



Village of Bald Head Island

Hurricane Florence Task Force

## Final Report

### TASK FORCE MEMBERS:

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### ADDITIONAL PARTICIPANTS

John May, Council Liaison  
Chris McCall, Village Manager  
Kevin Arata, Communications Working Group Participant

**IN SINCERE RECOGNITION AND APPRECIATION OF THE MANY  
PEOPLE ACTIVELY INVOLVED IN OUR ISLAND'S INITIAL RECOVERY**

Some were here on the first day they could return, when it took hours just to make some initial progress along North Bald Head Wynd.

Many pressed ahead with recovery efforts each day, even when they had their own storm issues to deal with at home, working in hot, humid, challenging, and potentially dangerous conditions often knee-deep or chest-deep in stormwater and in the company of alligators, snakes, and other hazards. They opened the island safely, without injury to recovery workers or property owners.

We thank them for their efforts and expertise in difficult and hazardous working conditions - and for their dedication to reopening the Island.

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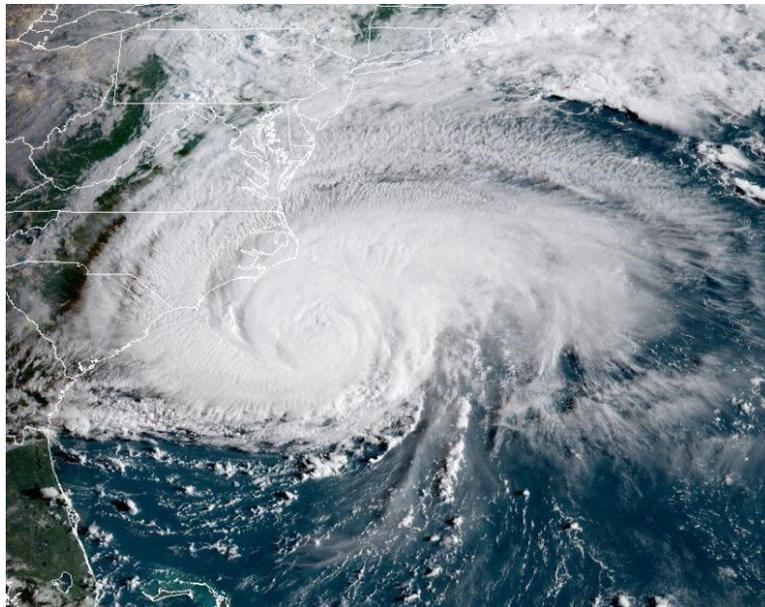
**Our recommendations are highlighted throughout this report by a blue background.** They are also listed separately in Appendix II.

## FLORENCE

Florence began off the west coast of Africa near the Cape Verde Islands, strengthened to 130 mph over the mid-Atlantic, then weakened to a tropical storm before again surging in strength, fed by warm waters and decreasing wind shear. On Monday, September 10<sup>th</sup>, Florence became a Category 4 storm, reaching wind speeds of 140 mph on a steady course toward the Cape Fear region.<sup>1</sup> We have included a timeline of events from that Monday through reopening of the island on October 1<sup>st</sup> as Appendix V.

By that Monday the Village's preparations for a major storm had been underway for days, guided by the Emergency Management Plan, and the Mayor now declared a state of emergency and ordered the first-ever mandatory evacuation of our island.

The timing of the last ferry from the island is determined by both the timing of the closure of the Cape Fear River in advance of the storm and sometimes by the need to relocate the ferries further up-river to better weather the storm.



Consequently, the Village must make evacuation declarations one or two days before our coastal neighbors who have road access in and out of their communities. The last ferry was initially scheduled to leave midday Wednesday. On Tuesday, the rapidly approaching Category 4 storm and the earlier closure of the river required moving the last departure earlier, to 9:30 a.m. Wednesday.

Later Wednesday, Florence began to weaken rapidly due to increasing wind shear and pulses of dry air entering the storm. Its wind speeds decreased, and its forward motion slowed markedly as it approached the Cape Fear region. It made landfall near Wrightsville Beach at 7:15 a.m. Friday as a Category 1 storm with maximum sustained winds of 90 mph. Florence then moved slowly southwest toward Southport. Friday at about 9:30 a.m. the center of circulation reached a point 10 miles north of Bald Head Island and then turned west, moving very slowly out of the region over the next 24-36 hours.

Maximum measured wind gusts reached 62 mph in Southport and 66 mph on Bald Head Island, with open location gusts estimated over 90 mph, but wind was not the main feature of this storm.

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<sup>1</sup> Descriptions of the storm and data were gathered from a variety of sources, particularly <https://www.weather.gov/ilm/HurricaneFlorence>. Local rainfall estimates came from that site and measurements at the BHI Club rain gauge.

Over two days, at least 40 inches of rain (nearly 2 billion gallons) fell on an island that had already seen a significant amount of recent rain. One- and two-day rainfall records were set throughout southeastern North Carolina, resulting in unprecedented flooding both on the island and in river basins throughout southeastern North Carolina. For days, road access to both Southport and Wilmington was cut off by road and bridge damage and by flooding in the Cape Fear River basin that turned stretches of I-40 into a lake. Southport and Wilmington became virtual islands needing resupply by sea and air. Damaged and flooded roads made road travel difficult to impossible for many Village staff and significantly complicated the recovery on Bald Head Island.

When the island's first responders arrived Monday morning from Southport, they found the island flooded, beginning near the ferry landing and extending along North Bald Head Wynd. Fallen trees and limbs blocked the roadway, which was several feet underwater in many locations. It took hours to clear the roads to reach the Public Works, Public Safety, and Village Utilities complex on Muscadine. The full extent of the flooding would become apparent over the next several days as the limited staff attempted to reach and open the ocean outfalls and to move pumps from their protected storage locations to the primary pumping sites. Appendix IV contains links from the Village's Voice to several sets of photographs and aerial videos of the island between September 17<sup>th</sup> and 19<sup>th</sup>. These give a graphic sense of the magnitude of the challenge facing the responders.

Thus began the long recovery process, as limited staff worked with great dedication in challenging conditions to clear the roads of trees and limbs and to begin to move water off the island.

**First and foremost, the recovery process depended on removing the unprecedented amount of stormwater from the island:** sewer service depends on power to operate grinder pumps, and power cannot be restored until the water has receded enough that flooded transformers are no longer submerged and can safely be energized. During the two weeks after landfall, because of dangerous conditions and limited emergency response capability, only individuals authorized by the incident commander were allowed to come to the island. Power was not restored to the island until Thursday, September 27, 15 days after the mandatory evacuation, and at that point some properties remained without power. Even with power restored, additional homes were without sewer service because their grinder pump vents remained submerged. Homeowners were not allowed to return to inspect their homes until Saturday or Sunday, the 29<sup>th</sup> or 30<sup>th</sup>, and the island was not re-opened to overnight residency until Monday, October 1st, 19 days after the mandatory evacuation. When homeowners returned, they found the expected refrigerator and freezer problems resulting from the power outage and some external damage, but the serious problems were caused by wind-driven rain that entered houses and led to water damage and mold and by flooding that had affected broad swaths of the island, damaging garages, carts, insulation, and ductwork. Notably, little of this damage would have been apparent on brief external home inspections. Arguably, even if re-entry had been possible a week earlier, homeowners would have been faced with much the same damage.

Nonetheless, homeowners had many questions about the extended recovery. Was the Village adequately prepared? Could the extent of flooding have been reduced by preemptive measures

such as pump pre-placement or lagoon lowering? Were there other steps that would have sped recovery and reentry? Could staff have left the island later or returned to the island earlier? Could homeowners have returned to inspect their property earlier? Were the decisions about who would be allowed early entry to the island appropriate? Was the proper balance struck between safety and access to property? In this context, the Village Council established the Hurricane Florence Task Force.

## **THE TASK FORCE**

The Village Council established the Hurricane Florence Task Force from a slate of interested volunteers in November 2018, to review the Village's preparation for and response to the extraordinary events of Hurricane Florence and its aftermath. Very brief bios of the members are found in Appendix III.

Rather than fixing a charge for the Task Force, the Council allowed the Task Force great latitude to determine the issues it would examine and to define our goals. The Task Force held its first meeting November 27, 2018. At that meeting, we set two broad goals:

- The initial goal would be to review the Village's planning for and response to Hurricane Florence to identify both areas of excellence and opportunities for improvement.
- The longer-term and more important goal would be to identify actions that will strengthen the Village's ability to respond to future major disasters, including both operational and infrastructure changes.

The members unanimously agreed that our focus would not be on finding fault, but rather on identifying constructive actions the Village should take to better prepare for future events.

### **Working Groups**

At that initial meeting, we also developed a strategy, forming four working groups focused on four broad areas of interest and concern. The working groups and their members are:

#### **Stormwater and Storm Damage Management Working Group:**

**Joe Brawner** is an engineer and business executive who has been a resident of Bald Head Island for 20 years, serving in a broad variety of leadership positions in our community. He has a formidable knowledge of the history of stormwater management on the island and chairs the working group.

**Scott Gardner** was an executive at Duke Energy, where among various responsibilities, he managed storm response communication in North Carolina. He currently serves as President of the Bald Head Island Club.

**Pete Fullam** served as BHI Limited's Facility Director, developed its Hurricane Plan, and now owns and operates Island Hardware

### **Disaster Planning and Decision-making Working Group:**

**Peter Menk** is a lawyer with years of military and civilian experience in logistics, crisis management, disaster response, and the rule of law in Iraq. He has taught strategic planning and critical thinking and chairs the working group.

**Keith Earnshaw** is an environmental scientist/health physicist who heads an environmental consulting firm and teaches at the university level about disaster preparedness, emergency management, risk management, terrorism, and radiation safety.

### **Communications Working Group:**

**Conn Sharp** retired from Nationwide Insurance, where he was Director of Change Management and Communications of the Property and Casualty Claims Division and helped develop plans for catastrophic storm debriefs. He chairs the working group.

**Scott Gardner** (bio above)

**Kevin Arata** is an expert in public relations, crisis communications and media relations. He formerly served in management roles in the Army, and now serves as the Communications Director for the City of Fayetteville. Although not a member of the Task Force, he was asked to join the Communications Working Group because of his expertise.

### **Other Issues including Good Government and Public Utilities:**

**Rex Cowdry** is a research neuropsychiatrist and health policy expert who has served in a variety of executive positions in state and federal government agencies, including the White House National Economic Council. He chairs the working group and the task force.

**Pete Fullam** (bio above)

### **Phase I: Information Gathering**

In this first phase of our work, members of the task force gathered information in a variety of ways:

**Written Comments.** The task force established an email address and invited written comments from any interested individual. We received and reviewed over 30 written

comments that helped define the issues, provided useful information, asked probing questions, and helped identify potential recommendations.

**Listening Session.** The task force also held a listening session on January 26<sup>th</sup> to gather additional information, questions, and concerns from the public. The listening session was moderated by Chris May, Executive Director of the Cape Fear Council of Governments. Approximately 100 people participated in this meeting in person and another 28 people joined by conference call.

**Individual meetings.** Members of each working group met with relevant Village staff, property owners, consultants, and other interested parties. To help assure frank discussions and accurate fact-finding, these information-gathering meetings held by each working group were not public, and in general we have not attributed facts or opinions to specific individuals.

**Documents.** The working groups also gathered and examined a wide variety of documents, including both general documents (such as the Village's Emergency Management Plan, previous studies and data from Village consultants and the Conservancy on stormwater management and the freshwater aquifer, relevant Village ordinances and State statutes, planning documents from other shoreline communities, other municipal websites) and documents specific to Hurricane Florence (such as the Village's Voices, the Maritime Market emails, the BHI Club facility manager's log, some social media postings, storm data from the Club and the National Weather Service, river and tide sensors, ferry boarding logs, and after-action reports).

Based on these meetings and documents, each working group prepared a presentation describing its preliminary findings and potential recommendations for the task force to consider.

## **Phase II: Discussions of potential findings and recommendations**

During this second phase of our work, the full Task Force held a series of meetings that were open to the public at which each working group presented its preliminary findings and proposed a series of recommendations for consideration by the full task force. Several meetings were held to consider a variety of issues and to determine which recommendations the task force would adopt.

**Interim Report of the Task Force.** Because the Village's July to June budget cycle required early receipt of any Task Force recommendations with significant budget implications, the Task Force identified a number of recommendations that would require funding and approved an Interim Report that summarized those recommendations and provided cost estimate of major infrastructure expenditures recommended for FY 2019/20 and 2020/21; in some cases, specific projects were recommended by the Task Force, while in other cases, the scope and details of the projects would be guided by the consultant studies recommended by the Task Force. The Interim Report was submitted to Council on May 31<sup>st</sup> and included in the public materials available for the regular June

meeting of Council. Those recommendations have also been incorporated into this final report.

**Preparation of the Final Report and Presentations to the Council and to property owners.** The revised working group reports were then integrated into a draft final report, which the task force members discussed in detail at a final meeting on June 17<sup>th</sup>, resolving remaining issues and refining the recommendations. The Final Report was posted on the Council's agenda page July 15<sup>th</sup> and discussed with the Village Council at its meeting on July 19<sup>th</sup>. On July 20<sup>th</sup> the Task Force held an open meeting during which the members briefly summarized the recommendations and responded to any comments and questions from those attending.

**Thank you.** The Task Force would like to thank the many people who shared their time, their knowledge, and their opinions with the Task Force, including the Mayor and Village Council (especially our liaison John May), Village staff (especially Chris McCall, Carl Pearson, Ben Liddle, Ken Bowling, and Daralyn Spivey), Chad Paul of BHI Limited, Jeff Petroff of Coastal Land Design (the Village stormwater consultant), Jim Cornette of Applied Resource Management (the Village hydrogeology consultant), Chris Shank and Beth Darrow of the Conservancy, Carrie Moffett, Pam Henson, and Diane Mesaris of the Bald Head Association, Robert Norton and Adam Bachmeier of the BHI Club, the Captain of the Port of Wilmington -- and especially the many residents, homeowners near and far, and business owners and employees who shared their views with us in writing, in meetings, in phone calls, and in chance encounters. We hope to have done them justice.

We also hope we have succeeded in getting the facts right and keeping the focus on improving our island's response to the next emergency - and that any comments that may be seen as critical are also seen as thoughtful, balanced, fair, and constructive.

## **STORM DAMAGE AND STORMWATER MANAGEMENT: STUDIES AND INFRASTRUCTURE PROJECTS**

In this report, we first turn to the most concrete challenges involving questions of fact and engineering: storm damage and stormwater management. These challenges also have the most significant funding implications.

### **Topography of Bald Head Island**

Bald Head Island has many features in common with other barrier islands, but its location at Cape Fear and the creeks running east-west parallel to the major dune ridges are distinctive.

Additionally, the Village Sand Management Plan has resulted in improved and more stable beach dunes. While this has added a level of security to beachfront homes and critical infrastructure, it has also allowed for more floodwater retention between the dune ridge and beach dune.

The relief sculpture on the right, generated from early LIDAR data and provided courtesy of the Bald Head Island Conservancy, illustrates many of the challenges to stormwater management resulting from our topography. The (unreal) illumination of this model from low in the virtual southern sky brings out the frontal dunes on South and East Beach and the long primary dune separating the oceanside landscape from the maritime forest. It also clearly shows the long parallel depressions in the maritime forest, and the high dune ridge forming Middle Island, with Bald Head Creek and Cape Creek on either side.



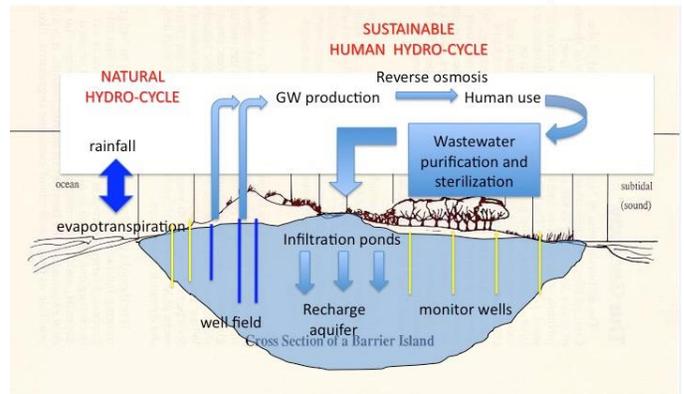
Previously, data like these were used in planning stormwater management strategies west of Muscadine. Understandably, limited attention was paid to areas east of Muscadine in part because there had been only limited flooding observed in these areas prior to Florence and because of later development of the Cape Fear Station area.

Future stormwater planning requires more detailed LIDAR data. The Task Force heartily endorsed the Village Manager’s initiative in commissioning a flyover to gather high-resolution LIDAR data. These data will be used by the stormwater management consultant to generate a detailed topographic map of the island; more importantly, these data allow the identification of natural bowls in the landscape that will collect water and the modeling of the effects of various amounts of rainfall. Finally, refinement of the models guide the placement of any additional proposed stormwater outfalls for either gravity or pumped transfer of stormwaters to ocean or creek.

### **Hydrogeology of Bald Head Island**

Underlying our barrier island is a freshwater aquifer that in many areas of the island has both a shallow and a deep component. Like other aquifers under barrier islands, it is recharged primarily by rainfall but also by return of water through wastewater management strategies such as infiltration lagoons and golf course irrigation using treated wastewater. It is depleted by pumping for drinking water, evaporation, transpiration, runoff, and discharge from the lagoons to Bald Head Creek. The dynamics are illustrated graphically on the right in an illustration from Dr. Paul Hearty’s 2009

Sustainable groundwater resources on barrier and oceanic islands: *The Concept*



description of the Hydrogeology Project.<sup>2,3</sup> A robust, healthy aquifer is essential to keep salt water intrusion at bay; depletion of the aquifer allows the natural pressure of saltwater at the sides of the aquifer to replace the aquifer beginning at its edges. The presence of a limestone ridge under part of the Island also affects the freshwater aquifer.

Information about our aquifer comes from that project and from studies conducted by James Cornette, a licensed geologist and hydrogeologist who serves as a consultant to the Village. The project in turn drew information from a series of test borings that identified the geologic strata at various locations under our island, and from shallow and deep wells at those boring locations and at water production sites around the island.

Many of these well locations are still regularly monitored for water depth and water quality by the Conservancy under contract from the Village.<sup>4</sup> Over a period of several years, the average water elevation in the wells is under 1' Mean Sea Level (MSL) near the BHI Club, about 2' MSL 400-600 yards east and north of the Club, 3-4' MSL near Stede Bonnet, and roughly 6' MSL near the lagoons on holes 13 and 14. East of Muscadine and on Middle Island, well water levels decline to 2-3.5' MSL. These data confirm the "lens" of fresh water with a high point in the middle of the island between Muscadine and Stede Bonnet. At most well locations, levels vary by 3-4 feet throughout the year depending on rainfall, pumping, and other factors.

This high water table under much of the island – a water table that rises yet higher with very heavy rainfall - helps explain how rapidly the soil can saturate during very heavy rains, creating pools of groundwater that will not percolate rapidly into the soil. Indeed, on October 1, 2018, water levels in wells in the center of the island showed water levels that were 3-6' above the customary high levels in those wells, reflecting the dramatic "recharging" of the aquifer to the point of continued ponding and surface flooding. These remarkably high water levels help explain why isolated areas pumped nearly dry would re-fill with water when pumping was stopped. It also has implications for our understanding of the lagoon system.

Water level profiles beneath the BHI surface are dynamic and often change as the navigational channel of the Cape Fear River is deepened or moved, irrigation sources and disposal points are moved, and other changes occur.

### **Lagoons on the Bald Head Island Golf Course**

One of the distinctive features of the island is its system of man-made lagoons. The lagoons contribute to the character and difficulty of the course; they also play vital roles in moving

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<sup>2</sup> Hearty, P.: "Aquifer study: Preliminary results of the Hydrogeology Project (HGP) March-May 2009, Bald Head Island, North Carolina" June 25, 2009, retrieved from [https://www.bhic.org/images/bhiconservancy/media/pdf/Aquifer\\_report\\_Hearty.pdf](https://www.bhic.org/images/bhiconservancy/media/pdf/Aquifer_report_Hearty.pdf)

<sup>3</sup> At that time, Dr. Hearty was Associate Professor in Sedimentary Geology, University of North Carolina at Wilmington, and Director of Conservation, Bald Head Island Conservancy.

<sup>4</sup> Data from BHI Conservancy, June 2019.

