ATTACHMENT A

STAFF RECOMMENDATION AND REQUEST FOR PUBLIC HEARING TO INFORM THE FINAL AGENCY DECISION - WAVE DISSIPATION SYSTEM

December 8, 2016

Staff Recommendation and Request for Public Hearing to Inform the Final Agency Decision - Wave Dissipation System

November 2016

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Introduction and Background

The South Carolina Department of Health and Environmental Control – Office of Ocean and Coastal Resource Management (DHEC-OCRM or the Department) is tasked with determining whether the Wave Dissipation System (WDS) has been successful in addressing an erosional issue and whether it is qualified for future use in emergency situations, pursuant to S.C. Code Ann. Regulation § 30-15(H).

The WDS is an experimental device intended to reduce wave energy and its erosive effects on the beach, while also protecting landward elements including houses and infrastructure. The WDS was independently designed and academically sponsored for research by The Citadel as an alternative to sandbags to employ only in emergency situations. The purpose of The Citadel's academic study was to determine the performance of the WDS under various wave loading scenarios, and to gather data on the resulting effects on the beach. Specifically, The Citadel's request letters to the Department to initiate the study all state that "The scarp behind the [WDS] will be measured and a performance measure will be the ability of the [WDS] to stabilize the scarp line….Finally, performance of the system will be measured using numerous tests where horizontal spacers and related horizontal elements are studied in regards to sand accretion and erosion in front of and behind the system." A scarp is characterized as a very steep or vertical slope on the beach due to wave action. The scarp line position is captured at the top of the vertical slope.

The WDS consists of vertical piles (encased in hard plastic) and horizontal members (PVC pipes). The spacing between the horizontal members can be adjusted based on tide and wave conditions to allow some sand and water to pass through the structure. The WDS structures were initially developed under a pilot program established by the South Carolina Legislature in Budget Proviso 34.51 of the 2014-2015 General Appropriations Act, and subsequently, Budget Proviso 34.48 of the 2015-2016 General Appropriations Act. The proviso language is listed in Appendix A.

The first WDS was constructed seaward of Seascape Villas in Wild Dunes on the Isle of Palms in November 2013, and was removed prior to a large-scale beach scraping project in November 2014. The Department found the results of this initial study to be inconclusive, so the Department acknowledged an expanded study at additional site types to allow The Citadel an opportunity to collect more data and evaluate the WDS under different conditions. Four WDS structures are currently in place along the state's beaches. One is on Harbor Island and the other three are in Wild Dunes on the Isle of Palms (Ocean Club Villas, Seascape Villas, and Beachwood East).

The Harbor Island WDS spans four lots on North Harbor Drive: lots 49, 52, 53, and 56. According to The Citadel, the purpose of this particular study location is to "determine and subsequently describe the performance of the [WDS] under less extreme loading (more tidal in this location due to low beach elevation and smaller waves with possible periods of respite)." The WDS is a single-tier structure at this location, and the pilings are spaced 10 feet apart. It is approximately 400 feet long.

The Ocean Club Villas WDS is seaward of Ocean Club Villas in the Wild Dunes development on the Isle of Palms. According to The Citadel, the purpose of this particular study location is to “determine and subsequently describe the performance of the [WDS] under extreme loading that is imminent as the beach continues to lower and the adjacent scarp line continues to retreat.” The WDS is a triple-tier structure at this location, and the pilings are spaced 8 feet apart. It is approximately 256 feet long. The WDS at this location was originally installed with two walls in April 2015, but a third wall was added in November 2015. The Seascape Villas WDS is seaward of Seascape Villas in Wild Dunes on the Isle of Palms. The WDS is a double-tier structure at this location, and the pilings are spaced 8 feet apart. It is approximately 120 feet long. The WDS at this location was originally installed with one wall in November 2015, but a second wall was added in January 2016. The Ocean Club Villas and Seascape Villas WDS installations were built separately at different times, but they are attached and are effectively one structure for monitoring purposes. The combined structure length is approximately 376 feet.

The Beachwood East WDS is installed on the beach seaward of nine houses in the Wild Dunes development on the Isle of Palms: 11, 12, 13, 14, 15, 16, 17, 18, and 19 Beachwood East. According to The Citadel, the purpose of this particular study location is to “determine and subsequently describe the performance of the [WDS] under less extreme loading than the installation at Ocean Club yet more extreme loading, and not as tidal, as the installation at Harbor Island.” The WDS is a single-tier structure at this location, and the pilings are spaced 8 feet apart. It is approximately 850 feet long. For additional information about the WDS sites, please see the attached final reports from The Citadel and GEL Engineering, LLC.

