TU48]
- Commission and Condition Assessment of #2 Union Street with accompanying research to prepare a historic data section.
- Forge a partnership with a university preservation program with the objective of preparing a set of record drawings of this historic structure.



Photo of the Front Elevation of #2 Union Street on the left. The asphalt roof needs to be replaced. Seen in the detail photo on the right, the sidewalk on the west, or leeward side, from the prevailing wind from the January 4th storm was littered with asphalt pieces off the #2 Union Street roof.

 Capital Expenditure Forecast Plan 2018-2022										
Forecast Year for Completion	Building	Project Package Title	Condition	Estimated Cost			Estimated Total FY Cost	Project to be completed by:	Package Number	Notes
				Urgent	Necessary	Desireable				
2018										
2018	Museum Complex (MC)	Floodproof North Elevation of the Giftshop Hyphen	Poor			\$75,000		Contractor	FY18MC1	
2018	Museum Complex	Regrade Courtyard Area Outside Museum Giftshop	Poor	\$5,000				In-House	FY18MC2	
2018	Thomas Macy Warehouse (M)	Complete Phase I Reroof with Slate Shingles/ install new gutters	new construction	183,200				Contractor	FY18MH3	
2018	Museum Complex	Retro-fit Drop-in Flood Gates at Candle Factory Entrance	new construction	5,000				Contractor	FY18MC4	
2018	Gosnold Center (GC)	Inset Barn Doors, Weatherproof Transom, Paint from Elevation	Fair	20,000				In-house	FY18GC6	
2018	Gosnold Center	Install a Drainage Channel to Carry Chiller Condensate	Poor	5,000				In-house	FY18GC7	
2018	Old Mill (OM)	Construct Prospect Street Entrance Steps & Retaining Wall	non-existent		\$75,000			Contractor	FY18OM8	
2018	Research Library (RL)	Install New Rooftop Chiller Unit w/Sound Attenuation	Poor		45,000			Contractor	FY18RL9	
2018	Museum Complex	Complete the Candle factory 2nd Floor Expansion	new construction		40,000			In-house	FY18MC18	
2018	Museum Complex	Install Glass Doors at Candle Factory First floor Level	new construction		10,000			In-house	FY18MC19	
2018	Hadwen House (HH)	Enhance Hadwen HVAC by upgrading to climate-control	Fair		28,276			Contractor	FY18HH28	Under contract
2018	Cart House (CH)	Move Existing interpretive panels & Install Plexiglas Barriers	Good			10,000		In-house	FY18CH36	
				FY2018 Subtotals	218200	198276	85000		\$501,476	
2019										
2019	Gosnold Center	Install New Large Diameter Gutters at All Four Elevations	new construction			\$15,000		In-house	FY19GC10	
2019	Gosnold Center	Relocate the woodworking shop to a rehabilitated Annex Building	new construction		200,000			Contractor	FY19GC11	
2019	Gosnold Center	Add Additional HVAC Zone to the Curatorial Staff Office Area	new construction	25,000				Contractor	FY19GC13	
2019	Gosnold Center	Add new UV system to storage area climate control system	fair	7,000				Contractor	FY19GC14	
2019	Museum Complex	Install Glass Doors at Candle Factory Second Floor Level	new construction			10,000		Contractor	FY19MC20	
2019	Museum Complex	Expand Museum Parking Area	good		75,000			Contractor	FY19MC23	
2019	Hadwen House	Rehabilitate staff bedrooms at the basement level	fair	25,000				In-house	FY19HH31	
2019	Hadwen House	Rehabilitate the Hadwen kitchen	fair		75,000			In-house	FY19HH32	
2019	Thomas Macy Warehouse	Complete Phase II Systems Upgrades	poor	191,600				Contractor	FY19MH42	