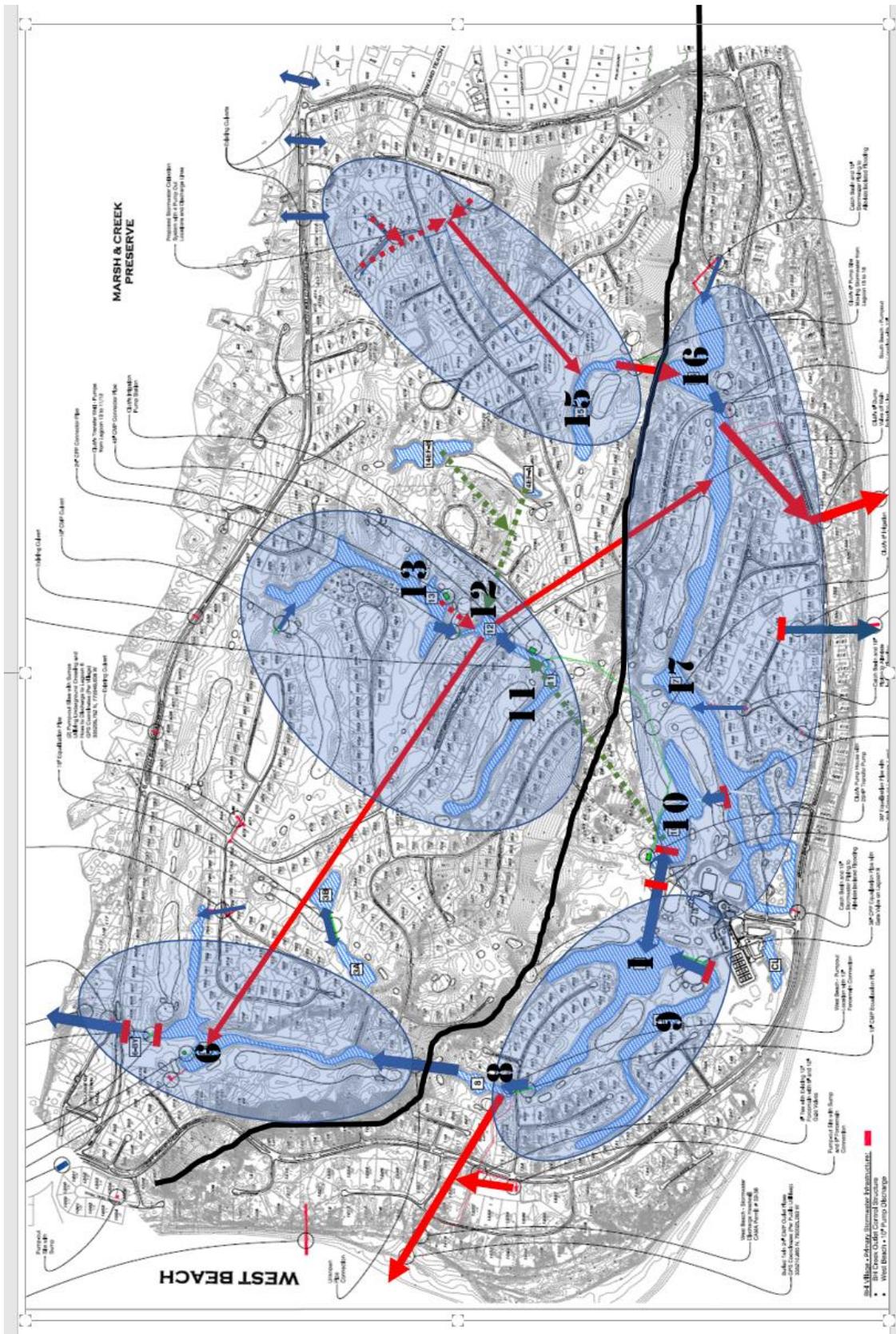
surface water across the island and ultimately off the island by gravity, in managing the wastewater generated on the island, and in irrigating the golf course. There is a map of our lagoon system on the next page.

**The normal flow of water through the lagoon system begins on the ocean side of the primary dune** (represented by a heavy black line). Water from the lagoons 16, 17, and 10 flows through a culvert under the golf course driving range into lagoons 1 and 8; water then flows through a pipe under the primary dune to lagoon 6. At the north end of lagoon 6, water flows into a small “bypass lagoon” and then into the gravity outfall to Bald Head Creek. While a valve controls flow between lagoons 10 and 1, there is no valve controlling the flow of water under the primary dune to lagoon 16. Several of the other connections between lagoons are controlled by gates or valves. Perhaps most importantly, a weir gate at the north end and a gate valve at the south end of the bypass lagoon control the flow of water into the gravity outfall.

**This gravity outfall from lagoon 6 to Bald Head Creek (shown as a thick blue arrow) is vital to floodwater management**, in part because it is the only outfall that is grandfathered and does not require permission to discharge into creek or ocean. However, its design is challenging. The limited elevation differential between bypass lagoon and outfall means that the pressure to move water through the discharge pipe is limited, particularly at high tide. High tides surge up the gravity outfall and very high tides require the weir gate to be closed to prevent saline creek water from entering the freshwater lagoons. In preparation for major storms with high tides and surge, the weir gate must be closed to prevent this backflow. The reality of sea level rise would lead one to conclude this situation will only worsen over time. Obviously, given the current design of the outfall and its manual controls, one of the early actions needed during recovery is to reestablish flow of stormwater out the gravity outfall to the creek. We return to this issue in the recommended actions.

**Lagoons 11, 12, and 13 are key components of both the island’s waste treatment system and the golf course irrigation system**, receiving treated wastewater and then pumping the wastewater and some water from these lagoons into the golf course irrigation/sprinkler system. The water level in these lagoons can be raised to supply water to the golf course spray irrigation system by pumping water from lagoon 10 to these lagoons (shown as a green pipeline). In major events, the irrigation system can move floodwaters from lagoons 11, 12, and 13 to dump valves feeding into lagoon 17 and or lagoon 6, near emergency outfalls to the ocean or creek respectively.

Some years ago, **lagoon 15** became one of the infiltration ponds used by the waste treatment system; at that time three sections of culvert were removed and replaced with concrete to isolate effluent in this infiltration lagoon from the freshwater in lagoons 16 and 17. As part of more recent improvements in stormwater management and wastewater management, lagoon 15 (which had never been continuously utilized for wastewater infiltration) was removed entirely from the Division of Environmental Quality effluent lagoon discharge permit and became the destination lagoon for water pumped from low lying areas along Edward Teach and in particular from Spanish Needles Court and Poorman’s Pepper Trail. However, lagoon 15 remains isolated from the other lagoons and has no natural outflow; there is only a connection (shown on the map as a red arrow) to pump water from lagoon 15 through a pipe under the dune ridge to lagoon 16.



This map of Stage I shows the key features of the lagoon system in normal operation and during stormwater management (red arrow = active pumping; blue arrow = gravity flow).

**The Lagoons and the Aquifer.** The exact relationship between the lagoons and the aquifer has not been fully established. There is good reason to think that the lagoons reflect the actual water table in the areas immediately surrounding the lagoons, and would somewhat reflect the water table on other parts of the island, rising along with the water table (and well water levels) during extended periods of heavy rain and falling along with the water table during periods of drought. For roughly a year beginning in 2013 and again in 2015, the Conservancy has recorded water levels in a small number of lagoons as part of its survey of well water levels, but the data are too limited both geographically and in time to determine how closely lagoon levels mirror well water levels and thus the aquifer. If the levels are related, it is unclear how rapidly the water level equilibrates: are the lagoons closely connected to the underlying aquifer, or does accumulated organic matter slow the flow of water between the aquifer and the lagoon?

**Implications for Lowering the Lagoons in Advance of Major Storms.** Many have asked why the Village and the Club have not acted to lower the water levels in the lagoons in advance of major storms.

In fact, the Village and the Club have worked together in some situations to manage lagoon levels. Most recently, heavy rains in June and July of 2018 resulted in high water levels in the lagoon system. Concerned about the effects of additional rains, the Village and the Club collaborated to lower water levels in the lagoons by opening the gates to the creek outfall. Low rainfall in August further lowered the levels. Had the lagoon levels (and presumably the water table) been left high in July, the flooding from Florence might have been worse.

However, lowering elevated water levels after periods of heavy rainfall is conceptually different than lowering “normal” lagoon levels in advance of a major storm.

- Lowering lagoon levels in advance of a storm would probably have to be accomplished through gravity outfall to the Creek, since the State is highly unlikely to approve pre-emptive pumping into state waters, particularly given the uncertainties involved in predicting storm track and rainfall. The expected denial of pre-emptive pumping would limit the volume of water that could reasonably be removed.
- Can “normal” lagoon levels be lowered independently of lowering the entire aquifer? This question relates to whether the lagoons and the aquifer are closely linked, and water equilibrates rapidly between the two.
  - If they are not closely linked, then lagoon levels could be lowered by 6” or more without immediate effects on the aquifer. But the volumes removed would be low and the net effects on rainfall absorption trivial. Since the surface area of the lagoons only cover about 4% of their basin, a 6” lowering of the lagoons would contain runoff stormwater equal to about ¼” of rain falling over the drainage area of the lagoons.
  - If they are are closely linked, then any lowering of the lagoons would draw water from the adjacent superficial aquifer. While this would improve the ability of the land to absorb rainfall, it is unclear how much water could be removed by gravity over the short period before a known storm arrives.

- Given the uncertainties involved, how would the potential benefit compare with the risk of removing water from the aquifer?
  - The aquifer serves as a source of drinking water and irrigation and in addition keeps the saltwater surrounding the island at bay. Other than the salt water intrusion realized on the southwest side of the island due to the deepening, widening, and eastward shifting of the navigational channel, there has been no evidence in recent years of increasing saline intrusion into our aquifer, suggesting that the aquifer has remained relatively stable (at least in its horizontal extent) and has been protected both by importing water from the Brunswick County system to reduce the demand on the aquifer for drinking water and by re-using the treated grey water produced by our waste treatment system for irrigation.
  - While water levels on the island naturally vary with rainfall by far more than any pre-emptive lowering could produce, if the predicted storm never arrives to replenish the aquifer, the aquifer would have been made more vulnerable to subsequent periods of drought, when saltwater intrusion could shrink our freshwater aquifer.

These issues should be addressed by the stormwater and aquifer consultants. The commitment of all parties, particularly the Village and the Club, to work together is particularly strong at present. If the consultants were to recommend a course of action, there is reasonable likelihood a collaborative agreement could be reached.

### **Managing Stormwater West of Muscadine**

As noted above, the first tool for managing stormwater is to assure optimal flow through the frontal lagoons under the frontal dune and out the gravity outfall to Bald Head Creek. The major deficiencies in this lagoon system are: 1) the limited capacity of the culvert leading from lagoon 6/7 to the bypass lagoon, coupled with the inadequate to non-existent head pressure moving water from the bypass lagoon into the gravity outfall when the tide is high or a surge is present, 2) the need for manual management of the gravity outfall to prevent backflow from the creek into lagoon 6/7, and 3) the lack of control over the flow of water under the primary dune from lagoon 8 to lagoon 6/7 (or in the reverse direction if pumping has lowered the water level south of the frontal dune to below the water level north of the primary dune). However, gravity outfall through the lagoons to the creek is fundamentally limited in what it can accomplish due to elevations and pipe sizes.

Over the years, the Village's stormwater management studies have led to permitting several **emergency outfalls to remove stormwater from the island to South and West Beaches**. Each consists of twin 24" outlet pipes. Of course, the beach end of each of these outfalls must be located and excavated before the outfall can be put into action. Pumped outfalls also require placement of an appropriate pump. State authorities must be notified prior to discharges to public waters.

- The **easternmost outfall** (shown as a thick red arrow) is located just **east of Mourning Warbler**. A pumpout location at the Stede Bonnet end of lagoon 17 has a 12" forcemain connection through which water is pumped to one of the outfall pipes at the castlebox just

off South Bald Head Wynd (pumping is also shown as a red arrow). A 10” pump was in operation at lagoon 17 on September 18, the earliest major pump placement. The second outlet pipe running from the castle box near Mourning Warbler to the beach outfall is not currently used.

- The **next outfall** (shown as a thick blue arrow) is just south of the intersection of **Black Skimmer Trail** and South Bald Head Wynd. Historically, this pair of pipes has not been used; the landward ends of the pipes have bolted caps that were underwater after Florence. To move water off the island more rapidly, one of the caps was unbolted with difficulty on September 21, and water flowed by gravity through the one outfall pipe to South Beach. The Village is already working with Island Contracting to convert the bolted caps to sluice gate like closures to allow easier operation in the future to remove floodwaters from this area along South Bald Head Wynd.
- The **third outfall** (shown as a thick red arrow) runs from a stormwater discharge headwall off **Cape Fear Trail** to West Beach. One of the outfall pipes has never been used; the other outfall pipe receives water pumped from two locations (shown as red arrows). There is a pump-out site with an 8” forcemain connection near the intersection of **Horsemint and West Bald Head Wynd**, where a 6” pump began operation on September 18<sup>th</sup> to try to lower flood levels in the area. There is a larger pumpout with a 12” forcemain connection on **Horsemint Trail at lagoon 8**, but the 10” pump could not be placed here because of the depth of the floodwaters. By September 20<sup>th</sup>, water levels in the area were low enough that the pump could be placed at the Horsemint site and begin pumping.
- The fourth outfall (indicated by a thick blue arrow) was designed to allow stormwater to flow by gravity from a location **between Cape Fear Trail and Seagull Trail** to the outfall on West Beach. This outfall has never been used during a flood event.

Several additional strategies move water from flooded areas west of Muscadine to the lagoon system for subsequent discharge through outfalls.

- A **pump on the pumping pad at the south end of lagoon 15** pumps water through the primary dune to lagoon 16 (pumping shown by a red arrow); from that location it can flow to lagoon 17 and be pumped to the South Beach outfall. This pump placement was delayed several days because of significant flooding along all routes between the Golf Course Maintenance facility (where the pump was stored) and lagoon 15. The pump was placed with some creative route-finding and began operating September 21. Reopening the culvert under the primary dune would allow water to flow between lagoons 15 and 16/17. With this connection re-established, the pump moving floodwater from lagoon 17 to the South Beach emergency outfall would also draw floodwater from lagoon 15, without the need for active pumping through the dune ridge.
- The **Club’s irrigation system pump can be used to pump floodwater from Lagoon 11** through the irrigation system pipes to “dump valves” at Lagoon 6/7 (from which it can flow into Bald Head Creek through the gravity outfall) and at lagoon 17 (from which it

can be pumped to the outfall on South Beach). (These routes of discharge are shown as red arrows.) The activation of this pump was delayed by the absence of power. Duke Progress and the Club worked to restore the electrical power to the pump as early as possible during recovery, before other parts of the grid could be safely energized. The pump power was restored temporarily on September 24<sup>th</sup> and 25<sup>th</sup> and fully on September 26<sup>th</sup>. Floodwaters could then be pumped from the irrigation lagoons to lagoon 17 and then from there to the emergency outfall on South Beach.

### **Emergency Breaches in the Frontal Dune**

Because of the profound flooding in areas without stormwater management infrastructure, several dunes were breached to allow stormwater to flow to the ocean. The dune in the vicinity of Green Teal Trail was breached on September 21 to handle severe local flooding. To remove floodwaters between the primary and frontal dunes east of Muscadine, where there is no stormwater management infrastructure, the frontal dune was cut in the vicinity of Brown Pelican, Scotch Bonnet, Killegray Ridge and Inverness Way between September 24<sup>th</sup> and 26<sup>th</sup>.

### **Managing Stormwater East of Muscadine**

The Village has had limited experience with flooding east of Muscadine. Because most of the early development on the island was in Stage I west of Muscadine, earlier stormwater management plans dealt only with those areas. Florence revealed or re-emphasized stormwater problems in many areas east of Muscadine, including a few areas south of the primary dune near Braemar, Federal Road near Kinnakeet, the intersection at the Conservancy, and some road sections in Cape Fear Station. Pumping from Braemar and nearby areas to the beach, pumping from the Federal Road through the maritime forest and across the dune to the beach, and a breach in the dune were ad hoc components of a developing plan. Careful study of the topography of the area will be the crucial first step to developing appropriate actions to mitigate flooding in these areas.

### **Stormwater Drains**

At one point, a question was posed about developing a system of stormwater drains. A conscious decision by the developer led to the use natural drainage, low density of development with limited impervious surfaces, and no stormwater drain system. Under normal conditions, this approach to stormwater helps assure that stormwater is retained on the island to recharge our precious freshwater aquifer, whereas stormwater drains would divert the freshwater to the sea or creek. While that decision perhaps complicates stormwater management, it also provides the advantage not only of recharging the aquifer but also of minimizing ongoing point discharges to the beaches that have become chronic problems for some other municipalities.

### **New State Guidance (perhaps) and a Floodwater Management Discharge Plan**

Previously, opening outfalls and initiating floodwater pumping were governed by very restrictive state rules; in essence, public roads had to be flooded beyond a certain depth. Recently, considerably more appropriate draft Floodwater Pumping Discharge Guidelines were circulated

(but never finalized). These guidelines would focus pumping decisions in emergencies on whether health and safety are endangered by the flooding.

The new draft guidance sets forth the required components of a **Comprehensive Floodwater Management Discharge Plan**, including data on the need for and design of pumping structures, objective criteria to determine what constitutes emergency flood stage conditions, a pumping protocol, a water quality monitoring regime, and the adoption of best management practices. We expect the floodwater management studies recommended below will lead to the development of such a plan – and particularly the identification of objective markers triggering opening the beach outfalls (or in the most serious circumstances, breaching the dunes). The use of objective criteria may speed both local decision-making and the issuance of permissions by government authorities.

### **RECOMMENDED ACTIONS:**

- 1) Study the topography of the entire island and develop a new stormwater management plan (Jeff Petroff)**
  - a. Acquisition of detailed LIDAR data to allow development of topographic maps and modeling of stormwater dynamics (Village funded and performed the LIDAR acquisition earlier this year; no future budget implications).
  - b. Identification of natural basins based on LIDAR data (underway).
  - c. Refinement of the models to reflect connections between natural basins and modeling of various stormwater events and management strategies.
  - d. Development of detailed recommendations about possible improvements in stormwater management on the island, including:
    - i. design of changes in the Bypass Lagoon and weir gate providing gravity discharge to Bald Head Creek.
    - ii. design of additional outfall(s) to South Beach, allowing gravity flow or pumping of water from areas east of Muscadine in front of the primary dune.
    - iii. determination about how to handle stormwater accumulations at multiple sites east of Muscadine and north of the primary dune, particularly those associated with flooding on Federal Road near Kinnakeet, on Federal Road at the Conservancy, and in Cape Fear Station, specifically whether pumped stormwater could be directed to Bald Head Woods, to Bald Head Creek, or to South Beach and the Atlantic Ocean.
    - iv. evaluation of the culverts under North Bald Head Wynd and Federal Road to determine whether they should be cleared, closed, or fitted with weir gates or one-way valves.
    - v. evaluation of the intersection of North and West Bald Head Wynds for potential drainage improvements.
  
- 2) Develop a Floodwater Management Discharge Plan for submission to the State that balances economic, public health, public safety, and environmental concerns (Jeff Petroff).** Although part of the overall stormwater management consultant

contract, the importance of this product warrants identification as a separate Recommended Action.

**Estimated contract cost for these two linked recommendations in FY 2019/20: \$80,000**

**3) Study the aquifer to understand the complex interactions between the aquifer and both the surrounding bodies of saltwater and the surface waters of the island, including the lagoons (Jim Cornette)**

- a. Evaluate existing longitudinal data from the various production and monitoring wells on the island;
- b. Perform experimental interventions and measurements that might provide additional information about aquifer dynamics, including the effects of drinking water pumping and pumping from the lagoons on water tables and saltwater intrusion;
- c. Determine whether additional monitoring wells would provide important additional information about the aquifer;
- d. Consider specifically the likely effects of lowering the lagoon levels in advance of storms, including whether the lagoons would rapidly refill from other sources of water, whether the pumping would promote saltwater intrusion under the island, and whether the effect (if any) of establishing a policy of precautionary lowering of the lagoons would be trivial or significant; and
- e. Understand seasonal and storm-related changes in the elevation of the freshwater lens across the entirety of the Island. Understand the size/depth of the freshwater aquifer and monitor changes therein to better understand the impact of sea level rise.

**Estimated contract cost in FY 2019/20: TBD soon - estimate requested from consultant**

### **New or Reactivated Primary Outflow Sites**

Establishing additional primary outflow sites (in addition to the gravity outfall to the Creek, the two pumping sites at Horsemint and Lagoon 17, and a gravity flow emergency outfall on South Beach near Black Skimmer) is both very high priority and complicated by the state permitting process. Nonetheless, establishing additional outfalls is essential to managing stormwater.

#### **RECOMMENDED ACTIONS:**

- 4) Establish new outfalls in areas along South Bald Head Wynd east of Muscadine (Peppervine/Coquina/Brown Pelican and/or Seaton/Dunedin).** Natural basins located along South Bald Head Wynd between the primary dune and the frontal dune trapped a huge amount of stormwater. Ultimately, the only way to clear the area of stormwater and restore passage along South Bald Head Wynd was to breach the dune to allow water to flow by gravity from the natural basin to the sea, rebuilding and replanting the dunes afterward. The best location for outfalls and whether they are

gravity outfalls or pumping sites will depend on the stormwater studies planned in the coming year and the resulting Emergency Stormwater Pumping Plan. They are a high priority that we have priced as a single emergency outfall with a 10” pump and accessories, realistically scheduled for FY 2020/21. (Note: One or more of these outfalls may also be used to serve sites near Federal Road north of the primary dune.)