Data Collection and Analysis

The Citadel

Data collection by The Citadel researchers involved collecting monthly beach elevation data along shore-perpendicular transects from the WDS to the low tide line, monthly measurements of the scarp line position, and photo/video documentation. However, there was no data collected landward of the WDS (between the scarp line and the WDS). DHEC-OCRM reiterated to The Citadel researchers on several occasions that they should also collect data landward of the WDS to determine whether erosion or accretion was occurring. In their study request letters to the Department, The Citadel had stated that they would collect elevation data landward of the WDS, and this was also required in the Department’s study acknowledgement letters. The Citadel data, including transects seaward of the WDS and the scarp line position, was provided to DHEC-OCRM as lists of coordinates and elevations in Excel spreadsheets, but no beach profile figures or data analyses were provided. The Citadel also provided raw data pertaining to water levels, wind speeds and directions, and wave heights for the duration of the study.

GEL Engineering

The Department drafted a Request for Proposals (RFP) to solicit an objective third-party review of the design and functionality of the WDS system. The RFP was intended to supplement the data being collected by The Citadel and to ensure that the Department had sufficient information to evaluate the effectiveness of the structures. Through the RFP process, the Department contracted with GEL Engineering, LLC of Charleston, SC to collect survey and photo data, and to answer specific questions pertaining to their observations of each WDS structure. GEL collected these data between March and July 2016 and produced a final report, which is provided along with this document.

Data collection by GEL involved collecting monthly beach elevation data along shore-perpendicular transects from the scarp line to the low tide line, monthly measurements of the scarp line position, and photo/video documentation. The transect data were requested by DHEC-OCRM to quantify the effectiveness of the WDS in maintaining the position of the scarp line landward of the WDS and to determine whether the WDS resulted in erosion (loss of sand) or accretion (gain of sand) landward of the WDS structure. By collecting data between the scarp line and the WDS at each study location, GEL was able to analyze erosion or accretion of the beach both landward and seaward of the WDS.

DHEC-OCRM

Department staff made regular visits to each of the WDS sites. Photographs and videos were taken in order to visually monitor changes to the beach profile and scarp line position, to document modifications of the WDS structures, and to document the frequency of scouring seaward and landward of the WDS structures.

Table 1 and Figure 1 compare the data collection efforts of The Citadel, GEL, and DHEC-OCRM.

Table 1: Data Collection Efforts

Type	Citadel	GEL	DHEC - OCRM staff
Scarp Line Position	Yes	Yes	N/A
Elevation Data Landward of WDS	No	Yes	N/A
Elevation Data Seaward of WDS	Yes	Yes	N/A
Trenching Documented	Yes	Yes	Yes
WDS Modifications Documented	Yes	Yes	Yes
Photos/Videos	Both	Both	Both

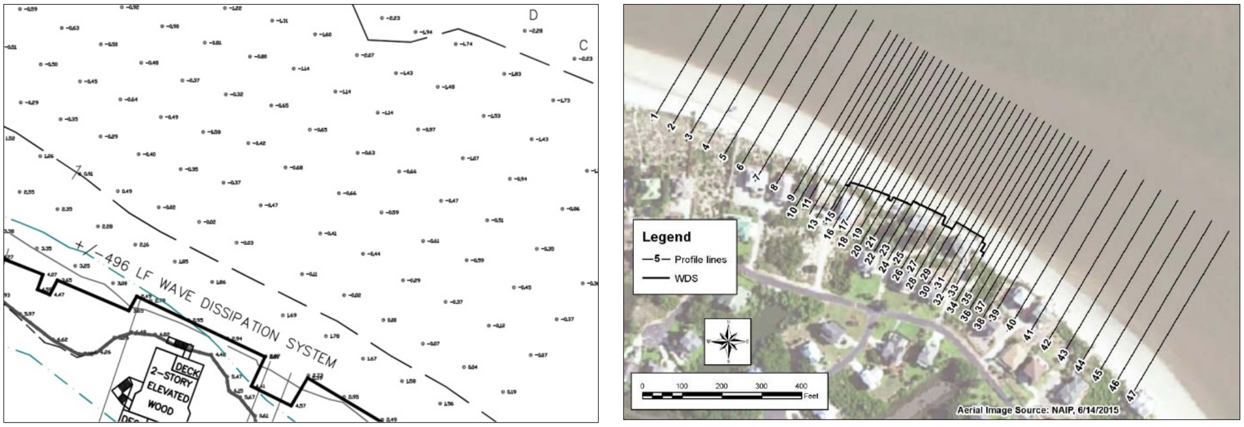


Figure 1: Example of The Citadel data collection transects (left) and GEL data collection transects (right) at Harbor Island. The main difference is GEL collected elevation data both landward and seaward of the WDS at each location, while The Citadel only collected data seaward of the WDS.