2019	#2 Union Street (TU)	Install New Slate Roof Shingles	poor	75,000				Contractor	FY19TU46	
2019	Museum Complex	Install new cap plug for the number 1 boiler	poor	15,000				Contractor	FY19MC46	
2019	#2 Union Street	Repair cracks in brick masonry walls, repaint.	poor		35,000			Contractor	FY19TU47	
				FY2019 Subtotal	338600	385000	\$25,000		\$748,600	
2020										
2020	Museum Complex (MC)	Elevate Gift Shop	poor	\$150,000				Contractor	FY20MC5	
2020	Old Mill	Construct New Prospect Street Entrance	poor			75,000		Contractor	FY20M9	
2020	Gosnold Center	Increase storage space for the small craft collection			\$50,000			Contractor	FY20GC12	
2020	Gosnold Center	Rehabilitate Former Shop Space to New Collections Receiving	Poor	15,000				Contractor	FY20GC15	
2020	Museum Complex (MC)	Replace Chilled Water Starter Coil	Fair	40,000				Contractor	FY20MC21	
2020	Museum Complex (MC)	Replace Fresnel Lenses Upper Support	Fair			25,000		Contractor	FY20MC22	
2020	Museum Complex (MC)	Upgrade Boiler Burners and Controls	good	15,000				Contractor	FY20MC25	
2020	Hadwen House	Install an ADA compliant elevator and access ramp	new construction			80,000		Contractor	FY20HH29	
2020	Old Mill	Design/Build an ADA compliant Main Entry Pathway	poor			20,000		Contractor	FY20M37	
2020	Thomas Macy Warehouse	Complete Phase III Interior Rehabilitation	poor	271,000				Contractor	FY20MH43	
2020	#2 Union Street	Repair and Preserve all Wood Windows	fair					Contractor	FY20TU48	
				FY2020 Subtotal	\$491,000	50000	200000		\$741,000	
2021										
2021	Gosnold Center	Upgrade Existing Fire Suppression System	fair	\$14,000				Contractor	FY21GC16	
2021	Gosnold Center	Purchase Additional Shipping Containers for Maintenance Storage.	new construction			15,000		In-House	FY21GC17	
2021	Museum Complex	Upgrade Fire Suppression System and Controls	fair	150,000				Contractor	FY21MC26	
2021	Hadwen House	Complete Hadwen Landscape Rehabilitation	fair			5,000		Contractor	FY21HH30	
2021	Hadwen House	Rehabilitate the Hadwen 2nd Floor Bathroom	poor		40,000			Contractor	FY21HH33	
2021	Old Mill	Relay Cobble Stones Along Circumference of the Wheel Track.	poor	20,000				Contractor	FY22OM38	
2021	Oldest House (OH)	Install New Roof Shingles/Repair Roof Gutter System.	fair		85,000			Contractor	FY21OH40	
2021	1800's House (EH)	Install New Roof Shingles/Repair Roof Gutter System.	fair		75,000			Contractor	FY21EH44	
				FY2021 Subtotal	\$184,000	200000	20000		\$404,000	
2022										
2022	Museum Complex	Rehabilitate the Foley-Vaughn Building	Poor			\$2,240,000		Contractor	FY22MC24	Square foot cost estimate
2022	Museum Complex	Install Shingle Siding at the Rear of the Museum	fair			50,000		In-house	FY22MC27	
2022	Hadwen House	Preserve Hadwen Cupola, Repair Chimney Caps	fair	\$25,000				In-house	FY22HH34	
2022	Greater Light (GL)	Replace the Pergola at the Rear Elevation.	Fair				7,500	In-house	FY22GL35	
2022	Old Mill	Re-shingle the mill structure	fair		75,000			Contractor	FY22OM39	
2022	Oldest House	Re-shingle all four elevations of the Oldest House	fair		65,000			Contractor	FY22OH41	
2022	1800's House	Re-shingle all four elevations of the 1800's House	fair		75,000			Contractor	FY22EH45	
				FY2022 Subtotal	25000	215000	\$2,290,000		\$2,530,000	
Total Five Year HHA Capital Expenditures Forecast							\$4,925,076			