**Estimated cost in FY 2020/21: \$150,000 for emergency outfall, \$100,000 for 10” pump and accessories**

- 5) **Reestablish the emergency gravity outfall between Cape Fear Trail and Seagull Trail.** This outfall is shown as twin 24” Corrugated Metal Pipe outlet pipes running from common area between the roads under the frontal dune to West Beach. If properly equipped, it could augment the removal of water from this northernmost area between the primary and frontal dunes. It has not been used in any recent stormwater event but could provide an inexpensive way to enhance stormwater removal capacity through gravity flow and an alternative to breaching the dune. Infrastructure like that used for the South Beach gravity-fed outfall would presumably be installed at the landward end.

**Estimated cost (FY2019/20): \$10,000-\$20,000.**

- 6) **Reestablish the capacity to use both pipes of the emergency gravity outfall across from Black Skimmer Trail. Only one of these outfall pipes was opened after Hurricane Florence. We recommend consultation to determine whether any physical changes are needed to facilitate the use of both 24” outfall pipes during a major flooding event.**

**Estimated cost (FY2019/20): Uncertain, but relatively minor. Possibly only operational changes are needed.**

### **Redesign of Bypass Lagoon 6**

**Increasing the flow of stormwater from the lagoon system to Bald Head Creek is a high priority.** Bypass Lagoon 6 and its associated weir gate and gate valve are on the path of water flowing from the entire lagoon system in front of the dune ridge into Bald Head Creek. This discharge path has been grandfathered and is both the normal path for water from the lagoon system to be directed off the island and a major path for stormwater accumulations to flow off the island by gravity. Management of this path using weir gates and gate valves has proven problematic because 1) the 24” diameter of the pipe connecting Lagoon 6 with Bypass Lagoon 6 limits flow to the 36” outfall pipe, and 2) the flow of stormwater out of the Bypass Lagoon is limited by the low elevation of the lagoon and is zero when high tides or storm surges in the creek require the weir gate to be closed to prevent backflow. During the initial week after Florence, water was so high in the lagoons that water flowed over the cart path and was not limited by the 24” pipe from lagoon 6 to bypass lagoon 6. By the 24<sup>th</sup>, water levels in lagoon 6 had decreased. The club weir gate was opened, and water began flowing through the 24” pipe into the bypass lagoon and creek. At that point, the 24” pipe was a limiting factor in the flow, so

a pump was added to move additional stormwater from lagoon 6 to bypass lagoon 6, from which it flowed through the 36” pipe to the gravity outfall to the creek.

At this point in the recovery, high tides in the creek slowed the flow from the bypass lagoon to the creek but were not high enough to produce backflow of creek water into the lagoons. In general, however, the magnitude and timing of storm surges are difficult to predict, and thus the combined effect of surges and tides affecting the height of the creek water is also difficult to predict. A strategy is needed to monitor water levels in the creek and to improve our management of the bypass lagoon and weir gate to speed the removal of stormwater and to prevent any backflow of creek water into the lagoon system. Opening this outfall at the earliest time possible after a storm is a key component of stormwater removal. Remote monitoring with automation is one option; earlier 24/7 staffing after a major storm is another.

### **RECOMMENDED ACTION:**

- 7) Redesign and rebuild Bypass Lagoon 6 and its associated weir gates.**
  - a. The pipe from Lagoon 6 should be increased to 36” and the weir gate replaced with a control valve (or one-way flow valve if it does not restrict maximum flow).
  - b. Increase the height of the berm surrounding Bypass Lagoon 6 so during flooding, supplemental pumping into the Bypass Lagoon can raise the level of the lagoon and increase the rate of stormwater discharge through the outfall.
  - c. Consider remote methods or earlier 24/7 staffing to control the height of the weir gate. The weir gate is routinely closed before a major storm to prevent backflow into the lagoon system. The more rapidly it can be opened after the threat of backflow from storm surge or very high tides has passed, the more rapidly water can be removed from the island using gravity flow through the Creek outlet ditch.
  - d. Consider whether a fixed pump that could operate automatically would facilitate removal of stormwater.
  - e. Consider other alternatives that would allow for 24/7 stormwater removal through the gravity outfall, including alterations to the ditch opening into the creek.

**Estimated cost of the full project, possibly in 2019/20: Depending on degree of re-design, decisions about a pump, and automation/remote control of valves and pumps, between \$25,000 and \$200,000.**

### **Lagoon System Projects**

The lagoon system is central to routine and emergency stormwater management west of Muscadine, to irrigation of the Bald Head Island Club golf course, and to the dispersal of gray water from the Village wastewater treatment plant. Specific infrastructure projects would improve the Village’s ability to manage flooding and stormwater removal by improving and controlling interconnections among the five lagoon systems: South Beach lagoons 16, 17 and 18; South Beach Lagoons 1, 9, and 8; Lagoon 6; the irrigation system lagoons 11, 12, and 13; and Lagoon 15, including Spanish Needles and Poorman’s Pepper Trail. We propose several projects to measure, improve, and control the flow of stormwater between lagoon systems.

## RECOMMENDED ACTIONS:

- 8) **Improve connection from Lagoon 3 to Lagoon 6/7 to facilitate removal of floodwater in the area around Lagoon 3 that has no natural drainage.** There is a saddle between Lagoon 3 and the ditch leading to Lagoon 6/7. Installing an overflow pipe from slightly above the natural elevation of Lagoon 3 under the saddle to the ditch and clearing the ditch would establish a natural path for water to move from Lagoon 3 to Lagoon 6/7 to the Creek Outfall.

**Estimate of project cost: \$10,000-\$20,000 in 2019/20**

- 9) **Install catch basin at intersection of Edward Teach and Sandwich Tern and feed into phase 3 pipe across Edward Teach. Install catch basin on Stede Bonnet at low point just south of the primary dune and pipe to drain into Lagoon 17.** This location is a natural bowl that collects water and floods the wynd.

**Estimate of project cost: \$20,000-30,000 in 2019/20**

- 10) **Reestablish connection from Lagoon 15 under the primary dune to Lagoon 16.** Currently, a portable pump must be placed to move water from the landlocked lagoon 15 system (serving areas on either side of Edward Teach just west of Muscadine) to the front lagoons where it can be pumped to the ocean outfall. Flooding made this placement impossible until landfall +7 days (Friday, September 21). Reestablishing a connection between Lagoons 15 and 16 would decrease reliance on placing a pump while increasing our stormwater removal capacity.

- a. Evaluate the condition of the pipe and feasibility of installing a control valve.
- b. If pipe is in reasonable condition and a valve can be placed, remove the sections of the pipe filled with concrete (previously placed to block flow from Lagoon 15 when Lagoon 15 was used as a waste treatment retention lagoon) or install a parallel pipe, ensuring proper gravity flow from 15 lagoon to 16 lagoon. Also, install a control valve to be operated only by the Village.
- c. Project is not felt to be dependent on stormwater studies, unless a valve is impractical, in which case the effects of reopening the pipe without a valve should first be evaluated.

**Estimate of full project cost: \$100,000 to \$150,000 in 2019/20**

- 11) **Improve and control the flow from lagoon 8 under the primary dune to Lagoon 6/7.**

- a. Locate the pipe and clear both openings.
- b. Evaluate the condition of the pipe, determine adequacy of flow through the pipe, and, if feasible, install a control valve to be operated by the Village.
- c. Project is not felt to be dependent on stormwater studies.

**Estimate of full project cost: \$50,000 in 2019/20**

## **Federal Road and Cape Fear Station**

Areas of substantial flooding occurred during Hurricane Florence, including Federal Road near Kinnakeet, Federal Road at the Conservancy, and areas in Cape Fear Station. Various options have been identified, including pumping stormwater to Bald Head Woods, to Bald Head Creek, or to South Beach and the Atlantic Ocean.

### **RECOMMENDED ACTIONS:**

- 12) Address stormwater flooding along Federal Road near Kinnakeet and at the Conservancy and in Cape Fear Station.** The nature and cost of the projects addressing these areas will emerge from further study and evaluation of the LIDAR mapping and exploration of permitting options.

**Estimate of project cost: \$100,000-200,000 in FY 2020/21**

- 13) Improve and/or install culverts under North Bald Head Wynd beginning at the intersection of West Bald Head Wynd and heading eastward along-Federal Road.** These will be evaluated to determine whether they should be cleared, closed, fitted with weir gates or one-way valves, or modified in other ways improve stormwater flow off the Island.

**Estimate of project cost: \$75,000 in FY 2020/21**

## **Middle Island**

The forest section of Middle Island is a 2-mile long dune ridge with little flooding of the landscape. The primary threat long term comes from rising sea levels and higher storm surges that may damage the gravel roads running alongside Bald Head or Cape Creek. No stormwater management activities are called for at this time. However, storm damage in the maritime forest can be significant. FEMA's Private Property Debris Removal program specifically authorized reimbursement of municipalities for funds spent collecting storm debris from the right-of-way of private roads, on the same terms that the debris is collected from Village rights-of-way.

### **RECOMMENDED ACTION:**

- 14) Adopt the ordinance authorizing the Village to remove debris from both public and private rights-of-way following the declaration of a state of emergency.**

## **Other Isolated Areas with Stormwater Accumulation**

We expect the stormwater modeling studies to identify other isolated areas that may benefit from pumping, either as part of the Village system if it serves large areas including municipal assets or as private pumping arrangements serving a limited number of private properties. Budgets cannot be established at this time.

Some areas are already known to be subject to significant, but local, ponding. These are often limited to a single property or a small group of properties with no Village rights-of-way involved that would justify Village intervention. In these situations, property owners should be able to get approval to pump ponded water, provided the pumping does not create or exacerbate flooding problems elsewhere. Currently, each episode requires the Development Director / Building Inspector to inspect and approve the pumping and the destination. Similarly, owners should be able to get approval to fill low-lying areas that are not wetlands, provided the fill does not create or exacerbate flooding problems elsewhere.

**RECOMMENDED ACTION:**

- 15) Private Pumping Arrangements.** The Village should develop a process to pre-approve certain pumping arrangements, including the routing and destination of the discharge hoses, so that property owners can send email notification and begin pumping during a local flooding event.

**STORM DAMAGE AND STORMWATER MANAGEMENT:  
OPERATIONAL ISSUES**

Since speeding the removal of floodwaters is the primary means of speeding the island’s recovery from a major flood event, the Task Force examined operational changes that could speed removal of floodwaters and reduce the time required to re-establish “routine” Village operations.

**Later Departure of a Final (staff only) Ferry from the Island**

In this unusual situation, a later departure from the island may have allowed reconsideration of the staff evacuation, since Florence had dramatically decreased in intensity by the afternoon. The timing of the last ferry is influenced by many factors, including the predicted arrival of gale strength winds. Time is usually built into the evacuation schedule to allow relocation of the ferry to a more secure location if necessary. Decisions obviously must be based on available information (rather than hindsight). It is unclear how often a later departure, were it possible, safe, and permitted by the Coast Guard, would affect other operational decisions.

**Staff Remaining on the Island**

One of the most powerful ways to speed recovery is to have core staff remain on the island that would perform preliminary clearing of North Bald Head Wynd and manage the weir gate at the creek outfall. In some cases, pumps could be placed and begin pumping earlier. The call for full evacuation of the island including all Village staff was based on safety considerations in the face of a Category 4 hurricane, and we do not question that decision, particularly since storms could strengthen further approaching land. However, raising the question of the criteria that will determine whether staff remain on the island in advance of other storms revealed some uncertainty about the design strength of the as-built Public Safety complex. To reduce the total cost of the building, parts of the building were changed from brick and mortar construction to

framed construction. The modified building was designed to withstand 3-second wind gusts of 160 mph, but the Task Force is still unclear about the design strength for sustained winds (on which the Saffir-Simpson Scale is based). Given the substantial expenditure to create a high quality facility that could shelter staff and serve as the Emergency Operations Center during an emergency, there should be a definitive answer about the design strength of the building in sustained hurricane strength winds so the incident commander can make an informed decision about staffing the island during a storm and so we can have confidence that staff will be able to remain on the island in a safe structure during that storm.

#### **RECOMMENDED ACTION:**

**16) Assessment of the Design Strength of the As-Built Public Safety Building.** The Village should have the engineering firm involved in the design of the building provide a written assessment of the ability of the as-built Public Safety building to withstand severe weather events including Category 2, 3, and 4 hurricanes and to provide safe shelter to staff during those events.

#### **Pre-placement of Assets**

The Task Force considered whether pre-placement of assets would be advisable to speed initial recovery actions, including:

- what equipment (if any) should be prepositioned at the ferry terminal if all staff are evacuated from the island, including road clearing equipment and high-water vehicles;
- under what circumstances should pumps be pre-positioned at key pumping locations, particularly:
  - the pump at lagoon 15 that was the last major pump placed because access routes were flooded (pumping operations could not begin until September 21). This pump sits in a relatively protected location behind the primary dune – but the need for this pre-placement would be eliminated by opening the culvert under the primary dune that connects lagoon 15 to lagoon 16, a preferable long-term solution.
  - the pumps at lagoon 17 and at Horsemint. These locations are considerably more exposed to winds and subject to storm surge and flooding. Reducing the risk of damage to preplaced pumps might require hardened, elevated structures. The value of a one- to two-day earlier start to pumping during relatively rare and specific circumstances is unclear when weighed against the aesthetics, cost, and risk to the equipment.
  - Consideration should be given to forecasted conditions and when appropriate, pumping operations begun on the back end of the event, even if it is still raining, in order to reduce flood potential and speed recovery.

#### **RECOMMENDED ACTION:**

**17) Pre-placement of assets.** In revising the Emergency Management Plan, the Village should re-evaluate the circumstances, if any, in which assets should be pre-placed either at the Marina or at pumping locations in advance of expected wind events or rain

events, and whether any further improvements to pumping locations would be desirable and cost-effective. (Naturally, although guided by the EMP, these operational decisions remain game-time calls.)

### **Earlier Staff Return after an Evacuation**

If staff do not remain on the island, are there steps that would facilitate an earlier return under most circumstances? In general, this has not been an issue for most storms, but the unique combination of massive rainfall, road and bridge damage, and road flooding hampered early return. Asking a core staff to remain at the mainland EOC facility is one option. The other key element of an early return is the ferry – how early will the Captain of the Port allow a ferry run of first responders after the event<sup>5</sup>, and how available will a core group of Ferry Transportation staff be immediately after a storm? What other non-ferry options exist or could be established/secured?

#### **RECOMMENDED ACTION:**

- 18) Earlier staff return after an evacuation.** Work closely with BHI Transportation or the Ferry Transportation Authority to assure the availability of both a vessel and staff to facilitate a return to the island at the earliest time allowed by the Captain of the Port. Consider alternative means of staff reentry by private boat or by land if ferry operations are delayed. Consider how to staff the island with a core crew 24/7 at the earliest feasible time in order to continue clearing the roads and managing the weir gate.

### **Earlier Overnight Staffing to Manage Weir Gate**

Because storms are often accompanied by higher than usual tides due to storm surge or increased flow in the Cape Fear River, the weir gate at the gravity outflow needs regular monitoring and adjustment to assure optimal flow of stormwater out the creek outfall, particularly during an island flooding event such as Florence. If the bypass lagoon is redesigned, staffing or reliable remote-control operation will facilitate its efficient operation.

#### **RECOMMENDED ACTION:**

- 19) Earlier overnight staffing to manage weir gate, if remote monitoring and valve control are not installed.** In a flood event, plan on early overnight staffing to manage stormwater removal. Because safety is vital, determine the criteria for safe overnight staffing, including reliable emergency communications with the mainland, generator power, and availability of drinking water.

### **High Water Vehicles**

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<sup>5</sup> See “Closure of the Cape Fear River and Marinas” on page 35 for further information about how the Captain of the Port regulates commercial/ferry operations on the Cape Fear River before, during, and after a storm, and who controls the use of the marinas during a state of emergency.

The arrival of additional high-water vehicles improved operations during recovery. During flood conditions, they allow easier and more efficient transportation of staff to work sites and would also facilitate earlier day visits or returns by full-time residents to begin mitigation efforts on their primary home.

**RECOMMENDED ACTION:**

- 20) High-water vehicles.** Either acquire a surplus high-water vehicle or formalize arrangements with the National Guard or other sources for access to one or more vehicles early in a significant flood event. In addition to their vital role during prolonged and deep flooding, high-water vehicles could also be useful for beach access from Fort Fisher in the event of a delay in establishing emergency ferry service.

**Earlier Breaching of the Frontal Dunes**

In these extreme flood conditions, the most rapid and effective way to move hundreds of millions of gallons of water is to breach the frontal dune at strategic locations. It is our expectation that the stormwater studies will identify floodwater volumes that will require this intervention, and the geographic markers that indicate flooding of that severity. These criteria can then be incorporated into the Floodwater Management Discharge Plan that will be developed as part of the recommended stormwater studies.

**RECOMMENDED ACTION:**

- 21) Breaching the frontal dunes.** Incorporate criteria with input from the State for flooding severe enough to justify breaching the frontal dune into the Floodwater Management Discharge Plan. Consider whether there are alternate operators should the contractor not be able to get to the island to operate the construction equipment used to breach the dune, and whether such arrangements for operation of the contractor's equipment should be incorporated into the agreement with the contractor. Alternatively, the Village could determine whether Public Works equipment and staff can breach the dunes if necessary.

**DISASTER PLANNING AND DECISION-MAKING**

The processes for disaster planning and decision-making are well established. An "All-Hazards" approach is mandated. BHI is a barrier island with restricted access and limited personnel and equipment response resources. BHI Village bears the primary responsibilities for maintaining and restoring public services. Private property owners are primarily responsible for their privately held properties. Prompt, effective response and speedy recovery is the result of critical thinking planning done over the years. Protection of lives and property begins at the local level where the emergency impact is felt immediately.

The historic levels of rainfall from Hurricane Florence overwhelmed much of the island's infrastructure and the resulting lessons learned caused the island to re-think its topography, hydrology, utility infrastructure, EOC staffing, and potential vulnerability to future hurricanes and other non-weather events. Hurricane Florence impacted BHI public infrastructure primarily with floodwaters while impacting private residences primarily with wind-blown rain. Future disasters may not bear any resemblance to Hurricane Florence.

The tasks assigned to the Disaster Planning and Decision-Making Group were to review the preparation and response to Hurricane Florence by BHI Village and by private property owners and to recommend how we all may be better prepared to respond to future events, including hurricanes and other possible disaster events.

It is clear that neither the Village nor most others in southeastern North Carolina anticipated and planned for the unprecedented, record-breaking deluge. While the Village's disaster planning was well-designed to deal with a significant wind event, key aspects of the planning were not well suited to an event characterized primarily by massive flooding, with property damage caused primarily by wind-driven rain and standing water rather than by high velocity winds. The Village staff adapted well to the unexpected challenges, but the event revealed shortcomings in the Village's disaster planning that should now be addressed.

### **Bald Head Island Emergency Management Plan**

The Bald Head Island Emergency Management Plan (EMP) was used by the Emergency Operations Center team to prepare for, and respond to, flooding and damage from Hurricane Florence. The plan states that its primary emphasis is on destructive weather events directly related to storm systems and that it will facilitate effective mitigation of destructive weather or "other events." The Incident Commander indicated that the plan generally served its purpose but wasn't designed to handle a historic flood event like Hurricane Florence. Also, it does not address other non-weather events such as fires, cargo vessel spills, tsunamis, or chemical/radiological events. It is clear that these other disasters require different preparation and education prior to an event and call for different communications and disaster responses should such an event occur. The Incident Commander has considered many of these other disaster scenarios and thought about the adaptations necessary to respond to them. At this point, a formal process is needed to consider each scenario and to develop a modified EMP with modules/appendices/scenarios addressing these different disasters. Considering a broader range of disaster scenarios will also require reconsideration of how we evacuate the island in response to different disaster scenarios, including reconsideration of other land and non-ferry options to get on and off the island.

In addition to planning for a variety of known but less-likely events, disaster planning will need to take into account the best scientific evidence about sea level rise and possible worsening of storm severity, as discussed later in this report (please see "Beyond 2021: Long Term Planning Issues" beginning on page 52).

The plan contains very useful checklists for various Alert Levels and many of the elements needed for emergency response related to destructive weather events. We have provided the

Village with notes from our review of the EMP that may be useful during the revision of the EMP that is now underway.

### **RECOMMENDED ACTIONS:**

- 22) Conduct a BHI All-Hazard and Vulnerability Analysis** to determine future risks from hurricanes, flooding, tsunamis, fires in the maritime forest, cargo vessel and oil spills, radiological events, etc., and determine if the island is prepared and equipped to protect people from such events.
- 23) Update and expand the Emergency Management Plan** to cover the other emergencies identified in the All-Hazard and Vulnerability Analysis. The Town of Carolina Beach Emergency Operations Plan shared by the BHI Village Manager is one example of a plan that contains multiple annexes, covering several types of events. Special attention needs to be given to evacuation strategies in different scenarios: in the event of a tsunami warning, where no evacuation is possible; in the event of a maritime forest fire, where the fire may prevent travel to the Marina; or in the event of radiation release from the Brunswick Nuclear Power Plant, where sheltering in place may be the optimal response.
- 24) Update the Emergency Management Plan to be more compatible with the National Incident Management System (NIMS).** The NIMS provides a comprehensive, nationwide, systematic approach to incident management, including the command and coordination of incidents, resource management, and information management. It also standardizes emergency response terminology, which makes it easier for emergency response personnel and organizations to communicate.
- 25) Establish Mutual Aid and First Right of Refusal agreements** with other counties/organizations to quickly obtain emergency assistance in the form of personnel, equipment, materials, and other services during future events. These types of agreements are especially critical for emergencies requiring immediate assistance, such as fires, spills, etc. Various types of mutual aid agreements are identified at: <https://emilms.fema.gov/IS703A/RES0102130text.htm>
- 26) Conduct well-planned emergency exercises** (drills and tabletop exercises) with BHI Village, BHI Limited Transportation, and volunteer staff to test the Emergency Management Plan, exercise participants, and emergency preparedness capabilities.
- 27) Engage federal and state agencies** to discuss early actions that may be allowed to enhance planning and preparation for future flood disasters.