Findings

In evaluating whether the WDS is a qualified system that was successful in addressing an erosional issue, and whether there were additional beach impacts, DHEC-OCRM relied upon the statutory language in S.C. Code Ann. § 48-39-320(C) and S.C. Code Ann. § 48-39-130(D)(2).

S.C. Code Ann. § 48-39-320(C) states, "(C) Notwithstanding any other provision of law contained in this chapter, the board, or the Office of Ocean and Coastal Resource Management, may allow the use in a pilot project of any technology, methodology, or structure, whether or not referenced in this chapter, if it is reasonably anticipated that the use will be successful in addressing an erosional issue in a beach or dune area. If success is demonstrated, the board, or the Office of Ocean and Coastal Resource Management, may allow the continued use of the technology, methodology, or structure used in the pilot project location and additional locations."

S.C. Code Ann. § 48-39-130(D)(2) provides, "(D) It shall not be necessary to apply for a permit for the following activities: (2) Hunting, erecting duckblinds, fishing, shellfishing and trapping when and where otherwise permitted by law; the conservation, replenishment and research activities of state agencies and educational institutions or boating or other recreation provided that such activities cause no material harm to the flora, fauna, physical or aesthetic resources of the area."

Finally, The Department reviewed the seven qualification criteria found within the budget provisos listed in Appendix A.

DHEC-OCRM finds that the WDS has not been successful in addressing an erosional issue, and results in additional impacts to the beach. In addition, findings also indicate that the WDS does not meet the qualification criteria of Budget Proviso 34.51 of the 2014-2015 General Appropriations Act or Budget Proviso 34.48 of the 2015-2016 General Appropriations Act.

This document is divided into three sections to provide support for the stated findings.

Section 1: The WDS is unsuccessful in addressing an erosional issue.
Section 2: The WDS results in additional impacts to the beach.
Section 3: The WDS does not satisfy the Budget Proviso qualification criteria.

Throughout this document, relevant direct excerpts from The Citadel's final report and GEL's final report are provided to document each conclusion. Rather than paraphrase and summarize those reports, DHEC-OCRM lists direct quotes and page numbers so the reader can refer to the reports directly. All tables and figures referenced by The Citadel or GEL should be referred to in their final reports. The conclusions drawn by DHEC-OCRM staff are based on a thorough evaluation of The Citadel's final report, GEL's final report, and frequent staff site visits throughout the study period. All photographs provided in this recommendation to the Board were taken by DHEC-OCRM staff, with the exception of those shown in Figures 18, 19, and 20.

Section 1: The WDS is Unsuccessful in Addressing an Erosional Issue

The Department based the ability of the WDS to address an erosional issue on three erosional indices: 1.) The ability of the WDS to hold the scarp line position, 2.) The ability to increase or retain sand volume on the landward side of the WDS, and 3.) The ability to minimize trenching and scour.

The Citadel

Scarp line position

- The Citadel collected scarp line position data, which was provided to DHEC – OCRM. They did not provide any analysis results or conclusions regarding the movement of the scarp line position in their final report.

The ability to increase or retain sand volume on the landward side of the structure

- The Citadel provided The Department with raw transect data points seaward of the WDS, but no analyses or conclusions were provided in the final report regarding sand volumes landward or seaward of the WDS.
- At all sites, The Citadel stated that "our review of the surveys and the related data (sand volumes gained and lost over time) leads to the conclusion that there is no negative or significant impact by the WDS on the adjacent beach profile" (The Citadel, pgs. 16, 19, and 26).
- At Beachwood East, "noticing the enormous level of accretion the research team forecast for several more weeks of accretion, Dr. Mays acted quickly and notified OCRM that the team wanted to test (as shown clearly during the previous Seascape study) that the sand accreting behind the system could be pushed back to allow the homeowners to reclaim the sand they lost from the 1,000 year event, to rebuild the dune to its initial configuration prior to the 1,000 year event, and to allow the removal of sandbags (which served no purpose) that the homeowners bought as added protection after the 1,000 year event damage to their property. It seemed like a perfect win-win for the research team and the community. However, OCRM did not allow the research team to prove that it could function in this capacity. This was disappointing since it is very important to prove that the system can perform as advertised" (The Citadel, pg. 19).
- At Harbor Island, "Although at first, there was some accretion, the wave energy was not strong enough to push it more than three ft or so beyond the WDS. This led to an unacceptable low space (relative to the accreted area) beyond the accreted sand. It should be noted that the horizontal panel system at Harbor Island was designed to be over two times as flexible as the one installed at Ocean Club (and Seascape in 2013-2014). This flexibility alone did not provide adequate 'breathing' of the ocean such that a more uniform distribution of accreted sand fell behind the system. For that reason, the research team added some trial spacers to encourage more natural sand accretion behind the system. The initial result of the added spacers was an improved distribution of sand behind the system. Soon after, the site developed what has been the biggest issue at Harbor Island. As the beach lowered and the added spacer elevations became too high (relative to the beach profile) to allow for exit water to efficiently leave the area behind the WDS, a trench developed directly under the system. (The Citadel pgs. 21-24).

<u>The Ability to Minimize Trenching and Scour</u>

- "The only major concern that the research team noted during the study is the temporary local trenching that occurred at times at each site….The trenching appears to be related to scour caused by extreme tides, significant erosion events, and the uncontrolled volume of water that is allowed to pass through the system (this same volume of water must escape as the tide goes back out)" (The Citadel, pg. 4).
- "Removing just the horizontal panels in areas of local trenching almost immediately restores the beach profile by eliminating the trenching effect and the horizontal panels are easily removed for this purpose" (The Citadel, pg. 4).
- Spacers were located at several locations during the second quarter of this study and it was determined that they are not the ideal solution to trenching. They help at times but they must be constantly adjusted with changing elevations." (The Citadel pgs. 21-24).
- "The [Vertical Porous Panels] VPPs are experimental prototypes that must be studied to determine their optimal configuration, hole pattern, length, etc. and the typical sketch given to OCRM was intended to provide an idea of what the panels should like [sic] during the first installation. During construction of the panel, the research team found that drilling slots was too difficult (and was damaging the panel) and that holes would work better. Hence the team made the decision to move forward with holes instead of slots. In addition, the actual as constructed version of the panel was actually more porous than the proposed version considering its overall purposely placed installation configuration. The goal of studying the vertical panels was to determine the optimal porosity and configuration. The research team spent hours designing different details for the porosity prior to OCRM saying that the VPPs could no longer be tested. We are very disappointed that the research team's main proposed method (prior to the expensive option of lowering of the system) for removing the team's one major concern from the study at Ocean Club and Seascape was not allowed to be studied for stated technical reasons that are not justified nor based on engineering mechanics, coastal engineering, or coastal geology principals" (The Citadel, pg. 10-11).
- At all WDS sites, "Trenching, caused by significant erosion events, and related to the system's allowance of rising tide levels (with moving water) behind the WDS can, when deep enough, become a concern. The study has shown that the system is always self-healing and that the trenching is always temporary. On the contrary, deep trenching on site should not be allowed and must be mitigated anytime it appears on site" (The Citadel, pgs. 16, 19-20, 26).
- "It has always been known that flooding the system using isolated panel removal can easily remove trenching and is almost instantaneous" (The Citadel, pgs. 16, 20).

GEL Engineering

<u>Scarp Line Position</u>

- At Harbor Island, "the erosion downdrift of the WDS, in the adjacent lot west of the WDS, is evident in Figures 4-33 and 4-34 (see changes at alongshore distances between 400 and 500 feet). The fraction of this erosion attributable to the WDS cannot be quantified, but the pattern suggests that the WDS may contribute to scarp erosion within a short distance (i.e., mostly within 100 feet) of the end of the structure (GEL, pg. 66).
- At Harbor Island, "the wave activity between the March and April surveys caused recession of the [Mean High Water (MHW)] shoreline along the entire study area. The WDS did not prevent erosion of the MHW contour landward of the WDS. The MHW

contour along the WDS receded by an average of 24 ft, a similar amount as the average recession to the east (24 ft) and the west (23 ft). During the subsequent survey periods, the wave climate was milder, and the MHW contour shifted seaward" (GEL, pg. 48). At lot 49 on Harbor Island, "there was erosion on the landward side of the WDS in this area during the March to April time period, but the sandbags and the top of the scarp remained stable. Small sand bags such as those deployed here do not remain stable when subjected to any significant wave action. The overall stability of the sandbags at lot 49 during the March to April timeframe demonstrates that the WDS was effective at attenuating wave action sufficiently such that there was only minimal, if any, erosion of the slope protected by the sandbags" (GEL, pg. 49).