### **Population Preparedness**

Resources to educate property owners about how to prepare for various disaster are readily available on the internet but do not necessarily address the unique challenges presented by Bald Head Island. A guide to optimal insurance coverage on barrier islands would be helpful as a

resource when binding or renewing insurance coverage. A guide to hurricane preparations, particularly when evacuation is mandatory, would also be useful, covering issues such as removing perishables from refrigerator and freezer, preparing low-lying structures, and considering where a golf cart would be least exposed to risk. And resources for “after-the-fact preparedness” would be invaluable, covering assessing and documenting storm damage, choosing contractors for remediation and restoring, and dealing with insurance companies.

This educational effort does not necessarily involve creation of new educational materials, although some publications or videos specific to the island would be highly desirable, describing hurricane categories and impacts, policies for evacuation and re-entry, and other pertinent information and educating homeowners on proactive steps they can take to lessen storm damages. Similarly, this does not need to be primarily a Village activity hosted on the Village website, although the Village will have the unique ability to convey information through a screen crawl on all cable channels on the island and, potentially, the governmental access channel made available by Spectrum (see the Communications section of this report).

**RECOMMENDED ACTION:**

- 28) Convene a meeting of communications staff from key island entities to discuss how to educate property owners on a wide range of disaster preparedness issues.**

**Operational Preparedness**

The existing EMP provided reasonable guidance in preparing for the hurricane. The checklists again proved a useful tool, although other types of disasters will obviously require different checklists and different preparations.

Overall preparedness of personnel can be enhanced through the following training.

**RECOMMENDED ACTIONS:**

- 29) Identify and train backup staff members for each critical EOC member.** This assures that more than one person can fulfill the function in the event of vacation or illness, or during longer-term emergencies requiring 24/7 coverage that will require two shifts. Backups also avoid gaps with sudden retirements, job changes, etc.

- 30) Consider requesting training support** from the Community Emergency Response Team (CERT). Educate/train private property owners by incorporating year-round CERT Program into existing Public Safety Programs.

- 31) Evaluate training needs for all emergency personnel and volunteers.** Consider specifically the following training for emergency personnel and elected/appointed officials.

- **Everyone involved in emergency management** (to include emergency operation center personnel in support of the field), regardless of discipline or level of

government, should **consider completing the following NIMS baseline curriculum courses** (IS-700.b and IS-100).

- IS-100.c Introduction to the Incident Command System - This course introduces the Incident Command System (ICS) and provides the foundation for higher level ICS training. The course describes the history, features and principles, and organizational structure of the Incident Command System. It also explains the relationship between ICS and the National Incident Management System (NIMS).
  - IS 700.b An Introduction to the National Incident Management System - This course provides an overview of NIMS. NIMS defines the comprehensive approach guiding the whole community - all levels of government, nongovernmental organizations (NGO), and the private sector - to work together seamlessly to prevent, protect against, mitigate, respond to, and recover from the effects of incidents. The course provides learners with a basic understanding of NIMS concepts, principles, and components.
- **For elected and appointed officials on BHI, the following training should be considered:**
- GO-402 Incident Command System (ICS) Overview for Executives/Senior Officials - This course provides executives and senior officials (including elected officials, city/county managers, agency administrators, etc.) an orientation to the Incident Command System (ICS).
  - GO-191 Incident Command System/Emergency Operations Center Interface - The course provides an opportunity for emergency management and response personnel to begin developing an Incident Command System (ICS)/Emergency Operations Center (EOC) interface for their communities. The course reviews ICS and EOC characteristics, responsibilities and functions and depends heavily on activities and group discussions to formulate an interface. This course works best when delivered to Incident Command System and Emergency Operations Center personnel from the same community.
- **Consider the following Professional Development Series** of seven online Emergency Management Institute independent study courses that provide a well-rounded set of fundamentals for those in the emergency management profession.
- IS-120.c An Introduction to Exercises
  - IS-230.d Fundamentals of Emergency Management
  - IS-235.c Emergency Planning
  - IS-240.b Leadership and Influence
  - IS-241.b Decision Making and Problem Solving
  - IS-242.b Effective Communication
  - IS-244.b Developing and Managing Volunteers

- **Consider other free, online Emergency Management Institute (EMI) Independent Study Courses.**
  - IS-42: Social Media in Emergency Management
  - IS-120.c: An Introduction to Exercises
  - IS -235.c: Emergency Planning
  - IS 241.b: Decision-Making and Problem Solving
  - IS-244.b: Developing and Managing Volunteers
  - IS-271.A: Anticipating Hazardous Weather & Community Risk
  - IS-320: Wildfire Mitigation Basics for Mitigation Staff
  - IS-322: Flood Mitigation Basics for Mitigation Staff
  - IS-3: Radiological Emergency Management
  - IS-326: Community Tsunami Preparedness
  - IS-554: Emergency Planning for Public Works
  - IS-706: NIMS Intrastate Mutual Aid - An Introduction
  - IS-775: EOC Management and Operations
  - IS-1024: Water and Wastewater Treatment System Considerations

### **Village’s Preparation for Florence and Mandatory Evacuation**

The Bald Head Island (BHI) Emergency Operations Center (EOC) team, supporting staff, and BHI Limited Transportation were proactive and effectively managed the timely evacuation of residents, employees, and visitors. Early preparations were started one full week before Hurricane Florence landfall. Preparations included meetings of key directors, implementation of the Village of Bald Head Island Emergency Management Plan (EMP) checklists, and procurement of extra equipment to clear debris and remove floodwaters from the island. While there were minor operational issues, none suggest the need for recommended action except shortcomings in the mainland EOC relating to the lack of a backup generator and the challenge of “remainers.”

Property owners whose primary residence is Bald Head Island are particularly likely to consider remaining on the island during a voluntary – or mandatory – evacuation. They may have had extensive experience staying through prior hurricanes without adverse consequences. They may have limited alternatives within reasonable striking distance on the mainland other than shelters or hotels. They may be concerned about damage to their residence and want to be present to deal with it before greater damage occurs. Unfortunately, the prolonged evacuation and prohibitions on returning in the aftermath of Florence may increase the likelihood that residents will choose to remain on the island during future storms. That poses a potentially dangerous situation, both for them and for first responders in the event of an emergency. It is anticipated that the much-needed property owner education described above will objectively highlight the dangers that remainers may face if they fail to abide by future evacuation orders. During the storm rescue is highly unlikely to impossible, and during a continuing emergency, successful evacuation for medical care remains challenging. And during Florence, taking care of and transporting those remainers required resources and time that could be used elsewhere.

The Village has few options. Municipalities do not generally remove people who are adamant about staying. The Village could impose a fine of \$50 “per offense” for violating the evacuation order and for being in a restricted area.<sup>6</sup> One of the few other options to make staying less attractive would be for the Village to emphasize that it will bill those who remain the full cost of any necessary rescue efforts undertaken during the state of emergency, as allowed under North Carolina law. The best option is probably to make evacuation more attractive by establishing resident-friendly policies governing returning to their homes. In particular, establishing reasonable return criteria (“water is on”; “home has either a septic system, a generator connected to the grinder pump, or Wag-bags”; perhaps “home has a generator”) coupled with a commitment to facilitate an early return might reassure residents that they will be able to return early if they are willing to accept a degree of risk.

#### **RECOMMENDED ACTIONS:**

**32) Explore finding a mainland EOC location that has a back-up generator.**

**33) Consider the best set of policies to encourage evacuation by all Village residents.**

#### **Decision-Making and the Emergency Operations Center**

The Emergency Operations Center (EOC) Team is well qualified and made hundreds of response operational level decisions under severe circumstances over a four-week period of pre-landfall planning and post-landfall response/recovery. The team articulated a reasonable rationale for each of the major decisions reached, including controversial ones. The team focused on the critical path items needed to get the island habitable again, which were clearing impassable roads, lowering the floodwaters, and regaining power and sewer services.

Most decisions were made by consensus. If a consensus decision was not reached, the Incident Commander would make final operational decisions and the Mayor would make policy decisions, such as proclaiming a State of Emergency, ordering evacuations, and rescinding the State of Emergency.

Shortly after the EOC Team arrived on the island, it became clear that the critical path items needed to get the island habitable again included: clearing impassable roads; lowering/removing the floodwaters; and regaining power and sewer services.

Following Hurricane Florence landfall, the EOC team, staff members, BHI Limited Transportation, and other volunteers did a commendable job and worked tirelessly clearing roads of debris, removing water from the island, and transporting emergency responders and equipment under severe and hazardous circumstances. Some Public Safety officers had to wade through chest high water to check on the well-being of homeowners who did not evacuate. The Incident Commander gave frequent and thorough safety briefings to anyone accessing the island with instructions to get immediate treatment if any cuts or injuries occurred. This emphasis on

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<sup>6</sup> Village of Bald Head Island Code of Ordinances Sec 8-43.

safety and allowing only a manageable number of qualified workers on the island likely contributed to the impressive “zero injury” recovery process.

While being understaffed and having to “wear many hats,” the EOC team and particularly the Village Manager prepared approximately 40 detailed Village’s Voice to keep interested parties well informed of daily recovery activities and challenges. The EOC Team was also fielding many outside inquiries that unnecessarily interrupted important emergency response activities. The team would have been well served having more administrative/communications staff fielding calls, updating activities and decisions in the crisis management software (WebEOC), and preparing draft Village’s Voice newsletters and announcements for review.

The open EOC with free entry was a source of some communications issues and potential misinformation. It is customary for an EOC to have restricted access so that work is not interrupted. However, if both physical entry to the EOC and calls to EOC personnel are restricted in the interest of operational efficiency and accurate communication, it becomes even more important to have effective means for people outside the EOC to convey information and for people off the island to ask questions and receive answers. A Public Information Officer can serve this communication role with those off the island, representing their point of view and concerns during EOC deliberations and assuring that they receive the information they are seeking. This issue is discussed further in the Communications section of the report.

While social media provided some very useful information to those not on the island, it was also a source of rumor and misinformation that impacted the EOC team’s recovery efforts. Aerial photos of the island showing minimal external damage to structures gave homeowners a false sense of security and could not capture interior damage caused by driving rain nor could they capture fully the challenges of moving around the island safely. However, photos and videos taken by emergency responders at ground level on the island showed significant flooding and downed trees over many roads not seen in the aerial photos. Some of these photos were placed on social media but were later taken down because of concerns over privacy. While it was important not to display homeowners’ private property, most of these photos showed public roads and lands. Showing flooded roads, downed trees, and other damages would have given homeowners an accurate view of what emergency responders were dealing with and a more realistic view of conditions on the ground. These photos would have also corroborated, in a visual way, the accurate description of conditions published in the Village’s Voice, thus offering even more credibility to these daily updates. Further, Damage Assessment Team photos, if taken early, could have been beneficial.

One of the principles of emergency management is real-time documentation of actions in a log or an electronic equivalent. In part this assists in communication within the EOC and in part it creates a lasting record of actions taken and, to some degree, the results of the actions. This documentation can aid after-action review and provide information about key actions that may help guide actions during subsequent events. Institutional memory can reside in people or documents, and given the significant expected turnover of departmental leadership in the next several years, documentation becomes increasingly critical to assure that lessons learned are not lost in the transition.

Although the Village's Voice included substantial information about the state of the island and the activities of the staff, the Task Force's review was hampered to some degree by a lack of real-time documentation of decisions and actions. Specifically,

- There was no comprehensive EOC log.
- Although the status of roads was illustrated each day on an island map, no documentation of each day's map was kept. A simple snapshot would have sufficed and helped document the extent of ponding and its response to pumping.
- Pump and hose placements could also have been indicated on a comprehensive map of the island for future reference, although decisions about pump placements and movement should also be recorded in the comprehensive log.
- Certain decisions, such as the criteria for reentry by property managers and contractors, were not documented nor were they announced publicly. The origin and timing of the reported ICE vehicle requirement remain unclear.

Limited staffing undoubtedly made documentation more difficult, and understandably, deciding and acting had a priority over written documentation. The fix during future events will be relatively easy: EOC staff should keep logs and make an entry at the time key information is received, a decision is made, or an action taken. Taking a cell phone photo of the planning map each day would provide visual documentation of the state of the roads and the pumps in operation, and might, in addition, be a useful visual to help convey the state of the island to property owners.

There is always a balance between safety, response operations, and re-entry decisions, and it was no different for this event. Being on an island, having most local mainland roads impassable, and having local hospitals at capacity, the decision to limit/manage the number of workers using heavy equipment and traversing the island to remove water was prudent. Also, the decision to allow initial re-entry of property managers with larger numbers of homes and ICE vehicles appears on the surface to be justifiable, but the lack of communication as to how this decision was made lead to some frustration and concerns over fairness. We discuss alternative principles guiding reentry below (pages 36-38). Some of the property management staff and property owners interviewed believed that re-entry was undertaken when conditions were still too hazardous to access many areas.

#### **RECOMMENDED ACTIONS:**

**34) Update the Emergency Management Plan to describe, in detail, the EOC Team decision-making process** and the method(s) by which final decisions will be made if consensus is not reached. Also, describe the role of Council Members and others, such as Subject Matter Experts, etc., in the decision-making process.

**35) The EOC should improve documentation of policy and operational decisions and actions.** EOC members should keep a written or electronic log of decisions and actions. Support staff may play a role in documentation, but a simple written log or WebEOC entry by decision makers would be simple and satisfactory.

- 36) **The EOC should maintain an island map in the EOC with road conditions and pump/hose placements indicated.** The map should be documented at least once a day by taking a photograph. Consider publishing these daily map photos to illustrate progress and remaining challenges. Consider creating **an Island Smart Map** for publication on the website showing status of roads, homes, businesses, sewer, utilities, access points (beach, docks), etc.
- 37) **EOC should initiate early contact** (day 1 or 2) with Council members.
- 38) **Consider the use of drones to get quicker initial assessment** and video footage of flooding and damage to island infrastructure and structures if waterways are closed to boat crossing.
- 39) **Restrict access to the EOC**, allowing only those people necessary for emergency response. Consider setting up a security/sign-in desk to limit access.

### **The Damage Assessment Team and Property Inspections by the Village**

The Damage Assessment Team (DAT) was not activated and used as described in the current version of the Emergency Management Plan, which is focused on managing wind events. After a wind event, the core responsibility of the DAT is to provide a rough estimate of the amount of external damage caused by the storm, using relatively crude damage metrics, in order to qualify regions for disaster assistance. The Damage Assessment Team survey is supposed to be conducted within 2 hours of initial reentry and reported back to the EOC to assist in decision-making and priority-setting. Under those circumstances, DAT members will return to the island earlier than businesses and homeowners and would generally use their own golf carts to conduct assessments. Local damage estimates based on the DAT survey are rolled up into county and regional estimates of damage.

Because the magnitude of the damage from Florence was self-evident, DAT surveys were not needed to qualify for disaster declaration and disaster assistance. While the exterior surveys conducted by the DAT are well-suited to wind events, they do not identify the often extensive interior damage caused by wind-driven rain and by floodwaters. Furthermore, the DAT members could not have conducted surveys in the usual way because of the extensive flooding on the island. While one Damage Assessment Team member stated that nearly all homes could have been viewed the second week if high-water vehicles or backhoes that were not needed for other emergency operations were available to transport DAT members, the usefulness of exterior-only assessments after a rain and flood event like Florence remains unclear. Developing distinct Emergency Management Plans for wind events and rain/flood events would help clarify the role of the DAT in different emergencies.

Historically, the Village has also had a process for homeowners to request an exterior inspection of their home following a hurricane utilizing Public Safety staff. Like the DAT assessment, the Village's exterior damage assessment primarily reflected obvious wind damage and could not identify much of the damage produced by a rain and flood event like Florence, where much of

the damage is interior, caused by wind-driven rain, leaks, flooding, and mold. Although advertised before Florence, the inspection request link usually posted on the Village website following a hurricane was not posted following the storm. Nonetheless, some homes were inspected, and the results provided to homeowners. Some published information suggested that all homes had been inspected, which confused people who had been unable to sign up and had received no information from the Village.

We note that the Village has grown substantially following its original offer years ago to inspect any home on request after a storm. There is some question whether fulfilling that offer is still feasible, given staffing levels and competing priorities. Should the DAT and/or a fully volunteer group routinely inspect the exterior of every house after a storm and provide a brief, standardized email report to homeowners, assuming the homeowner has provided an email address linked to the address? If so, any report should be accompanied by a boilerplate disclaimer about the significant limitations of a brief exterior inspection and the many types of damage that may have occurred that will not be detected. A report of no damage may well be misleading.

Several members of the Task Force noted that the only reasonably reliable assessment with a low false negative rate would include an interior inspection and require access to a key. As an alternative to an inadequate exterior inspection, the Village (and the Bald Head Association, which has a key holding service) could instead facilitate an inspection program using private contractors that would provide a more reliable report to homeowners at, presumably, a standardized reasonable cost, or a volunteer, neighbor-to-neighbor program.

#### **RECOMMENDED ACTIONS:**

- 40) Reassess the role of the Damage Assessment Team.** The DAT's primary role should be clarified and focused on the assessment needed to quantify community storm damage. With appropriate transportation, DAT members could also provide exterior inspections after flooding (although such reports would be heavily qualified and of limited value because of the expected interior damage). DAT members could also help document the state of roads and the extent of flooding.
- 41) Re-evaluate requirements and role for Damage Assessment Team members** such as health, ability to work under physically- stressful conditions, and knowledge of the island and island infrastructure.
- 42) Reassess the Village's commitment to provide property reports after storms.** Sometimes these reports have conveyed damage information seen by the DAT. Other property reports have been based on exterior inspections conducted on request by Public Safety staff. The Village needs to reconsider whether its staffing allows it to continue its offer to provide exterior evaluations of individual properties on request after a storm.
- 43) Consider facilitating a property inspection program using interested companies and individuals that would perform brief exterior *and interior* inspections using either the Association's key service or access to key boxes installed by**

**homeowners.** This program could operate after both wind and flood events and could be fee-based or volunteer. Given that people would be entering homes with a key, potential liability may pose a challenge; consideration should be given, then, to an entirely private “program,” with homeowners encouraged to place lock boxes and then calling on trusted individuals who express a willingness to serve neighbors and friends.

- 44) Whenever the Village offers homeowners damage reports on their property, whether through the DAT, Public Safety, or a new program, feedback should be a standardized emailed assessment with appropriate disclaimers.**

### **Closure of the Cape Fear River and the Marinas**

A conference call with the Captain of the Port in Wilmington clarified aspects of the operations of the ferries and other vessels as Florence approached and during the recovery and reentry period. The Captain of the Port follows a well-defined sequence of closures that apply to large vessels and to many commercial operations including carrying passengers for hire. These closures affect the Cape Fear River, adjacent waterways, and sea approaches to the river, culminating in Condition Zulu approximately 12 hours before the arrival of gale force winds (>39 mph), when the river is closed to all traffic. The last ferry run is usually scheduled based on the anticipated full river closure, allowing time for any necessary repositioning of the vessels upriver.

After the storm, the port goes to Condition Recovery. After Florence, conditions delayed the reopening of the river until Tuesday afternoon, September 18<sup>th</sup>. Prior to that re-opening, Transportation requested and received permission for an exploratory trip on Monday with a small group of first responders and then for further ferry operation on Tuesday, at which point the river opened to traffic during daylight hours. Because of logs and debris coming down the Cape Fear River, the daytime-only restriction remained in place for a week after partial re-opening of the river. There are some customary restrictions on carrying individuals for hire relating to certification of the captain for such commercial operations. There are also restrictions on vessels carrying passengers for hire in North Carolina waters.

**The closure of the Bald Head Island Marina by the Village was in place during the state of emergency and was largely unrelated to the status of the Cape Fear River.** The closure to all but ferry and barge traffic was enforced initially by Public Safety personnel and subsequently by North Carolina Marine Fisheries and North Carolina Wildlife Resources officers in order to restrict people on the island to those authorized as part of the recovery effort during the state of emergency. One reason for enforcing such closures is to prevent random people from landing either to explore or perhaps to loot. A second is to assure that people are treated equally, and if not allowed on the ferry should not be allowed to arrive by private (or commercial) vessel.

The important fact is that the marina closure, like other restrictions on entry, is a decision made by the Village. There may be reasons to allow limited access by boat to people otherwise explicitly authorized to re-enter; owners and staff of food establishments in the marina area, if allowed early access to clean their facilities and prepare for eventual health department

inspection, as suggested elsewhere, might be given approval to come by boat rather than by ferry, but exceptions should be clearly stated and limited.

**RECOMMENDED ACTION:**

- 45) The Village will close the marina when the island is under a mandatory evacuation order.** The closure order will explain the rationale for the closure to all traffic other than ferry and barge traffic. Any exceptions to the closure will be announced publicly and explained.