- At Beachwood East, "the wave action between the March and April surveys resulted in recession of the MHW contour along the WDS by an average of 8 feet. In contrast, the MHW contour to the east moved seaward by an average of 3 feet in this time period. Over the whole study period between March and July, the MHW contour along the WDS segment eroded by an average of 6 feet, while the MHW contour east of the WDS moved seaward by an average of 38 feet. The accretion pattern east of the WDS is the result of the spreading of sand from the attaching shoal east of the BE project site. Scarp lines experienced only minor changes during the monitoring period. The stability of scarp along the east end is due to the accretion from the shoal attachment and spreading. The stability of the scarp line on the landward side of the WDS despite the recession of the MHW contour in this area can be attributed to the combination of the WDS and the large sandbags that protect a majority of the scarp line along this segment of the beach (GEL, pg. 67).
- At Ocean Club and Seascape Villas, "the wave activity between the March and April surveys caused recession of the MHW shoreline along the entire study area…. The MHW contour along the WDS receded by an average of 32 feet. The areas to the east and west receded by 22 and 19 feet, respectively, on average. During the subsequent survey periods, the wave climate was milder, and the MHW contour shifted seaward" (GEL, pg. 80). "The landward most top-of-scarp line surveyed in March remained mostly stable throughout the study period. A small section of this scarp adjacent to the east side of the OC building receded about 4 feet over the course of the study" (GEL, pg. 82).
- "During the monitoring period, March through July, the scarp was stable in areas where the WDS was used in combination with sandbags (except where small sandbags or fill material were stacked at an excessively steep angle). In some areas fronted only by the WDS, scarp erosion was observed following the storm wave action that occurred between the March and April surveys. <u>The survey data collected by The Citadel researchers shows large amounts of scarp erosion at the BE and OC/SV site following the initial installation of the WDSs"</u> (GEL, pg. 124-127).

<u>*The ability to increase or retain sand volume on the landward side of the structure*</u>

- "During the typical storm wave conditions that occurred during this monitoring study, the WDS allowed erosion of sand from the landward side of the WDS. In areas where the WDS was at relatively high elevations on the beach, scour holes did not develop that extended below the horizontal members. In these scenarios, transport of sand seaward through the WDS was minor. Figure 5-5 shows an example of erosion on the landward side of a section of the Seascape Villas WDS that occurred after the March through April period when waves caused large amounts of erosion of the entire beach. Areas with the greatest amount of erosion during storm events occurred in areas where the scour passed beneath the WDS, or the entire beach profile was lowered beneath the WDS, which allowed sand to be transported seaward. When this occurs, large volumes of sand were transported seaward underneath the WDS horizontal panels. During the subsequent natural beach recovery, large volumes were also observed to move landward underneath the WDS horizontal panels" (GEL, pg. 124).

- At Harbor Island, "the WDS allows some transport of accreting sand through the WDS. However, given the buildup of sand observed on the seaward side of the WDS, it appears that the WDS can inhibit the amount of natural landward migration of sand during mild wave conditions" (GEL, pg. 55).
- At Harbor Island, "The fact that the upper beach showed a small net loss of sand behind the WDS (-0.2 cy/ft) while the entire beach down to the low tide line showed accretion (1.1 cy/ft), indicates that the accretion in the WDS beach segment shown in Table 4-3 and Figure 4-33 occurred on the seaward side of the WDS" (GEL, pg. 65).
- At Ocean Club and Seascape Villas, "The net change over the study period showed a small amount of accretion to the west of the WDS (0.3 cy/ft, on average), erosion landward of the WDS (-0.7 cy/ft at SV and -0.9 cy/ft at OC, on average), and a small amount of erosion east of the WDS (-0.2 cy/ft, on average)". (GEL, pg. 100).
- At Beachwood East, "Similar to the observations at Harbor Island, the upper beach showed a small net loss of sand on the landward side of the WDS over the March to July period (-0.6 cy/ft) while the entire beach down to the low tide line for the same segment showed accretion (1.4 cy/ft) (compare Table 4-5 to Table 4-6). This indicates that the accretion in the WDS beach segment occurred on the seaward side of the WDS" (GEL, pg. 79).

The Ability to Minimize Trenching and Scour

- At Ocean Club, "the waves between March and April eroded and lowered the beach profile in this area to the point that the bottom of the WDS horizontal members were above the beach. In response, sections of the OC WDS system were lowered by 2 feet in April. Additional sections were lowered in May…. Typically, during lowering of the WDS, a trench is excavated along the WDS, and the sand is placed on the landward side" (GEL, pg. 82).
- "Scour occurred at all four WDS sites prior to the April survey, and the beach in these areas subsequently accreted" (GEL, pg. 101).
- "High tide observations of wave action at these sites confirmed that if the scour hole is deep enough to allow free flow of water beneath the horizontal members, the WDS becomes less effective at attenuating waves" (GEL, pg. 107).
- "Based on our field observations, scour can occur at the WDS when subjected to erosive wave action. This scour is limited to a temporary localized effect that allows greater wave energy to be transmitted to the landward side of the WDS. There is no evidence of adverse impacts other than reduced WDS performance (i.e., reduced wave attenuation" (GEL, pg. 107).
- "In general, when a wave interacts with a coastal structure such as the WDS, some of the wave energy is dissipated through wave breaking or structure deflection, some of the wave energy is reflected, and some of the wave energy is transmitted landward of the structure. Wave interaction with the WDS is dependent on the water level and offshore wave conditions. As the tide rises and the stillwater level approaches the WDS, the WDS

is within the swash zone, which is the area of the beach where waves run up the beach after breaking. During these conditions, the WDS is effective at blocking the uprush of the wave, either dissipating or reflecting all of the wave energy when there are no spacers between the horizontal members" (GEL, pg. 107). "When the WDS is in deeper water (e.g., at the seaward-most tier of the OC WDS, or during very high tide conditions at the other WDS sites), the fraction of transmitted wave energy increases. The amount of wave energy transmitted depends on the presence of spacers between the horizontal members, the water depth, the incident wave characteristics and the presence/absence of scour beneath the WDS" (GEL, pg. 107).

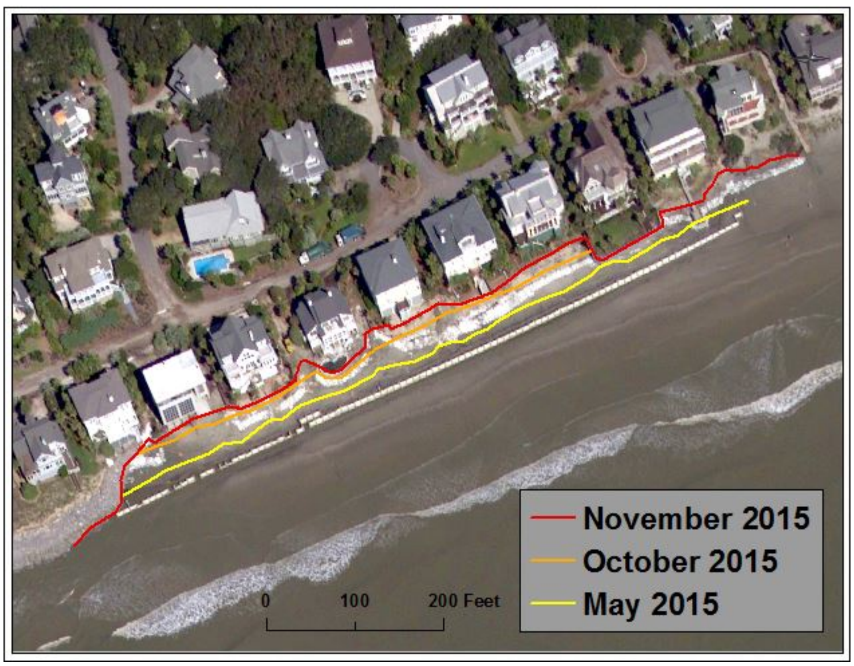
- "During energetic wave conditions, wave overtopping was observed (Figure 4-107). The return flow of water from wave overtopping likely contributes to the creation of scour holes beneath the WDS during high tides with energetic waves. The transport of overtopping water laterally along the shoreline can also contribute to erosion landward of the WDS" (GEL, pg. 109).

DHEC-OCRM Observations

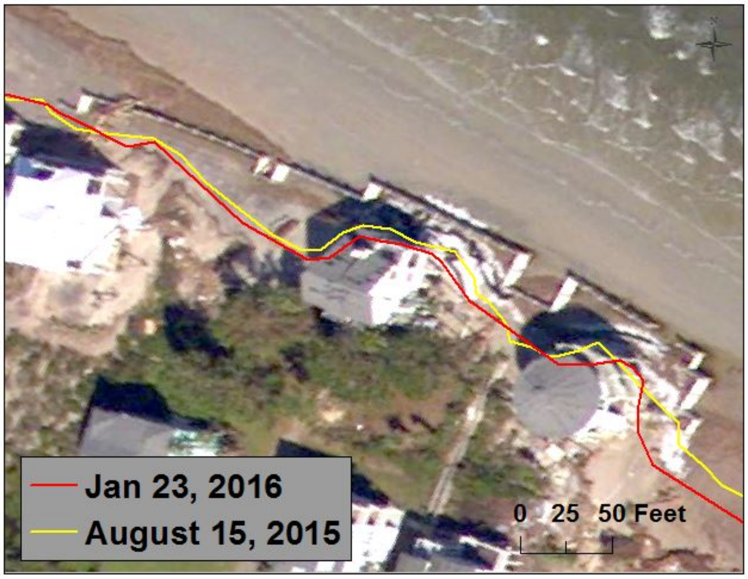
<u>*Scarp Line Position*</u>

- The WDS <u>did not maintain the scarp line or MHW positions.</u> While the scarp line position did not change drastically during GEL's study, which covered the time period between March and July 2016, <u>the scarp eroded significantly at each WDS site after the structures were installed, but before GEL began their study (Figure 2). This earlier scarp line movement was documented in the data collected by The Citadel and mapped by DHEC – OCRM (Maps 1 and 2).</u> This continued scarp erosion led to property owners requesting emergency sandbags for scarp protection at different times during the study at all four WDS locations. The sandbags at Harbor Island were already present prior to installation of the WDS at that location, but several renewals of the sandbag Emergency Orders were issued by DHEC-OCRM during the study to allow property owners to continue to protect their property from erosion (Figure 3). At Beachwood East, sandbags have been on the beach landward of the WDS since Fall of 2015 (Figure 4). At Ocean Club Villas, the sandbags were cut open after the broken slab beneath the building was repaired to allow the sand to be added landward of the WDS (Figure 5). The sandbags were subsequently removed from the site. At Seascape Villas, the sandbags were also cut open to allow the sand to be added landward of the WDS. The sandbags were cut open and removed after the second tier of the WDS was installed (Figure 6).