**Reentry by Helicopter**

Several individuals re-entered by helicopter before the Village conveyed to helicopter operators that the island was closed to re-entry and they were not permitted to land. These individuals pose a policy challenge for the Village, since they may have food and water, a generator, and waste disposal options and be well-equipped to remain if they accept the problems with rescue in the event of illness or injury. Since arrest at home is hard to imagine, the Village does face a policy decision about whether the requirement to remain at home will be enforced and about whether to issue a fine of \$50 “per offense” for entering a restricted area.<sup>7</sup> In any event, a sense of fairness suggests that no commercial activity on behalf of clients should be allowed by those on the island until competitors have similar access. Although we can hope for voluntary compliance, the actual enforcement of such a prohibition is more likely to be a determination of the moment rather than something determined in advance.

**RECOMMENDED ACTION:**

- 46) The Village will close the island to helicopter landings when the island is under a mandatory evacuation order.** The closure order will explain the rationale for the closure. Any exceptions to the closure will be announced publicly and explained. Local helicopter companies should be notified of the landing prohibition.

**Reentry Process for Business Owners and Homeowners**

There is broad perception that the emergency plan/re-entry procedures were not followed, particularly related to the order in which people and businesses were allowed on the island. The re-entry procedure phase 1(B) lumps several entities together such as island businesses, the Damage Assessment Team, public safety volunteers, etc., but does not prioritize their re-entry. The Emergency Management Plan needs to be flexible and adaptable to allow the decision-makers to adjust to conditions in the field, but the re-entry section needs to be “tightened up” to clearly state the order of re-entry and the rationale behind the order. Any deviation from this would need to be justified and communicated.

**Re-entry by certain businesses.** The decisions to allow reentry of a range of property management and contractor businesses to inspect their client’s properties was a way to assess

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<sup>7</sup> Village of Bald Head Island Code of Ordinances Sec 8-43.

many island properties relatively safely with a limited number of people, but it also raised a number of issues. Implications and unintended consequences may not have been adequately examined.

- What were the criteria that businesses needed to meet? They were not publicized. Property managers and some contractors were allowed, while others were not, and some listing agents were not allowed to inspect their clients' houses. Company size was discussed early on, but no objective criteria were established. An ICE vehicle requirement was described at some point but was not an explicit requirement at boarding. The end result was that some firms were allowed access and their competitors were not, and real estate companies with property management arms were advantaged over those without.
- What functions were the businesses performing? The announced function was "inspections only" and many workers were told their tools were not allowed because repairs were not allowed. Yet some workers performed repairs that were documented on social media. Inconsistent enforcement of rules leads to a perception of favoritism, whether true or not.
- Were the needs of homeowners whose principal residence is on the island adequately considered? Although the decision to allow commercial entities access days before homeowners could be justified as an effort to examine the condition of the largest number of properties with the fewest people exposed to risk, it inherently prioritized commercial interests and rental property owners (and certain other individuals) over full-time residents of the island.

**Homeowner Re-entry for Inspection.** On Thursday, September 27, the EOC Team decided to allow homeowners day access for the first time on Saturday, September 29. Council Members did a very good job of quickly preparing a public announcement and BHI Limited Transportation was already prepared to transport homeowners to and from the island. The planning and execution of running the trams continuously in two separate "loops" was a success. No injuries occurred, which was fortunate given that hazardous conditions still existed on some parts of the island where access was granted.

That said, the reentry process also illustrated some decision-making issues:

- After the announcement and further consultation with Limited, it became apparent that the demand could not be met on a single day and the two-day "west/east of Muscadine" plan established. Unfortunately, some homeowners had promptly begun a long drive from home and arrived to learn that they would have to find overnight lodging and return the following day.
- Golf cart travel on the island was first forbidden, then allowed.

**Full Re-entry.** The decision to lift the state of emergency and open the island Monday morning was a welcome one, and the re-entry went smoothly.

The decision-making issues that arose when planning business and homeowner reentry might be traced to several factors. The EOC had been operating daily with few or no breaks for

decisionmakers, emphasizing the usefulness of designated alternates and days off during a prolonged siege. The Council was taking a more active role, diffusing the clear decision-making authority earlier in the emergency. There was substantial public pressure for re-entry that may have led to rushed decision-making. Could these problems with the original plan have been resolved prior to the first announcement with more formalized “red team” thinking – or with a more formal “planning” individual or group were responsible for identifying and planning for events still days in the future? While the collaborative decision-making during most of the EOC operations appears to have worked quite well, results can sometimes be improved if one or more people are responsible for “long-term” planning and/or red team analysis of tentative decisions.

#### **RECOMMENDED ACTIONS:**

- 47) Re-evaluate the re-entry procedure for prolonged states of emergency.** Safety will always be a fundamental consideration, but re-entry decisions by the EOC will need to strike a balance between a reasonable degree of safety and early return to homes and businesses on the island.
- 48) Whether established in advance or developed during the emergency, reentry criteria should be clear and published so all those who might qualify know the criteria.**
- 49) The Task Force recommends that the Council endorse the following re-entry principles:**
  - a. Reentry policies should prioritize businesses that establish agreements with the Village to provide early responders with certain services and products during an emergency, such as the market and the hardware store.
  - b. Reentry policies should then prioritize the early return of other food establishment operators who will have to pass Health Department inspections before reopening.
  - c. After these groups, individuals with primary residences on the island should have the highest priority for reentry, whether only for inspection or for return to the residence.
  - d. Reentry policies should not favor business interests serving their clients (such as property managers, real estate agents, and contractors) over individuals with residences on the island.
  - e. Reentry policies should not favor some property management and contractor entities over their competitors, or over other agents willing to inspect homes for their clients or for the public.
  - f. During prolonged emergencies, the EOC should consider the feasibility of reentry by neighborhood, based on the condition of the roads, the extent of any flooding, and the availability of water, power, and sewer; or reentry of individuals in reasonably accessible locations who can demonstrate self-sufficiency (such as water, power from an operating generator, septic or alternative waste management).

## COMMUNICATIONS

The three members of the communications work group have experience in public information from corporate, utility, and local government entities. To gain perspectives as to how effectively the Village conducted communications and the extent to which citizen information needs were met over the course of Hurricane Florence, the Communications Work Group interviewed members of the Village Council, business leaders, property managers, and the sponsor of a Facebook group dedicated to Bald Head Island property owners. The committee's initial observations were presented at public meetings and through working sessions (also open to the public), all of which led to the recommendations listed below for consideration by the Village Council.

### **Village's Communication Avenues**

The Village has several crucial avenues of communication with people who live on, work on, or own a second home on Bald Head Island.

**Village's Voice.** The primary avenue is the Village's Voice, which is sent to everyone who has signed up to receive the Voice. This newsletter is an excellent source of official information from the Village, particularly during an emergency. However, despite multiple campaigns to encourage sign-up, the Voice does not reach everyone who should be informed about Village issues, particularly during an emergency.

During Florence, the Village Manager was committed to frequent communications with property owners during the event and wrote nearly 40 editions of the Voice from the initial preparations for Florence through the process of re-entry and debris collection. Often Chris McCall wrote the Voice in the evening, following a long day on the island in the EOC, demonstrating his commitment to communication. As might be expected, the newsletters were praised by many, but others wanted more and/or different information, including more details about the challenging conditions on the island. Despite aerial video footage and ground level photographs, some readers felt they did not understand the magnitude of the problems; the most common requests were for more pictures and more specific information. A map illustrating impassable roads coupled with regular pictures of key locations would graphically illustrate the general message that the conditions were challenging and travel around the island impossible.

The Task Force concluded that the work of the Village Manager during the storm was more than one person, however dedicated, could perform, and that his workload would be more manageable and communications more effective if the Village were to hire a Public Information Officer who could prepare issues of the Village's Voice for review and approval by the Village Manager. We address this recommendation in more detail in a later section, since the PIO would serve many functions during an emergency.

### **RECOMMENDED ACTIONS**

- 50) Continue using the Village’s Voice as the primary means of official communication to the public during an emergency.** Consider having a structured section of each update that provides specific information about impassable roads and the status of power, water, sewer systems, cellular, and broadband services.
- 51) Conduct a campaign to increase the audience reach of the Village’s Voice, with a goal of increasing the number of subscribers by 20%.** Ideally, the subscribers could be identified as homeowners, unimproved property owners, and business owners or employees to provide an avenue of communication to each of these groups independently, if necessary.
- 52) During and after future events, use more visual media such as photos, video recordings, and maps of impassable roads and utility outages to supplement the Village’s Voice written updates,** but in a way that does not violate homeowners’ privacy.

### **Village Website**

The Village web site [www.villagebhi.org](http://www.villagebhi.org) must be a primary means of communication, both normally and during an emergency, and a primary repository of information useful to property owners. Some municipalities develop a state of emergency or hurricane landing page and substitute it for the usual home page in advance of a storm. During an emergency the landing page would convey urgent information, provide visuals showing the state of the island through photographs and/or status maps, provide a link to recent Village’s Voices, and guide people to general information that is useful during emergencies including how to prepare for major hurricanes and other possible disasters, evacuation policies and procedures, and the likely reentry process in different situations.

Unfortunately, [www.villagebhi.com](http://www.villagebhi.com) has gone through several design iterations in recent years, resulting in a website that has inadequacies that limit its usefulness, including slow performance, poor searching tools, problems accessing the site from mobile devices, and challenging navigation. More attention and investment would be needed to make the website a valuable resource both for day-to-day use and during an emergency.

Two major alternatives have been identified: hiring a consultant for a one-time redesign/rebuilding using the current website tools or hiring a website design and hosting service with expertise and a track history of building and hosting municipal sites in the coastal Carolinas and elsewhere.

## RECOMMENDED ACTIONS

**53) Redesign and rebuild the Village web site using a website design and hosting service with experience with municipal websites.** Prepare a Request For Proposal (RFP) as soon as possible to seek bids for building a new Village website, incorporating best practices for usability, functional design, compatibility with mobile devices, speed and performance. Work with peer municipalities to quickly obtain RFP specifications input.

**Cost estimate: \$25,000 in FY2019/20, with ongoing annual costs of approximately \$6000.**

**54) Develop a hurricane home page and relevant hurricane content in advance of the peak hurricane season (September/October).** The home page and linked information pages should provide information aimed at property owners for storm preparations, including links to other municipal, state, and federal government content. Also develop BHI specific storm readiness concerns (golf carts, grinders, pre-storm planned electrical outages, refrigerator/freezer content clearance, debris management, and evacuation and reentry). Coordinate and augment website content with links to other web resources, including federal and state sites and the Bald Head Association's site. Announce availability of this information to the public via a Village's Voice communication.

**55) Create an archive page on the current website for Village's Voice communications posted over the past 24 months.**

### Spectrum Cable

As part of the cable and broadband franchise, Spectrum provides two capabilities: a government access channel and a scroll insertion capability. The Village has purchased the equipment to insert emergency messages as a scroll on all cable channels on the island and is waiting for Spectrum to connect the insertion equipment to the broadband system. This will improve communication with many renters on the island during hurricane season, who are unlikely to be Village's Voice subscribers. Developing content for the government access channel would be much more challenging and require resources that are not currently available.

## RECOMMENDED ACTIONS

**56) Implement the emergency message scroll capacity on all cable channels for the current hurricane season.** The emergency banner should direct viewers to a dedicated emergency informational page on the existing Village website for purposes of providing critical instructions/directions. Update as needed throughout the crisis.

**57) Activate the capability to broadcast over the government access cable channel that Spectrum provides to the Island for Public, Educational, and Government (PEG) content.** Initially, the channel could be active only during an emergency, with content

running as a loop presentation publicizing emergency messaging and educational content.

- 58) Consider developing, perhaps in conjunction with island non-profits, a “welcome to Bald Head Island” presentation for island visitors with useful non-commercial information and advice that would run as a loop on the government access channel, to be replaced with a loop presentation about hurricane preparedness and evacuation that could run when storms approach.**

### **Other Communication Channels**

Key messages in the Voice are often amplified in other avenues, particularly communications from the Bald Head Association and from the Maritime Market.

During the prolonged recovery and rebuilding period, the Association was particularly instrumental in providing information about insurance coverage. The Association’s Architectural Review Committees can further encourage (or in some cases require) design features that improve resistance to wind and to wind-driven rain and that qualify for lower insurance rates.

There is an excellent opportunity for a collaborative effort between the Village and the Association to provide information and advice for homeowners in a crisp, readily accessible form. For example, after the storm the state insurance commissioner’s office provided valuable information about recommended insurance coverage and policy features. Advice about dealing with insurance companies (and perhaps even consumer ratings of their insurers based on their experience after Florence) would be useful, as would advice about choosing contractors for post-storm recovery, based on unfortunate experiences following Florence. Much of this content might be more appropriately hosted on the Association’s website – the goal would be a collaboration that includes links from one site to the other so users can readily find the information they need – and may not have known they need.

Communications from the Maritime Market provided invaluable good cheer and first-hand details about the state of the island and recovery efforts. Although efforts were made to coordinate the information and messages with the Village, the newsletter may have contributed to unrealistic expectations about the pace of recovery. Here, too, the presence of a Public Information Officer could help ensure that both the Village’s and others’ communications to the public are reasonably consistent in conveying the state of the island, the pace of recovery, and the likely time of re-entry.

As we all know, social media can pose major challenges for government communications, particularly during an emergency. While some social media may convey information that is both accurate and useful, it also may convey misinformation and inflame passions. Some Council members worked to modulate the social media commentary, but here, too, a PIO with immediate access to the EOC could play a vital role monitoring social media, conveying concerns and questions to the EOC, and provide information either on social media or through the Village’s Voice to respond to questions and to correct possible misinformation.

Finally, phone calls from members of the public to the Village during an emergency should not go directly to EOC staff managing the state of emergency but rather should be directed to a site with Village staff and volunteers trained to handle inquiries during an emergency. The main Village telephone number should be forwarded to that site, which might be on the mainland, or if that is not possible, a separate telephone number for the Emergency Call Center should be established and publicized in the Village's Voice and on the website. Similarly, an email address should be established for questions. The Center would gather questions from the public and either respond immediately with known information or consolidate the questions to send to the Public Information Officer or other designated person in the EOC, returning the calls or emails when accurate information is received back from the EOC. Alternatively, a written response to individual questions can be posted on the emergency landing page of the website under Frequently Asked Questions (FAQs), which will get the information to a larger group of people.

### **RECOMMENDED ACTIONS**

**59) Collaborate with the Bald Head Association to develop or identify links to the best content for insurance coverage in advance of a storm, storm preparation steps, evacuation information, re-entry information, and information about choosing contractors and interacting with insurance adjusters in the aftermath of a storm, to determine the best site to host a given type of information, and to provide mutual links to vital information.**

**60) Develop plans for an Emergency Call Center staffed by Village employees or volunteers that would be the primary point of contact for the public, receiving incoming calls and emails from property owners and other members of the public, conveying relevant questions or comments to the designated Public Information Officer and providing information, either immediately or when the information is verified by the PIO.**

### **Public Information Officer**

In analyzing how the communications surrounding a disaster could be improved, numerous factors including several mentioned above have led the Task Force to recommend a full-time Public Information Officer (PIO). Emergency plans generally and the Village's own Emergency Management Plan in particular assume a PIO is part of the management team during an emergency.

An effective PIO will wear many hats, particularly during an emergency. We assume the PIO will, among other duties:

- Serve as an active member of the EOC, conveying information, questions, and concerns expressed by property owners or the public and assuring that information provided by the Village is accurate and responsive.
- Oversee Village staff and volunteers who are answering calls and emails to the Village during an emergency, conveying relevant questions to the EOC staff and providing

accurate information to respond to callers. Assure that the staff and volunteers have accurate and timely information to respond to callers/senders.

- Draft the Village's Voice for editing and approval by the Village Manager.
- Work with the Association and with the Maritime Market to coordinate the island's public messaging.
- Monitor island organizations and social media to identify concerns, questions, rumors, and factual inaccuracies, and discuss responses that may address the concerns, questions, rumors or inaccuracies.
- Be the contact point for the public and for news media during an emergency (but the Mayor, Village Manager, and Incident Commander would determine who, if anyone, provides an interview or briefs the public and the media).

More generally, the PIO would oversee website content and collaborate with other organizations to assure that property owners have access to useful, accurate, and timely information – both generally and specifically regarding emergencies. The goal would be information and websites that are complementary and coordinated, to the extent appropriate. The PIO would also be involved in any collaborative efforts to develop basic content for the government access cable channel. A skilled writer in the PIO role could also play an important role in other Village communications and grant applications.

Putting the necessary resources in place will enable the Village to deliver communications that can better meet the needs and expectations of the public.

## RECOMMENDED ACTIONS

- 61) Budget for and promptly hire a Public Information Officer.** The PIO's initial priority would be storm preparation communications and web content.
- 62) The Public Information Officer should convene the group of communications specialists that will collaborate on population preparedness (see recommendation 28 above).**
- 63) Revise the Emergency Management Plan to assure that the PIO is an active member of the EOC with specific duties.**
- 64) Undertake an Emergency Preparedness Simulation activity for BHI's Emergency Operations Center** involving Village officials and personnel having designated positions, roles, and responsibilities as outlined in the Emergency Management Plan.

## Other Communications Issues Relevant to Managing Emergencies

**Emergency Broadband Access.** Broadband access to much of the island is dependent on nodes having power. To ensure that the EOC can gather information from internet sources and can email from the EOC during an emergency, the village has now installed a **passive fiber optic switch** providing broadband cable access to the EOC even during prolonged power outages. If

there is broadband service to the fiber under the Cape Fear, the EOC will have a broadband connection.

**Emergency Communications Infrastructure.** The task force also notes that, prior to Hurricane Florence, the Village was already planning to approve **a taller communications tower serving the island**. Upon completion this will improve communications using both cellular systems and the VIPER system currently used by Public Safety to communicate internally and with Brunswick County dispatch. For redundancy and improving upon poor VIPER reception and/or possible power failure at the tower, the Village is acquiring **400 MHz communications equipment** that can provide on-island communication among Village staff and volunteers, and that is supported by the backup power at the Public Safety Complex.

### **Follow-up**

#### **RECOMMENDED ACTION**

- 65) At the conclusion of the 2019 Hurricane Season, the Village Manager will convene a meeting with the HFTF Communications Committee to review the status and debrief the above-listed recommendations.**

## **BALD HEAD ISLAND UTILITIES**

Because the island's utilities – power, water, sewer, cellular, and broadband – are such crucial elements during the recovery period, and restorations of power, water, and sewer are on the critical path to re-entry, we have provided some information about each of the systems that will help clarify the crucial design features of each system, the nature of the system failures during recovery, and the steps that might make the systems less vulnerable to flooding.

### **The Power Distribution System**

Following a major storm, rapid restoration of power is essential to rapid re-opening of the island. While Public Safety, Public Works, Utilities, the cell tower, the sewer system's primary lift station, and Village Hall (and some businesses and private homes have backup generators) to protect vital functions, generators can fail, overheat, or run out of diesel or propane fuel. Other critical infrastructure – specifically the grinder pumps at residences and businesses and nodes in the broadband distribution system – generally have no backup (beyond batteries) and are dependent on power from the grid.

Power comes to the island through two cables under the Cape Fear River that also contain fiberoptic bundles. The distribution system on the island is largely a branching system with limited redundancy and limited switching capacity. Few facilities have redundant routes for power from the main distribution trunk. Existing cables are aging and have underground splices that are more prone to failure.

Duke Energy/Progress has designed significant improvements to the basic distribution system that will improve redundancy for much of the island by replacing key elements of the system with stainless cables, by extending the system to create a network (loop) system for much of the island, and by installing new switching capacity that will facilitate alternative routing for power in the event of a failure at one location in the loop. Work is currently underway. When complete, the system will have greater redundancy and flexibility, and greater ability to isolate some power failures to a smaller area of the island.

These improvements do not address one significant source of system vulnerability: the transformers that are located only slightly above ground level and are vulnerable to flooding (and in some cases, burial by sand) during a major storm. After Florence, power could not be restored to the island until the Thursday before re-entry because of flooded transformers that could not be safely energized.

During the general power failure, Duke Energy/Progress worked actively with the Club to re-route power to serve the Club's irrigation system pump. The effort was hampered by damage to that branch line, but eventually succeeded on September 26<sup>th</sup>. This pump is critical to move water from the catchment basin of the irrigation lagoons (11, 12, and 13) to lagoon 17, where the water could be pumped off the island.

Several homeowners have asked whether the transformers should be elevated. Duke Energy/Progress regards Florence as a 100- to 500-year event. Although not explicitly stated, strategies like elevating transformers that may be vulnerable to very rare flood events is not regarded as an appropriate use of rate-payer funds. Needless to say, this calculus may change if major flood events become more common.

For now, the more robust loop distribution and switching system currently being built will help isolate and limit outages - and should result in greater ability to restore power by neighborhood as flooding in that area subsides. But ultimately, the key to restoring power more rapidly remains our ability to get stormwater off the island more rapidly.

#### **RECOMMENDED ACTIONS:**

**66) Assure that the current improvements to the power distribution system allow early restoration of power to critical locations** such as Public Safety/EOC, Public Works, Utilities, the telecommunications tower, the Club's irrigation pump, and the primary lift station at Timber Creek Mulch Site.