Figure 2: Scarp erosion landward of the Beachwood East WDS during storm conditions before the placement of emergency sandbags. This was approximately 1 month after the WDS was installed.



Map 1: Shows the landward movement of the scarp line position at Beachwood East after the WDS was installed.



Map 2: Shows the landward movement of the scarp line position at Harbor Island after the WDS was installed.

Figure 3: Harbor Island WDS location after WDS installation (left) and after new sandbags (right).

Figure 4: Beachwood East WDS location before (left) and after (right) sandbags.

Figure 5: Ocean Club Villas WDS location before (left) and after (right) sandbags.

Figure 6: Seascape Villas WDS location before 2nd tier installed (left) and after 2nd tier installed (right).

- DHEC-OCRM staff observed that the pooling of water on the landward side of the WDS allowed waves to re-form and break higher up on the beach, thus impacting the sandbags or eroding the scarp line (Figure 7).

Figure 7: Waves re-forming and breaking on the landward side of the Beachwood East WDS. Video screen-grab from September 29, 2015.

- When used as the sole erosion mitigation technique, the WDS does not hold the scarp line position or protect property landward of it. At Beachwood East and Harbor Island, sandbags were requested and employed by property owners for the duration of the study to stabilize the scarp line and protect their property. At Ocean Club, sandbags were deployed for part of the study. When sandbags were not present at that location, the three-walled system of the WDS was sufficient to break enough wave energy to minimize damage to the building. However, the parking slab beneath the building collapsed and had to be replaced, and the scarp continued to move landward beneath the building (Figure 8).

Figure 8: Continued erosion beneath Ocean Club Villas Building #1. Also note the scour (trenching) that is present on both sides of the WDS.

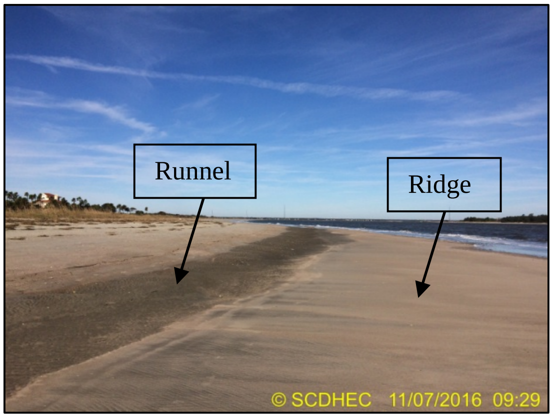
The ability to increase or retain sand volume on the landward side of the structure

- As observed by GEL during their study of the WDS, there was a loss of sand on the landward side of the structure at all four sites. Accretion of sand at all sites was always on the seaward side of the structure, not on the landward side. The WDS blocks the natural accretion of sand on the shoreline during calm conditions, and is ineffective without sandbags during storm conditions. Therefore, the WDS does not increase or retain sand on the landward side. (Table 2)

	Ocean Club	Seascape Villas	Beachwood East	Harbor Island
Volume change landward of low tide line (cy/ft)	1.3	3.1	1.4	1.1
Volume change landward of WDS (cy/ft)	-0.9	-0.7	-0.6	-0.2

Table 2: All four sites saw sand volume decrease landward of the WDS between March and July, while the beach seaward of the WDS accreted sand. This indicates that the WDS blocked the natural movement of sand up the beach.

- As noted by GEL, "sand often migrates onshore through a process of landward movement of ridge-and-runnel features that gradually merge onto and widen the dry beach" (GEL, pg. 96). Figure 9 is an example of a ridge-and-runnel feature moving onto the beach in November 2016 northeast of the Ocean Club WDS on Isle of Palms. The ridge of accreting sand is the light colored smooth surface to the right of the photograph. Another example from Folly Beach in December 2015 is also shown in Figure 9. The Folly Beach photograph was taken at approximately the same time that several horizontal panels were removed from the Beachwood East WDS to allow the naturally accreting sand to move landward of the WDS. The landward movement of ridge-and-runnel features occurs during calm conditions and is a natural process.