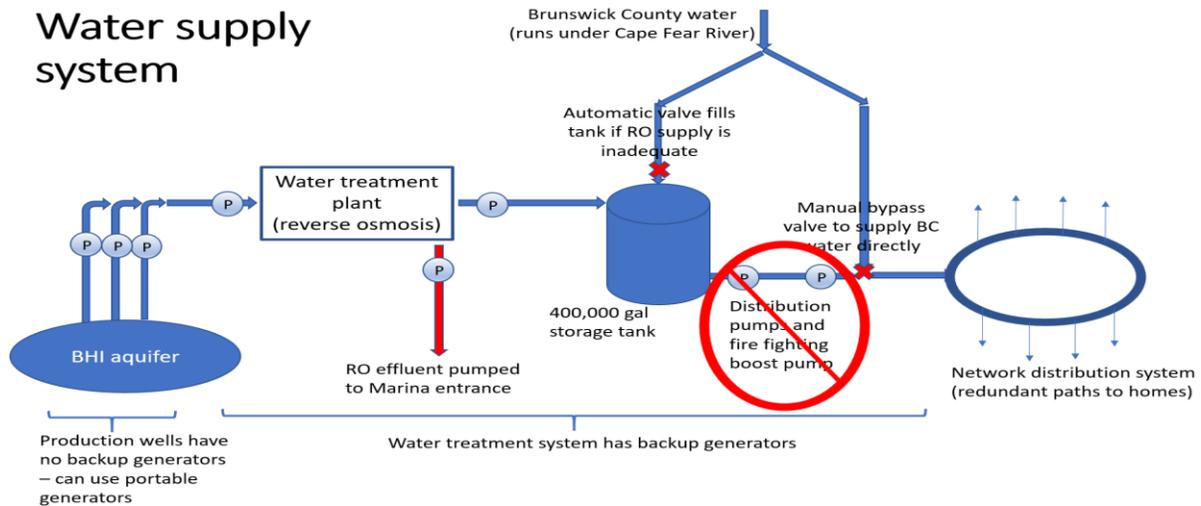
**67) Monitor all electrical transformers on the island and document each transformer prone to burial or flooding during storm events.** Duke Energy/Progress regards the flooding associated with Hurricane Florence as an event too rare to fall within their planning horizon that determines infrastructure improvements. Documentation of specific equipment prone to recurring flooding will be necessary to justify relocation or elevation of existing transformers.

## The Island's Water Supply

The island's water supply provides an excellent illustration of how redundant systems are less vulnerable to disasters. In the case of our water system, that involves having two sources of water and a ring distribution system that reduce, but do not eliminate vulnerabilities.

Key features of the water supply system are illustrated in the figure.

- One source of water is the production well system at multiple locations across the island. Well water is pumped out of the wells to the water treatment plant by pumps powered by the electrical system. If power is out, the wells will supply water only if a portable generator were taken to individual wells.
- Well water flows to the reverse osmosis water treatment plant and, after treatment, into the 400,000-gallon storage tank. The treatment plant can be operated using a backup generator, but only if wells are producing water.
- Water from the storage tank is pumped into the distribution system (and boosted if fighting a major fire requires greater pressure) by pumps dependent on power or a backup generator.



- The second source of water is the Brunswick County water system, which comes to the island through a pipe under the Cape Fear River and flows directly to the Utilities complex. An automatic fill valve at the storage tank supplements the output of the water treatment plant when levels drop in the storage tank. Alternatively, a manual bypass valve connects the Brunswick County water directly to our distribution system. This connection is dependent on adequate pressure in the Brunswick County water system but does not depend on power on the island.
- The water distribution system is a network (loop) system, except for the line out Middle Island. While this should allow significant control of water flow and enhance the ability to isolate pipe leaks/breaks/penetrations, valves in the system that are always open may not operate to isolate a leak, so major breaks may require the system to be shut down for repairs.

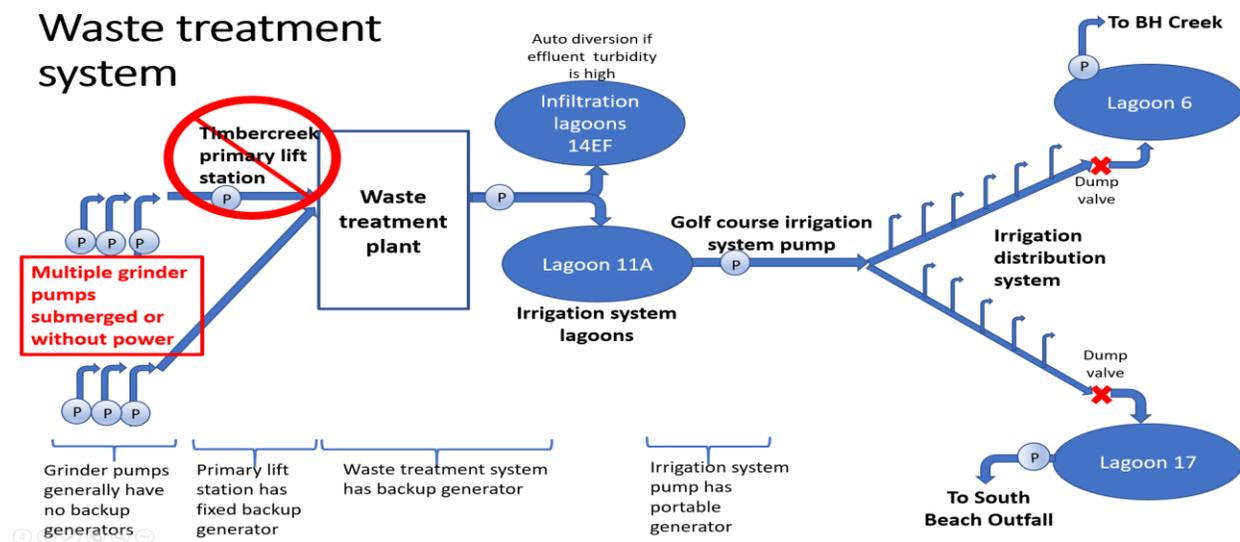
The dual sources (one of which is not dependent on island power) result in a relatively resilient system – indeed, water service was restored very early in the recovery process. This restoration was possible despite a serious break in the main water line leaving the distribution pumps probably due to storm-related weakening of the soil supporting the pipe: the Village simply opened the valve connecting Brunswick County water to the distribution system. In fact, the water main damage was so severe that Brunswick County remained the sole source of island water for several months after Florence.

Reliance solely on Brunswick County exposes certain vulnerabilities: the available water pressure is relatively low, the pressure may be inadequate to fight a major fire<sup>8</sup>, and the volume may not be adequate during peak utilization in the summer.

Recently, a different part of the system failed as drilling along North Bald Head Wynd damaged the main pipe from Brunswick County. The system then ran entirely from the wells and water treatment facility. Fortunately, when that incident occurred, the severe pipe rupture at the Utilities complex had been repaired. Had there been a power failure as well, the system could pump water from the reserves in the 400,000-gallon storage tank into the distribution system using power from a backup generator. After those reserves were depleted, portable generators would have to be placed to power some of the production wells, allowing the reverse osmosis treatment plant (operating on the backup generator) to supply at least a limited supply of water to the island.

### The Island’s Waste Treatment System

While a number of houses remain on septic systems that are not dependent on power, the vast majority of buildings are on the island’s low-pressure sewer system, shown below.



<sup>8</sup> A boost pump at Caswell Beach can be activated to increase system pressure but requires power at that location and water must be diverted from Caswell Beach users.

This system begins with grinder pumps at each home or business that are placed in the ground and are powered from the electrical supply to the home. Few are connected to a whole-home backup generator, and thus cannot operate during a power outage. Importantly, these pumps also should not operate when submerged because they will continuously pump the floodwaters into the sewer pipes, with two serious consequences: 1) the pump may fail from continuous high speed operation, and 2) the pumped floodwaters from multiple pumps will overwhelm the capacity of the waste treatment plant. Because of this, Utilities cuts off the power to submerged pumps before power is restored to prevent these consequences.

Grinder pumps can have snorkels installed that may allow them to operate if the water does not submerge the snorkel and is not more than 30” deep. Fully sealed grinder pumps with PVC vents that extend up house pilings could be installed instead of the usual grinder pumps in low lying locations that are prone to flooding. For existing homes that have experienced several episodes of flooding deep enough to prevent grinder pump operation, or for new construction at locations shown to be in flood basins by the new LIDAR maps, the Village could consider either allowing or requiring the installation of fully sealed pumps at additional cost.

Waste pumped from all grinder pumps east of Muscadine and some pumps west of Muscadine travels directly to the waste treatment plant. The waste from all other grinder pumps travels first to the primary lift station at the Timbercreek Mulch Site, from which it is pumped to the waste treatment plant by a pump reliant on power from the grid or from its backup generator. Unfortunately, that high voltage generator failed, requiring that a replacement be brought to the island by barge. Hardening the power supply to the site would make the system less vulnerable to failure.

The waste treatment plant and related pumps run on a backup generator during power outages, sending effluent either to the infiltration lagoons on hole 14 or to the irrigation system lagoon on hole 11. From there, water and effluent are pumped into the golf course irrigation system to water the course.

As previously noted, the golf course irrigation system pump is needed during flood events to move water from the catchment basin of the irrigation lagoons (11, 12, and 13) to lagoon 17, where the water can then be pumped off the island.

**RECOMMENDED ACTION:**

- 68) Sealed grinder pumps.** For existing homes that have experienced several episodes of flooding deep enough to prevent grinder pump operation, or for new construction at locations shown to be in flood basins by the new LIDAR maps, the Village should consider either allowing or requiring the installation of fully sealed pumps at additional cost.

**Telecom Tower**

The telecom tower is critical to cellular and emergency communications. It is served by two non-redundant backup generators, one of which needed repairs early in the recovery process to

power vital telecom equipment on the tower and improve cellular reception. Specific strategies to address communications issues during emergencies are addressed above in the Communications section of the report.

## **Backup Generators**

### **RECOMMENDED ACTION:**

**69) Backup generator review.** Given the number of backup generators critical to recovery efforts, some of which failed, the Village should review all backup generators for all systems regardless of department and determine whether one or more generic backup generators capable of serving multiple locations should be on hand, or at a minimum, covered by agreements to assure availability if needed.

## **GOVERNANCE ISSUES**

### **Potential or Perceived Conflict of Interest**

Some of the most heated discussion during recovery and re-entry revolved around potential or perceived conflict of interest. It is vital to put this sensitive issue into some context and review the provisions of North Carolina law to understand the challenges faced by the Task Force in examining this issue and the Council in crafting policies to deal with it. Much of the summary of North Carolina law is drawn from UNC School of Government publications.<sup>9</sup>

The level of impartiality necessary for certain government functions is high and relatively clearly defined in law. Situations in which voting (and in most cases, participation in deliberations) is forbidden and may constitute a misdemeanor include:

- Zoning decisions in which the member has a financial interest
- Quasi-judicial decisions in which the member has a fixed opinion, bias, financial interest, or close personal relationship
- Public contracts from which the member or spouse derives a direct financial benefit. (These contracts are generally forbidden regardless of the member's recusal from voting. For small municipalities, an exception may apply, but there are formidable procedural requirements for entering into such a contract beyond the member's non-participation.)

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<sup>9</sup> See particularly:

Bluestein, Frayda S. and Norma R. Houston. "Chapter 7: Ethics and Conflicts of Interest" County and Municipal Government in North Carolina, Second Edition. Chapel Hill: UNC School of Government  
Bell, A. Fleming, II. *Ethics, Conflicts, and Offices: A Guide for Local Officials*. 2nd ed. Chapel Hill: UNC School of Government, 2010.

The far more hazy (and far more common) situation occurs when a matter before the board involves a member’s “financial interest.” North Carolina law requires a member to vote on issues before the board unless excused by the board because the matter involves the member’s own financial interest or official conduct. Unfortunately, there is no generally accepted standard in North Carolina for what constitutes financial interest that would warrant being excused. The Village attorney has interpreted the exclusion very narrowly and the duty to vote very broadly, suggesting that if any others have the same or a similar financial interest as the member, the member should not be excused. Understandably, members have made decisions about participation based on this interpretation.

North Carolina laws enacted in 2011 require ethics training and the adoption of a code of ethics by municipal governing bodies<sup>10</sup>. Following discussions with the Task Force, the Village Council determined that it had not adopted a code and acted promptly this spring to adopt a model code modeled on a code developed by the UNC School of Government.<sup>11</sup>

While useful, the code adopted does little to clarify what constitutes a financial interest for which a member could – or should – be excused from voting. This leaves members vulnerable to criticism for participating in issues that some, at least, would regard as constituting a potential conflict of interest that could undermine public trust in the integrity of government. Some North Carolina municipalities have adopted codes of ethics or a code of conduct that defines financial conflict and allowable (or required) exclusion from debate and voting more clearly.

**RECOMMENDED ACTION:**

**70) Financial interest.** Council should amend the Code of Ethics to provide clearer standards for determining when Council should excuse a member from voting due to a financial interest in the outcome.

**Decision-making Authority and the Role of Council During Civil Emergencies**

While the council is the governing body of the Village, elected by the voters, the Village’s Civil Emergencies ordinance empowers the mayor to declare a state of emergency by proclamation. The mayor or his designee may impose any restrictions authorized by the ordinance, including ordering the evacuation of the Village and prohibiting access to part or all of the Village. The mayor is also empowered to lift the state of emergency. Council is given no power to re-assume its governing role. In the mayor’s absence, the mayor pro tempore or a Council designee shall have the mayor’s powers.

While it is a principle of emergency management that one person have ultimate responsibility for decisions, there seemed to be an informal understanding that the mayor would have ultimate responsibility for broad policy decisions (such as the imposition or lifting of the emergency and associated restrictions), the Director of Public Safety would serve as Incident Commander and

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<sup>10</sup> NCGS § 160A-86. Local governing boards' code of ethics

<sup>11</sup> Bell, A. Fleming, II. *A Model Code of Ethics for North Carolina Local Elected Officials*. Chapel Hill: UNC School of Government, 2010.

have authority to make all operational decisions, and the Village Manager would handle financial, procurement, and personnel issues.

In practice, when there were issues, decisions were made by leadership consensus. Group deliberations may be particularly effective in assuring that different views are heard and different expertise brought to bear on a decision. As noted elsewhere, during a prolonged emergency it may be desirable to assign an explicit planning function to one or more individuals who would look at situations days down the road (such as re-entry procedures and policies), identifying likely issues and possible solutions.

Under the ordinance, the role of council during the emergency and particularly during the transition back to usual governance is problematic – the council has no authority until the mayor ends the civil emergency. This lack of a defined role for council, noted in several interviews, is amplified by the absence of any provision for council meetings by conference call during an emergency – although as long as council has only an advisory role and no governing authority for the duration of the emergency, discussions with and advice from council by conference call may be less legally problematic.<sup>12</sup> Retaining this limited, consultative role for council may be the optimal resolution to preserve a clear line of authority during the emergency.

### **Succession Planning**

In the course of its interviews, the Task Force became aware of several likely retirements of department heads within the next few years. Obviously, the turnover of much of the leadership makes both succession planning and good documentation even more important for the Village so it can function day to day and in emergencies, even when key staff retire or resign. We assume that annual reviews with department heads include discussions of the development of potential internal candidates and of documentation that would ease the life of any successor, whether internal or external.

## **BEYOND 2021: LONG-TERM PLANNING ISSUES**

Our previous recommendations focus on near-term projects based largely on “lessons learned” from Hurricane Florence. While that near-term focus is important, it is equally important for the Village to think strategically, planning for the coming decades. In this section we address specific long-term trends that should be included in the island’s planning.

### **Sea Level Rise**

Numerous studies examine both the broad effects likely to result from climate change and more specific, quantifiable effects such as glacial retreat and sea level rise. Hundreds of studies by

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<sup>12</sup> For a discussion of the legal issues involved in council meetings with participation by conference call, see Bluestein, Frayda: “Remote Participation in Local Governmental Board Meetings” UNC School of Government Local Government Law Bulletin No. 133, August 2013.

both academic institutions and government agencies such as NOAA and the Army Corps of Engineers have examined recent historical increases sea level and used a variety of climate models to predict the further rise in sea levels that we should expect over the next 30 to 100 years. For a deep dive into the science of global and regional sea level rise predictions, NOAA Technical Report NOS CO-OPS 083 provides a good diving pool.<sup>13</sup> It predicts a global rise in sea level from 2000-2100 of 0.44 to 0.74 meters (17 to 29 inches) based on low and high scenarios, without accounting for the dynamics of Antarctic melting, which may further accelerate sea level rise.

The most useful report for our strategic planning purposes on Bald Head Island is the 2015 update to the North Carolina Sea Level Rise Assessment Report, prepared by the N.C. Coastal Resources Commission Science Panel.<sup>14</sup> This report provides projections for five coastal North Carolina locations for the thirty-year period from 2015 to 2045, drawing on historical trends in sea level collected by NOAA tide gauges along the coast.

While the many details in the report will be of interest, the table summarizing the findings of the Science Panel is sufficient to emphasize the need for including sea level rise in our long-term planning for the island.<sup>15</sup>

Station	Tide Gauge Projections		IPCC RCP 2.6 + VLM		IPCC RCP 8.5 + VLM	
	RSLR in 30 years (inches)		RSLR in 30 years (inches)		RSLR in 30 years (inches)	
	Mean	Range	Mean	Range	Mean	Range
Duck	5.4	4.4-6.4	7.1	4.8-9.4	8.1	5.5-10.6
Oregon Inlet	4.3	2.7-5.9	6.3	3.9-8.7	7.3	4.7-9.9
Beaufort	3.2	2.8-3.6	6.5	4.2-8.7	7.5	5.0-10.0
Wilmington	2.4	2.0-2.8	5.8	3.5-8.0	6.8	4.3-9.3
Southport	2.4	1.9-2.8	5.9	3.7-8.2	6.9	4.4-9.4

\*Note: Projections were rounded to the nearest tenth of an inch.

Table ES1. Three relative sea level rise (RSLR) scenarios by 2045 using published tide gauge rates (NOAA 2014a), and IPCC scenario projections RCP 2.6 and RCP 8.5 (Church et al. 2013) representing the lowest and highest greenhouse gas emission scenarios, combined with local vertical land movement (VLM) at each tide gauge.\*

The first column (“Tide Gauge Projections”) takes the long-term historical data from tide gauges and projects the trends forward 30 years. The report then uses the global sea level rise

<sup>13</sup> Downloaded from [https://tidesandcurrents.noaa.gov/publications/techrpt83\\_Global\\_and\\_Regional\\_SLR\\_Scenarios\\_for\\_the\\_US\\_final.pdf](https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf) June 24, 2019.

<sup>14</sup> Downloaded from <https://files.nc.gov/ncdeq/Coastal%20Management/documents/PDF/Science%20Panel/2015%20NC%20SLR%20Assessment-FINAL%20REPORT%20Jan%202016.pdf> June 24, 2019.

<sup>15</sup> *Ibid.* p 5

projections from the most recent Intergovernmental Panel on Climate Change Report (IPCC Report) to make additional projections of likely sea levels along the coast based on scenarios with low and high rates of greenhouse gas emissions (columns headed IPCC RCP 2.6 and 8.5 in the table).

**Over the coming 30 years, Bald Head Island (Southport) can expect to see a sea level rise of half a foot - 5.9” in the best emissions scenario to 6.9” in the worst emissions scenario, with a 95% confidence interval of 3.7” to 9.4”.** Given the low elevation of much of the island, including critical road and utility infrastructure, and the high elevation of the water table, the expected half-foot rise in sea level will increase so-called “nuisance flooding” from king tides and wind-driven surges, raise the water table further, and increase the severity of flooding associated with tropical storms and hurricanes, even without the predicted increases in tropical cyclone intensity and rainfall. Recent studies of the economic effects of sea level rise suggest that a hurricane of any given intensity will cause even more property damage than would occur at lower ocean water levels. The rise in sea level is also likely to increase to some degree the saltwater encroachment on the edges of the aquifer and, by raising the water table, may further reduce the freshwater holding capacity of the island soil, contributing to more severe flooding.

We can take cold comfort in the realization that Bald Head Island will fare better than barrier islands of the Outer Banks north of Cape Lookout. Whereas the land mass in the Cape Fear region shows little subsidence and may be rising slightly, partially offsetting the global rise in sea level, the land around Albemarle Sound including the Outer Banks is sinking, contributing to the greater rise in relative sea level projected in that region over the next 30 years, as shown in the table.<sup>16</sup> The Outer Banks areas also show greater effects from changes in the flow of ocean currents such as the Gulf Stream that may accompany warming of the ocean waters and rise in the level of the sea.

### **Increases in Storm Intensity**

Climate change studies have also examined the effects of global warming on the intensity of storms. The Geophysical Fluid Dynamics Laboratory of the National Oceanic and Atmospheric Administration (NOAA) recently revised and reissued “Global Warming and Hurricanes: An Overview of Current Research Results”.<sup>17</sup> In addition to warning about sea level rise and increased coastal inundation from tropical cyclones, the Summary Statement concludes that:

- Tropical cyclone rainfall rates will likely increase in the future.... on the order of 10-15% for rainfall rates averaged within about 100 km of the storm for a 2-degree Celsius global warming scenario.
- Tropical cyclone intensities globally will likely increase on average (by 1 to 10% according to model projections for a 2-degree Celsius global warming).
- The global proportion of tropical cyclones that reach very intense (Category 4 and 5) levels will likely increase.... There is less confidence in future projections of the global number of Category

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<sup>16</sup> Ibid. pp 6-10

<sup>17</sup> Downloaded from <https://www.gfdl.noaa.gov/global-warming-and-hurricanes/> June 24, 2019.

4 and 5 storms, since most modeling studies project a decrease (or little change) in the global frequency of all tropical cyclones combined.<sup>18</sup>

**Appropriate long-term planning by the Village will therefore include planning for the combined effects of increases in sea level, tropical cyclone intensities, and tropical storm rainfall that we will face over the over the next several decades.**

### **Adverse Effects of Dredging, Deepening, and Relocating the Cape Fear River Channel**

A final factor to consider in long-term planning for hurricanes and stormwater management is the dredging and possible deepening and relocation of the Cape Fear River channel to the Port of Wilmington, with resulting effects on erosion of West and South Beach and potential saltwater intrusion into the aquifer. These changes can be tracked by continuing study and monitoring of the aquifer. The deepening and relocation of the navigation channel may also directly affect the resistance of the island to tropical storms. Dredging appears to increase local tidal flows, displace ocean sand, accelerate beach erosion, and increase the instability of the BHI shoreline.

### **The Need for a Long-term Planning Process**

We believe the Village will need a specific long-term planning process to address expected problems – not only the long-recognized problems such as beach erosion, stormwater management, the transportation system, and the utility infrastructure, but also emerging problems associated with climate change and/or sea level rise that may exacerbate recognized problems and create new issues. **In this report, we will address only long-term planning issues related to stormwater management.**

We would like to emphasize that **each of the near-term recommendations presented earlier in the report is also directly relevant to our long-term stormwater management strategy.** For example:

- The **studies of the island’s topography** using the high-resolution LIDAR data will improve our understanding of and ability to model the effects of sea level rise, including both increased “nuisance flooding” at king tides and increased flooding from overwash or rainfall.
- The **studies of the island’s aquifer** should be extended long-term to monitor changes in the water table and saline intrusion, including both local effects due to channel dredging and beach erosion and broader changes in the aquifer resulting from changes in the sea level, water withdrawal patterns, aquifer recharging through rainfall and grey water.
- **Managing (and possibly redesigning) the gravity outfall at the creek** becomes even more important as high tides become higher and further limit the effectiveness of the creek outfall as it is currently designed and operated.
- **Higher water tables** will increase the size of already wet areas, reduce the capacity of the land to absorb rainfall, and complicate efforts to pump some areas dry. Routine

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<sup>18</sup> Ibid. p 1.

surface water management such as pumping after ordinary rainfall may become more common.

- The **expected increases in flooding** due to a variety of factors will make it even more important to:
  - **utilize fully the outfall capacity of the four sets of twin outfall pipes** to move more water off the island in a shorter period of time,
  - **staff the recovery effort to assure the earliest possible start on pumping,**
  - **actively consider pre-positioning equipment in hardened locations and installing automated or remote-control systems** to manage pumping and the creek outfall gates.

**Any near-term recommendation not implemented in 2020 or 2021 should be carried over and remain part of long-term project planning.** Beyond the near-term actions listed above, we also recommend the following actions:

#### **ADDITIONAL RECOMMENDED ACTIONS:**

**71) The Village should establish a formal long-term planning process with a time horizon of several decades**

**72) The Village’s long-term planning for stormwater management should be based on the projected 6-inch rise in sea level over the next 30 years.** When designing the near-term fixes recommended earlier in this report, project planners should consider plan modifications that take this projected rise in sea level into account.

**73) Working with other coastal communities, the Village should intensify the on-going discussions with the State to create policies and programs that address the needs of municipalities dealing with severe storms and sea level rise,** and to develop stormwater management strategies that balance environmental concerns with economic, public health, and public safety concerns.

**74) The Village’s shoreline studies should continue to address the challenges posed by any proposed dredging, deepening, and relocation of the Cape Fear River channel,** enabling active advocacy on the issues both separately and together with other coastal communities.

**75) The Village’s shoreline studies should continue to address the challenges posed by any proposed changes to “the Rocks”** that would starve Bald Head Island beaches and make the island more vulnerable to storms, enabling active advocacy on the issues both independently and together with other coastal communities.

**76) The Village should consider changes to the building code and the Bald Head Association should consider changes in its guidelines and review process to encourage or require design features that make island buildings more resilient to high winds, driven rain, and flooding.**

## **FUNDING STORMWATER INFRASTRUCTURE PROJECTS**

The Task Force noted that 88 municipalities in North Carolina had a stormwater management fee in FY18/19. The UNC School of Government report summarizing those fees is found at: [https://efc.sog.unc.edu/sites/default/files/2019/NC2018\\_19\\_StormwaterFeeTables\\_0.pdf](https://efc.sog.unc.edu/sites/default/files/2019/NC2018_19_StormwaterFeeTables_0.pdf)

Most of the municipalities use utility billing as the method of collecting the stormwater management fee. For a 3000 square foot home, the monthly fees ranged from \$.50 in parts of Person County to \$15.44 in Charlotte; fees for oceanfront communities near us ranged from \$2.94 for Oak Island to \$13.50 for Carolina Beach, averaging about \$8.00 a month. Fees collected through property taxes are complex (and uncommon). Most municipalities charge a flat fee (or occasionally a tiered flat fee) for a residential utility account. Utility-based fees on commercial properties may be flat fee but are more commonly based on Residential Equivalent Units.

The advantages of a stormwater management fee to fund stormwater management include:

- A widespread perception following Hurricane Florence that more investment in stormwater management is needed.
- Funds raised can only be used for stormwater management, providing a dedicated funding source.
- The fee varies over time depending on the actual costs for floodwater management infrastructure and operations, so once the infrastructure is in place and paid for, the fee decreases rather than becoming part of the tax base.
- It is a reasonably equitable method of allocating costs, although unlike property taxes, it applies only to improved residential and commercial properties.

## **FOLLOWUP ON TASK FORCE RECOMMENDATIONS**

We recognize that the Council and Manager will take these recommendations and make implementation decisions based on their merit and on a range of factors that the Task Force did not directly consider, including financing and competing budget priorities. To the extent that it would be helpful, members of the Task Force and additional working group participants would be happy to provide further information or to assist Village staff or Council members in planning and implementation of the recommended actions. Subject areas of particular interest include:

- Stormwater management: Joe Brawner, Scott Gardner, Pete Fulham
- Disaster response planning and emergency operations center: Peter Menk and Keith Earnshaw
- Communications: Conn Sharp and Kevin Arata
- Utility systems and good government issues: Rex Cowdry

## RECOMMENDED ACTION:

- 77) The Task Force members recommend that the Village Manager report to Council in early 2020 on actions taken to address each component of the Task Force report, perhaps at the Council retreat. We also recommend that the Task Force members be invited to participate in the discussion.**

## CONCLUSION

While we certainly hope that Bald Head Island does not face another 500 year deluge like Florence in the near future, we are confident that the experience gained from Florence and the actions taken in its wake will further improve the Village's response not only to a major flood event but also to any other major emergency that may arise.

**APPENDIX I**

**Summary of Estimated Costs**

**(from the Interim Report of the Task Force)**

<b>PROJECT</b>	<b>FY 19/20</b>	<b>FY 20/21</b>
Studies: topography and stormwater management	\$80,000	
Studies: aquifer	\$50,000 (placeholder estimate)	
New outfalls: South Bald Head Wynd east of Muscadine		\$250,000
Explore reestablishing the emergency outfall between Cape Fear Trail and Seagull Trail	\$10,000- \$20,000	
Redesign Bypass Lagoon 6 and its weir gates	\$25,000- \$200,000	
Improve the connection from Lagoon 3 to Lagoon 6/7	\$10,000- \$20,000	
Improve drainage from Stede Bonnet just south of primary dune	\$20,000- \$30,000	
Reestablish connection from Lagoon 15 to Lagoon 16	\$100,000- \$200,000	
Improve and control the flow from Lagoon 8 to Lagoon 6	\$50,000	
Address stormwater flooding along Federal Road near Kinnakeet and the Conservancy and in Cape Fear Station		\$100,000- \$200,000
Improve culverts under North Bald Head Wynd and Federal Road		\$75,000
Redesign and rebuild Village web site	\$25,000	\$6,000
<b>TOTALS</b>	<b>\$370,000- \$675,000</b>	<b>\$431,000- \$531,000</b>

## APPENDIX II

### List of Recommendations

#### STORM DAMAGE AND STORMWATER MANAGEMENT: STUDIES AND INFRASTRUCTURE PROJECTS

##### Studies and Development of a Floodwater Management Discharge Plan

- 1) Study the topography of the entire island and develop a new stormwater management plan (Jeff Petroff)**
  - a. Acquisition of detailed LIDAR data to allow development of topographic maps and modeling of stormwater dynamics (Village funded and performed the LIDAR acquisition earlier this year; no future budget implications).
  - b. Identification of natural basins based on LIDAR data (underway).
  - c. Refinement of the models to reflect connections between natural basins and modeling of various stormwater events and management strategies.
  - d. Development of detailed recommendations about possible improvements in stormwater management on the island, including:
    - i. design of changes in the Bypass Lagoon and weir gate providing gravity discharge to Bald Head Creek.
    - ii. design of additional outfall(s) to South Beach, allowing gravity flow or pumping of water from areas east of Muscadine in front of the primary dune.
    - iii. determination about how to handle stormwater accumulations at multiple sites east of Muscadine and north of the primary dune, particularly those associated with flooding on Federal Road near Kinnakeet, on Federal Road at the Conservancy, and in Cape Fear Station, specifically whether pumped stormwater could be directed to Bald Head Woods, to Bald Head Creek, or to South Beach and the Atlantic Ocean.
    - iv. evaluation of the culverts under North Bald Head Wynd and Federal Road to determine whether they should be cleared, closed, or fitted with weir gates or one-way valves.
    - v. evaluation of the intersection of North and West Bald Head Wynds for potential drainage improvements.
- 2) Develop a Floodwater Management Discharge Plan for submission to the State that balances economic, public health, public safety, and environmental concerns (Jeff Petroff).** Although part of the overall stormwater management consultant contract, the importance of this product warrants identification as a separate Recommended Action.
- 3) Study the aquifer to understand the complex interactions between the aquifer and both the surrounding bodies of saltwater and the surface waters of the island, including the lagoons (Jim Cornette).**

- a. Evaluate existing longitudinal data from the various production and monitoring wells on the island;
- b. Perform experimental interventions and measurements that might provide additional information about aquifer dynamics, including the effects of drinking water pumping and pumping from the lagoons on water tables and saltwater intrusion;
- c. Determine whether additional monitoring wells would provide important additional information about the aquifer;
- d. Consider specifically the likely effects of lowering the lagoon levels in advance of storms, including whether the lagoons would rapidly refill from other sources of water, whether the pumping would promote saltwater intrusion under the island, and whether the effect (if any) of establishing a policy of precautionary lowering of the lagoons would be trivial or significant; and
- e. Understand seasonal and storm-related changes in the elevation of the freshwater lens across the entirety of the Island. Understand the size/depth of the freshwater aquifer and monitor changes therein to better understand the impact of sea level rise.

#### **New or Reactivated Primary Outflow Sites**

- 4) **Establish new outfalls in areas along South Bald Head Wynd east of Muscadine (Peppervine/Coquina/Brown Pelican and/or Seaton/Dunedin).** Natural basins located along South Bald Head Wynd between the primary dune and the frontal dune trapped a huge amount of stormwater. Ultimately, the only way to clear the area of stormwater and restore passage along South Bald Head Wynd was to breach the dune to allow water to flow by gravity from the natural basin to the sea, rebuilding and replanting the dunes afterward. The best location for outfalls and whether they are gravity outfalls or pumping sites will depend on the stormwater studies planned in the coming year and the resulting Emergency Stormwater Pumping Plan. They are a high priority that we have priced as a single emergency outfall with a 10” pump and accessories, realistically scheduled for FY 2020/21. (Note: One or more of these outfalls may also be used to serve sites near Federal Road north of the primary dune.)
- 5) **Reestablish the emergency gravity outfall between Cape Fear Trail and Seagull Trail.** This outfall is shown as twin 24” Corrugated Metal Pipe outlet pipes running from common area between the roads under the frontal dune to West Beach. If properly equipped, it could augment the removal of water from this northernmost area between the primary and frontal dunes. It has not been used in any recent stormwater event but could provide an inexpensive way to enhance stormwater removal capacity through gravity flow and an alternative to breaching the dune. Infrastructure like that used for the South Beach gravity-fed outfall would presumably be installed at the landward end.
- 6) **Reestablish the capacity to use both pipes of the emergency gravity outfall across from Black Skimmer Trail. Only one of these outfall pipes was opened after Hurricane Florence. We recommend consultation to determine whether any**

**physical changes are needed to facilitate** the use of both 24” outfall pipes during a major flooding event.

- 7) Redesign and rebuild Bypass Lagoon 6 and its associated weir gates.**
- a. The pipe from Lagoon 6 should be increased to 36” and the weir gate replaced with a control valve (or one-way flow valve if it does not restrict maximum flow).
  - b. Increase the height of the berm surrounding Bypass Lagoon 6 so during flooding, supplemental pumping into the Bypass Lagoon can raise the level of the lagoon and increase the rate of stormwater discharge through the outfall.
  - c. Consider remote methods or earlier 24/7 staffing to control the height of the weir gate. The weir gate is routinely closed before a major storm to prevent backflow into the lagoon system. The more rapidly it can be opened after the threat of backflow from storm surge or very high tides has passed, the more rapidly water can be removed from the island using gravity flow through the Creek outlet ditch.
  - d. Consider whether a fixed pump that could operate automatically would facilitate removal of stormwater.
  - e. Consider other alternatives that would allow for 24/7 stormwater removal through the gravity outfall, including alterations to the ditch opening into the creek.

### Lagoon system projects

- 8) Improve connection from Lagoon 3 to Lagoon 6/7 to facilitate removal of floodwater in the area around Lagoon 3 that has no natural drainage.** There is a saddle between Lagoon 3 and the ditch leading to Lagoon 6/7. Installing an overflow pipe from slightly above the natural elevation of Lagoon 3 under the saddle to the ditch and clearing the ditch would establish a natural path for water to move from Lagoon 3 to Lagoon 6/7 to the Creek Outfall.
- 9) Install catch basin at intersection of Edward Teach and Sandwich Tern and feed into phase 3 pipe across Edward Teach. Install catch basin on Stede Bonnet at low point just south of the primary dune and pipe to drain into Lagoon 17.** This location is a natural bowl that collects water and floods the wynd.
- 10) Reestablish connection from Lagoon 15 under the primary dune to Lagoon 16.** Currently, a portable pump must be placed to move water from the landlocked lagoon 15 system (serving areas on either side of Edward Teach just west of Muscadine) to the front lagoons where it can be pumped to the ocean outfall. Flooding made this placement impossible until landfall +7 days (Friday, September 21). Reestablishing a connection between Lagoons 15 and 16 would decrease reliance on placing a pump while increasing our stormwater removal capacity.
- a. Evaluate the condition of the pipe and feasibility of installing a control valve.
  - b. If pipe is in reasonable condition and a valve can be placed, remove the sections of the pipe filled with concrete (previously placed to block flow from Lagoon 15 when Lagoon 15 was used as a waste treatment retention lagoon) or install a parallel pipe, ensuring proper gravity flow from 15 lagoon to 16 lagoon. Also, install a control valve to be operated only by the Village.

- c. Project is not felt to be dependent on stormwater studies, unless a valve is impractical, in which case the effects of reopening the pipe without a valve should first be evaluated.

**11) Improve and control the flow from lagoon 8 under the primary dune to Lagoon 6/7.**

- a. Locate the pipe and clear both openings.
- b. Evaluate the condition of the pipe, determine adequacy of flow through the pipe, and, if feasible, install a control valve to be operated by the Village.
- c. Project is not felt to be dependent on stormwater studies.

**Addressing specific problem areas**

**12) Address stormwater flooding along Federal Road near Kinnakeet and at the Conservancy and in Cape Fear Station.** The nature and cost of the projects addressing these areas will emerge from further study and evaluation of the LIDAR mapping and exploration of permitting options.

**13) Improve and/or install culverts under North Bald Head Wynd beginning at the intersection of West Bald Head Wynd and heading eastward along Federal Road.** These will be evaluated to determine whether they should be cleared, closed, fitted with weir gates or one-way valves, or modified in other ways improve stormwater flow off the Island.

**14) Adopt the ordinance authorizing the Village to remove debris from both public and private rights-of-way following the declaration of a state of emergency.**

**15) Private Pumping Arrangements.** The Village should develop a process to pre-approve certain pumping arrangements, including the routing and destination of the discharge hoses, so that property owners can send email notification and begin pumping during a local flooding event.

**STORM DAMAGE AND STORMWATER MANAGEMENT:  
OPERATIONAL ISSUES**

**16) Assessment of the Design Strength of the As-Built Public Safety Building.** The Village should have the engineering firm involved in the design of the building provide a written assessment of the ability of the as-built Public Safety building to withstand severe weather events including Category 2, 3, and 4 hurricanes and to provide safe shelter to staff during those events.

**17) Pre-placement of assets.** In revising the Emergency Operations Plan, the Village should re-evaluate the circumstances, if any, in which assets should be pre-placed either at the Marina or at pumping locations in advance of expected wind events or rain events, and whether any further improvements to pumping locations would be

desirable and cost-effective. (Naturally, although guided by the EMP, these operational decisions remain game-time calls.)

- 18) Earlier staff return after an evacuation.** Work closely with BHI Transportation or the Ferry Transportation Authority to assure the availability of both a vessel and staff to facilitate a return to the island at the earliest time allowed by the Captain of the Port. Consider alternative means of staff reentry by private boat or by land if ferry operations are delayed. Consider how to staff the island with a core crew 24/7 at the earliest feasible time in order to continue clearing the roads and managing the weir gate.
- 19) Earlier overnight staffing to manage weir gate, if remote monitoring and valve control are not installed.** In a flood event, plan on early overnight staffing to manage stormwater removal. Because safety is vital, determine the criteria for safe overnight staffing, including reliable emergency communications with the mainland, generator power, and availability of drinking water.
- 20) High-water vehicles.** Either acquire a surplus high-water vehicle or formalize arrangements with the National Guard or other sources for access to one or more vehicles early in a significant flood event. In addition to their vital role during prolonged and deep flooding, high-water vehicles could also be useful for beach access from Fort Fisher in the event of a delay in establishing emergency ferry service.
- 21) Breaching the frontal dunes.** Incorporate criteria with input from the State for flooding severe enough to justify breaching the frontal dune into the Floodwater Management Discharge Plan. Consider whether there are alternate operators should the contractor not be able to get to the island to operate the construction equipment used to breach the dune, and whether such arrangements for operation of the contractor's equipment should be incorporated into the agreement with the contractor. Alternatively, the Village could determine whether Public Works equipment and staff can breach the dunes if necessary.

## DISASTER PLANNING AND DECISION-MAKING

### Bald Head Island Emergency Management Plan

- 22) Conduct a BHI All-Hazard and Vulnerability Analysis** to determine future risks from hurricanes, flooding, tsunamis, fires in the maritime forest, cargo vessel and oil spills, radiological events, etc., and determine if the island is prepared and equipped to protect people from such events.
- 23) Update and expand the Emergency Management Plan** to cover the other emergencies identified in the All-Hazard and Vulnerability Analysis. The Town of Carolina Beach Emergency Operations Plan shared by the BHI Village Manager is one example of a plan that contains multiple annexes, covering several types of events. Special attention needs to be given to evacuation strategies in different scenarios: in the

event of a tsunami warning, where no evacuation is possible; in the event of a maritime forest fire, where the fire may prevent travel to the Marina; or in the event of radiation release from the Brunswick Nuclear Power Plant, where sheltering in place may be the optimal response.

- 24) **Update the Emergency Management Plan to be more compatible with the National Incident Management System (NIMS).** The NIMS provides a comprehensive, nationwide, systematic approach to incident management, including the command and coordination of incidents, resource management, and information management. It also standardizes emergency response terminology, which makes it easier for emergency response personnel and organizations to communicate.
- 25) **Establish Mutual Aid and First Right of Refusal agreements** with other counties/organizations to quickly obtain emergency assistance in the form of personnel, equipment, materials, and other services during future events. These types of agreements are especially critical for emergencies requiring immediate assistance, such as fires, spills, etc. Various types of mutual aid agreements are identified at: <https://emilms.fema.gov/IS703A/RES0102130text.htm>
- 26) **Conduct well-planned emergency exercises** (drills and tabletop exercises) with BHI Village, BHI Limited Transportation, and volunteer staff to test the Emergency Management Plan, exercise participants, and emergency preparedness capabilities.
- 27) **Engage federal and state agencies** to discuss early actions that may be allowed to enhance planning and preparation for future flood disasters.

### Population preparedness

- 28) **Convene a meeting of communications staff from key island entities to discuss how to educate property owners on a wide range of disaster preparedness issues.**

### Operational preparedness

- 29) **Identify and train backup staff members for each critical EOC member.** This assures that more than one person can fulfill the function in the event of vacation or illness, or during longer-term emergencies requiring 24/7 coverage that will require two shifts. Backups also avoid gaps with sudden retirements, job changes, etc.
- 30) **Consider requesting training support** from the Community Emergency Response Team (CERT). Educate/train private property owners by incorporating year-round CERT Program into existing Public Safety Programs.
- 31) **Evaluate training needs for all emergency personnel and volunteers.** Consider specifically the following training for emergency personnel and elected/appointed officials. [please see the report for the listing of training opportunities]

32) **Explore finding a mainland EOC location that has a back-up generator.**

33) **Consider the best set of policies to encourage evacuation by all Village residents.**

### **Decision-making and the Emergency Operations Center**

34) **Update the Emergency Management Plan to describe, in detail, the EOC Team decision-making process** and the method(s) by which final decisions will be made if consensus is not reached. Also, describe the role of Council Members and others, such as Subject Matter Experts, etc., in the decision-making process.

35) **The EOC should improve documentation of policy and operational decisions and actions.** EOC members should keep a written or electronic log of decisions and actions. Support staff may play a role in documentation, but a simple written log or WebEOC entry by decision makers would be simple and satisfactory.

36) **The EOC should maintain an island map in the EOC with road conditions and pump/hose placements indicated.** The map should be documented at least once a day by taking a photograph. Consider publishing these daily map photos to illustrate progress and remaining challenges. Consider creating **an Island Smart Map** for publication on the website showing status of roads, homes, businesses, sewer, utilities, access points (beach, docks), etc.

37) **EOC should initiate early contact** (day 1 or 2) with Council members.

38) **Consider the use of drones to get quicker initial assessment** and video footage of flooding and damage to island infrastructure and structures if waterways are closed to boat crossing.

39) **Restrict access to the EOC**, allowing only those people necessary for emergency response. Consider setting up a security/sign-in desk to limit access.

### **The Damage Assessment Team and Property Inspections by the Village**

40) **Reassess the role of the Damage Assessment Team.** The DAT's primary role should be clarified and focused on the assessment needed to quantify community storm damage. With appropriate transportation, DAT members could also provide exterior inspections after flooding (although such reports would be heavily qualified and of limited value because of the expected interior damage). DAT members could also help document the state of roads and the extent of flooding.

41) **Re-evaluate requirements and role for Damage Assessment Team members** such as health, ability to work under physically- stressful conditions, and knowledge of the island and island infrastructure.

**42) Reassess the Village’s commitment to provide property reports after storms.** Sometimes these reports have conveyed damage information seen by the DAT. Other property reports have been based on exterior inspections conducted on request by Public Safety staff. The Village needs to reconsider whether its staffing allows it to continue its offer to provide exterior evaluations of individual properties on request after a storm.

**43) Consider facilitating a property inspection program using interested companies and individuals that would perform brief exterior *and interior* inspections using either the Association’s key service or access to key boxes installed by homeowners.** This program could operate after both wind and flood events and could be fee-based or volunteer. Given that people would be entering homes with a key, potential liability may pose a challenge; consideration should be given, then, to an entirely private “program”, with homeowners encouraged to place lock boxes and then calling on trusted individuals who express a willingness to serve neighbors and friends.

**44) Whenever the Village offers homeowners damage reports on their property, whether through the DAT, Public Safety, or a new program, feedback should be a standardized emailed assessment with appropriate disclaimers.**

#### **Closure of the Island to Boats and Helicopters**

**45) The Village will close the marina when the island is under a mandatory evacuation order.** The closure order will explain the rationale for the closure to all traffic other than ferry and barge traffic. Any exceptions to the closure will be announced publicly and explained.

**46) The Village will close the island to helicopter landings when the island is under a mandatory evacuation order.** The closure order will explain the rationale for the closure. Any exceptions to the closure will be announced publicly and explained. Local helicopter companies should be notified of the landing prohibition.

#### **Re-entry Process for Businesses and Homeowners**

**47) Re-evaluate the re-entry procedure for prolonged states of emergency.** Safety will always be a fundamental consideration, but re-entry decisions by the EOC will need to strike a balance between a reasonable degree of safety and early return to homes and businesses on the island.

**48) Whether established in advance or developed during the emergency, reentry criteria should be clear and published so all those who might qualify know the criteria**

**49) The Task Force recommends that the Council endorse the following re-entry principles:**

- a. Reentry policies should prioritize businesses that establish agreements with the Village to provide early responders with certain services and products during an emergency, such as the market and the hardware store.
- b. Reentry policies should then prioritize the early return of other food establishment operators who will have to pass Health Department inspections before reopening
- c. After these groups, individuals with primary residences on the island should have the highest priority for reentry, whether only for inspection or for return to the residence.
- d. Reentry policies should not favor business interests serving their clients (such as property managers, real estate agents, and contractors) over individuals with residences on the island.
- e. Reentry policies should not favor some property management and contractor entities over their competitors. or over other agents willing to inspect homes for their clients or for the public.
- f. During prolonged emergencies, the EOC should consider the feasibility of reentry by neighborhood, based on the condition of the roads, the extent of any flooding, and the availability of water, power, and sewer; or reentry of individuals in reasonably accessible locations who can demonstrate self-sufficiency (such as water, power from an operating generator, septic or alternative waste management)

## COMMUNICATIONS

### Village's Communications Avenues

- 50) **Continue using the Village's Voice as the primary means of official communication to the public during an emergency.** Consider having a structured section of each update that provides specific information about impassable roads and the status of power, water, sewer systems, cellular, and broadband services.
- 51) **Conduct a campaign to increase the audience reach of the Village's Voice, with a goal of increasing the number of subscribers by 20%.** Ideally, the subscribers could be identified as homeowners, unimproved property owners, and business owners or employees to provide an avenue of communication to each of these groups independently, if necessary.
- 52) **During and after future events, use more visual media such as photos, video recordings, and maps of impassable roads and utility outages to supplement the Village's Voice written updates,** but in a way that does not violate homeowners' privacy.

### Village website

- 53) Redesign and rebuild the Village web site using a website design and hosting service with experience with municipal websites.** Prepare a Request For Proposal (RFP) as soon as possible to seek bids for building a new Village website, incorporating best practices for usability, functional design, compatibility with mobile devices, speed and performance. Work with peer municipalities to quickly obtain RFP specifications input.
- 54) Develop a hurricane home page and relevant hurricane content in advance of the peak hurricane season (September/October).** The home page and linked information pages should provide information aimed at property owners for storm preparations, including links to other municipal, state, and federal government content. Also develop BHI specific storm readiness concerns (golf carts, grinders, pre-storm planned electrical outages, refrigerator/freezer content clearance, debris management, and evacuation and reentry). Coordinate and augment website content with links to other web resources, including federal and state sites and the Bald Head Association’s site. Announce availability of this information to the public via a Village’s Voice communication.
- 55) Create an archive page on the current website for Village’s Voice communications posted over the past 24 months.**

### Spectrum Cable

- 56) Implement the emergency message scroll capacity on all cable channels for the current hurricane season.** The emergency banner should direct viewers to a dedicated emergency informational page on the existing Village website for purposes of providing critical instructions/directions. Update as needed throughout the crisis.
- 57) Activate the capability to broadcast over the government access cable channel** that Spectrum provides to the Island for Public, Educational, and Government (PEG) content. Initially, the channel could be active only during an emergency, with content running as a loop presentation publicizing emergency messaging and educational content.
- 58) Consider developing, perhaps in conjunction with island non-profits, a “welcome to Bald Head Island” presentation for island visitors with useful non-commercial information and advice that would run as a loop on the government access channel,** to be replaced with a loop presentation about hurricane preparedness and evacuation that could run when storms approach.

### Other Communications Channels

- 59) Collaborate with the Bald Head Association to develop or identify links to the best content for insurance coverage in advance of a storm, storm preparation steps, evacuation information, re-entry information, and information about choosing contractors and interacting with insurance adjusters in the aftermath of a storm,**

**to determine the best site to host a given type of information, and to provide mutual links to vital information.**

- 60) Develop plans for an Emergency Call Center staffed by Village employees or volunteers that would be the primary point of contact for the public,** receiving incoming calls and emails from property owners and other members of the public, conveying relevant questions or comments to the designated Public Information Officer and providing information, either immediately or when the information is verified by the PIO.

### **Public Information Officer**

- 61) Budget for and promptly hire a Public Information Officer.** The PIO's initial priority would be storm preparation communications and web content.
- 62) The Public Information Officer should convene the group of communications specialists that will collaborate on population preparedness (see recommendation 28 above).**
- 63) Revise the Emergency Management Plan to assure that the PIO is an active member of the EOC with specific duties.**

### **Other Communications Issues**

- 64) Undertake an Emergency Preparedness Simulation activity for BHI's Emergency Operations Center** involving Village officials and personnel having designated positions, roles, and responsibilities as outlined in the Emergency Management Plan.
- 65) At the conclusion of the 2019 Hurricane Season, the Village Manager will convene a meeting with the HFTF Communications Committee to review the status and debrief the above-listed recommendations.**

## **BALD HEAD ISLAND UTILITIES**

- 66) Assure that the current improvements to the power distribution system allow early restoration of power to critical locations** such as Public Safety/EOC, Public Works, Utilities, the telecommunications tower, the Club's irrigation pump, and the primary lift station at Timber Creek Mulch Site.
- 67) Monitor all electrical transformers on the island and document each transformer prone to burial or flooding during storm events.** Duke Energy/Progress regards the flooding associated with Hurricane Florence as an event too rare to fall within their planning horizon that determines infrastructure improvements. Documentation of specific equipment prone to recurring flooding will be necessary to justify relocation or elevation of existing transformers.

**68) Sealed grinder pumps.** For existing homes that have experienced several episodes of flooding deep enough to prevent grinder pump operation, or for new construction at locations shown to be in flood basins by the new LIDAR maps, the Village should consider either allowing or requiring the installation of fully sealed pumps at additional cost.

**69) Backup generator review.** Given the number of backup generators critical to recovery efforts, some of which failed, the Village should review all backup generators for all systems regardless of department and determine whether one or more generic backup generators capable of serving multiple locations should be on hand, or at a minimum, covered by agreements to assure availability if needed.

### GOVERNANCE ISSUES

**70) Financial interest.** Council should amend the Code of Ethics to provide clearer standards for determining when Council should excuse a member from voting due to a financial interest in the outcome.

### BEYOND 2021: LONG-TERM PLANNING ISSUES

**71) The Village should establish a formal long-term planning process with a time horizon of several decades.**

**72) The Village's long-term planning for stormwater management should be based on the projected 6-inch rise in sea level over the next 30 years.** When designing the near-term fixes recommended earlier in this report, project planners should consider plan modifications that take this projected rise in sea level into account.

**73) Working with other coastal communities, the Village should intensify the on-going discussions with the State to create policies and programs that address the needs of municipalities dealing with severe storms and sea level rise,** and to develop stormwater management strategies that balance environmental concerns with economic, public health, and public safety concerns.

**74) The Village's shoreline studies should continue to address the challenges posed by any proposed dredging, deepening, and relocation of the Cape Fear River channel,** enabling active advocacy on the issues both separately and together with other coastal communities.

**75) The Village's shoreline studies should continue to address the challenges posed by any proposed changes to "the Rocks"** that would starve Bald Head Island beaches and make the island more vulnerable to storms, enabling active advocacy on the issues both independently and together with other coastal communities.

- 76) The Village should consider changes to the building code and the Bald Head Association should consider changes in its guidelines and review process to encourage or require design features that make island buildings more resilient to high winds, driven rain, and flooding.**

#### **FOLLOWUP ON TASK FORCE RECOMMENDATIONS**

- 77) The Task Force members recommend that the Village Manager report to Council in early 2020 on actions taken to address each component of the Task Force report, perhaps at the Council retreat. We also recommend that the Task Force members be invited to participate in the discussion.**

## APPENDIX III

### TASK FORCE MEMBERS

**Joe Brawner** is an engineer and business executive who has been a resident of Bald Head Island for 20 years, serving in a broad variety of leadership positions in our community. He has a formidable knowledge of the history of stormwater management on the island and chairs the Stormwater Management working group.

**Rex Cowdry** is a research neuropsychiatrist and health policy expert who has served in a variety of executive positions in state and federal government agencies, including the NIH and the White House National Economic Council. He chairs the task force.

**Keith Earnshaw** is an environmental scientist/health physicist who heads an environmental consulting firm and teaches at the university level about disaster preparedness, emergency management, risk management, terrorism, and radiation safety.

**Pete Fullam** served as BHI Limited's Facility Director, developed its Hurricane Plan, and now owns and operates Island Hardware

**Scott Gardner** was an executive at Duke Energy, where among various responsibilities, he managed storm response communication in North Carolina. He currently serves as President of the Bald Head Island Club.

**Peter Menk** is a lawyer with years of military and civilian experience in logistics, crisis management, disaster response, and the rule of law in Iraq. He has taught strategic planning and critical thinking and chairs the Disaster Planning and Decision-Making working group.

**Conn Sharp** retired from Nationwide Insurance, where he was Director of Change Management and Communications of the Property and Casualty Claims Division and helped develop plans for catastrophic storm debriefs. He chairs the Communications working group.

### WORKING GROUP MEMBER

**Kevin Arata** is an expert in public relations, crisis communications and media relations. He formerly served in management roles in the Army, and now serves as the Communications Director for the City of Fayetteville. He serves on the Communications Working Group.

## APPENDIX IV

### LINKS TO PHOTOGRAPHS AND AERIAL VIDEOS FROM SEPTEMBER 17<sup>TH</sup>, 18<sup>TH</sup>, AND 19<sup>TH</sup>

#### September 17<sup>th</sup> (Village's Voice #9)

Aerial video of South Bald Head Wynd

<http://villagebhi.org/pdf/VV/video.mp4>

Photographs taken by EOC team on initial trip to BHI, Marina to Muscadine/Edward Teach

<http://villagebhi.org/pdf/VV/Pics.pdf>

#### September 18<sup>th</sup> (Village's Voice #10)

Aerial Video of South Beach, West Beach, Marina

<https://www.youtube.com/watch?v=cwMXETPZqgc>

Aerial video of East Beach to Shoals Club

<https://www.youtube.com/watch?v=6khh0IBMVIE>

Aerial photographs of East Beach and eastern end of South Beach

<http://villagebhi.org/pdf/VV/EB.pdf>

#### September 18<sup>th</sup> (Village's Voice #10a)

**Aerial photographs posted by Steve Montgomery**

<https://www.facebook.com/media/set/?set=a.626657734397416&type=1&l=d461395d45>

#### September 19<sup>th</sup> (Middle Island POA)

Aerial video of Middle Island

<https://www.youtube.com/watch?v=BpsVyjPzp-Y&feature=youtu.be> MI 9/19

## **APPENDIX V**

### **Timeline**

Date	Village's Voice#	Summary of new developments	BHI Road Status	Stormwater Mgmt	Power	Water	Sewer	Ferry passengers
Mon, Sep 10	1, 2	Predicted landfall as Cat 4 8PM: Mandatory evacuation on Wednesday, last ferry at 9:30am, no Public Safety, utilities			Yes	Yes	Yes	*
Tue, Sep 11	3				Yes	Yes	Yes	*
Wed, Sep 12	4	9am: water, sewer off 9:30am: last ferry			Yes	No	No	*
Thu, Sep 13	5	8:15pm Cat 2 (100mph) with 20-30" rain predicted. River/port closed.			Yes	No	No	0
Fri, Sep 14		7:15am LANDFALL as Cat 1 (90 mph) just N of Wilmington 9:15am eye about 10 mi N of BHI, slowing, turning W. Gusts measured at 62-66 mph with open area gusts 90 mph est. Very heavy rain.			*	No	No	0
Sat, Sep 15	6	Heavy rain continues. Southport isolated by flooding. Many roads closed.			No	No	No	0
Sun, Sep 16	7	Same, with wind and rain abating. I40 closed, Southport & Wilmington isolated. Curfews in effect.			No	No	No	0
Mon, Sep 17	8, 9	Emergency Ops Ctr team to island. Cleared NBHW of debris, working in deep water. Reached PS/PW/Util area.	Massive flooding of areas never previously flooded. Widespread debris and deep water hinders all travel. Aerials and pix.		No	No	No	25
Tue, Sep 18	10	River reopened daylight hrs. DP/BHI Marinas remain closed. Limited staff incl Mayor on island. Ferries arrive in Southport w food & workers		Beach ends of emergency outfalls excavated. 10" pump Stede Bonnet > beach outfall. 6" pump WBHW > beach outfall. Gravity outfall to creek still high.	No	No	No	32

Date	Village's Voice#	Summary of new developments	BHI Road Status	Stormwater Mgmt	Power	Water	Sewer	Ferry passengers
Wed, Sep 19		Larger assessment teams incl utilities. Cellular service restored after generator repair.		Still unable to place Horsement 10" pump b/o deep water	No	8:30- 4:30 Brunasco water	No	46
Thu, Sep 20	11	Addl right-of-first-refusal rental pumps (7) arrive. Wildlife Resource officers @ marina.	Roads cleared to Conservancy but flooded. More drone flights and pix.	Horsemint 10" pump in place, pumping > WBHW outfall. Still unable to reach pump pad on #15	No	8:30- 4:30 Brunasco water	No	55
Fri, Sep 21	12	Still no reliable mainland route to Wilmington/ Southport area.	Roads cleared to Middle Island. Water depths SBHW WBHW improving (still >2' at Horsemint). Inland low areas deep esp Musc, Edw T., secondary roads.	Pumping Lagoon #15 > lagoon #17 > SBHW outfall. Dune breached at Green Teal. S Beach gravity outfall opened & operating, water receding E of Club.	No. Team on island	8:30- 4:30 Brunasco water	No	74
Sat, Sep 22	13	3 safe routes to ILM identified by DOT.	All 1° roads clear of debris. Major probs even for some ICE vehicles: WBHW, SBHW W of Club, Stede B, EdwTeach, Musc, Fed Rd, Floras B/Killigray, Conserv.		No. Assessment complete. Working on power supply from mainland.	8:30- 4:30 Brunasco water	No	67
Sun, Sep 23	14	Natl Guard mobilized w/ 2 high water vehicles. Assessment of grinder pumps underway. Brunswick Co still under curfew.	All 1° and 2° roads clear of debris. Work removing "leaners and hangers" (tree dangers) continues.	12+ pumps running.	No	8:30- 4:30 Brunasco water	No. Breakers to submerged pumps are being turned off.	59
Mon, Sep 24	15 16	Much of island's garbage picked up. I-40 now open	Similar to 9/22 but improving	6" pump at lagoon #6. Brief pumping from irrigation lagoons. 9/24-26 Dunes breached SBHW (Brown P to Inverness)	No. 50% of Stage I XF under water or buried	8:30- 4:30 Brunasco water	No	57
Tue, Sep 25	17	Resid and comml trash pickup complete. VV: prop mgrs and contractors on island tomorrow "in support of Village assessments"	Continued gradual improvement.	Brief pumping from irrigation lagoons. 9/24-26 Dunes breached SBHW (Brown Pelican to Inverness)	No. Temp power at Club irrigation pump yesterday & today	8:30- 4:30 Brunasco water	No	68

Date	Village's Voice#	Summary of new developments	BHI Road Status	Stormwater Mgmt	Power	Water	Sewer	Ferry passengers
Wed, Sep 26	18	Property managers and contractors on island "in support of Village assessments"	Roads ICE vehicle passable. Deep pools not golf cart passable at CF Station, Stede Bonnet, Edw Teach, some 2° roads	Pumping from irrigation lagoons to lagoon 17	Power to Club irrig system.	8:30- 4:30 Brunsko water	No. 96 pumps under water	87
Thu, Sep 27	18 abcd	Propety managers and contractors on island 8P: Saturday reentry for property owner inspections announced. Some internet service returns as power is restored.			Power restored in phases. 122 without power, plus addl failures N of NBHW	8:30- 4:30 Brunsko water	No. 83 pumps under water	114
Fri, Sep 28	19 19ab	Many contractors, property managers, commercial staff on island. 2:30P Two-phase (W/E of Muscadine) property owner inspection reentry announced				8:30- 4:30 Brunsko water		176
Sat, Sep 29	20	6P Golf cart travel restrictions lifted		Focused pumping in area of power line serving the sewer system's primary lift station.	72 + WmRhett, IbisR, Royal J, Sabal P, Stede Bonnet Close, Timbercreek	8:30- 4:30 Brunsko water	53 + WmRhett, Palmetto C, Stede Bonnet Close, Timbercreek	353
Sun, Sep 30	21	2PM Island will reopen tomorrow. However, primary lift station generator failed and power supply is damaged. Replacement generator purchased.			Duke/Progress will attempt repair of 3 phase line to 1° lift station tomorrow	8:30- 4:30 Brunsko water		*
Mon, Oct 1		State of Emergency lifted. Island reopened to all. Ferry and barge operating. Marinas open. DAT to begin work. Debris removal info.			Restored to all homes	Brunsko water 24/7	29 still without sewer	*

- = data unknown/not requested