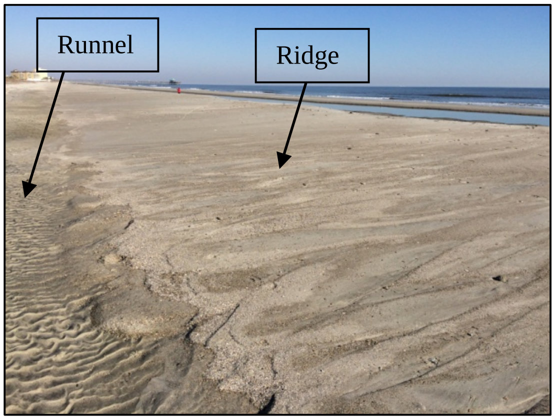


Figure 9: Landward movement of ridge-and-runnel features at Isle of Palms in November 2016 (left) and at Folly Beach in December 2015 (right). The natural widening of the beach during this process occurs during calm conditions.

- Figure 10 below compares typical beach cross-section profiles during storm conditions, after storm conditions, and during calm conditions. During storm conditions, the beach profile lowers and the berm (dry sand beach) erodes as waves and currents transport sand seaward. After a storm, the eroded sand has been deposited just offshore or in the intertidal zone as sand bars. During calm conditions, the sand that has been deposited on the sand bars is gradually pushed back towards the beach by gentle wave action, forms ridge-and-runnel features, and then fully welds onto the berm and widens the dry sand beach. Again, this process of beach erosion during storm conditions followed by accretion during calm conditions is a natural phenomenon and cannot be attributed to the presence of the WDS.

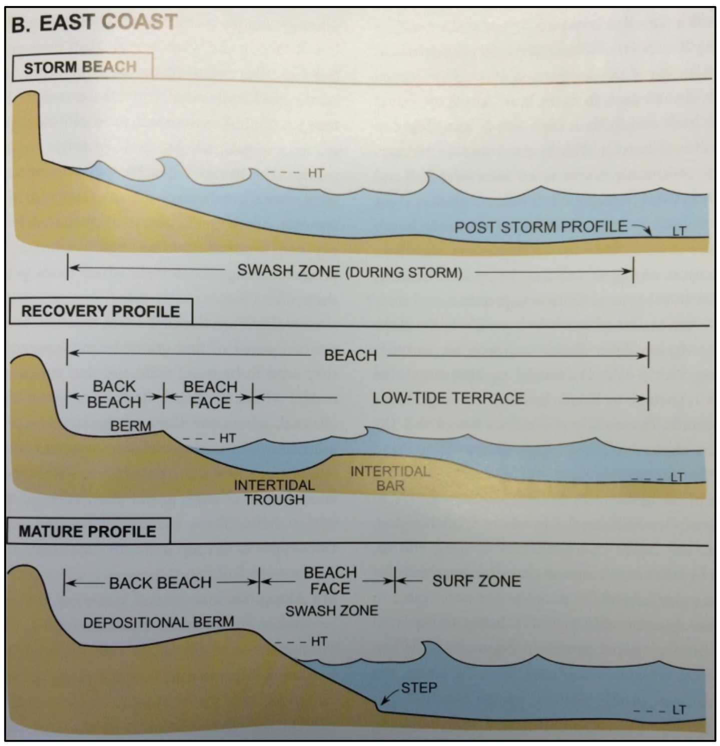


Figure 10: Typical beach cross-section profiles during storm conditions (top), after storm conditions (middle), and during calm conditions (bottom). Source: Miles O. Hayes and Jacqueline Michel. 2008. A Coast for All Seasons: A Naturalist's Guide to the Coast of South Carolina.

- The Citadel researchers requested to bulldoze sand on the landward side of the WDS at Beachwood East to build a dune. DHEC-OCRM denied the request for two reasons: 1.) Bulldozing the sand would have altered the study data. Beach profile data (elevations and scarp line positions) were collected monthly throughout the study by both The Citadel and by GEL to determine the effects of the WDS on the beach. Artificially altering the beach profile by bulldozing or minor renourishment would have resulted in an inconclusive study, 2.) During the first WDS study at Seascape Villas in 2014, The Citadel researchers bulldozed the sand behind that WDS installation without prior DHEC-OCRM authorization, and the piled up sand eroded away in a matter of days (Figure 11). Lowering the beach profile landward of the WDS by bulldozing allowed the waves to reach higher up the beach and erode the scarp line more quickly.

Figure 11: Sand that was scraped and piled up by The Citadel research team at Seascape Villas on September 19, 2014 (left), which had almost completely eroded by September 22, 2014 (right).

- Where the WDS is present during calm conditions, sand that is naturally moving landward (up the beach profile) becomes trapped on the seaward side of the WDS. This results in the need for spacers and periodic panel removal to allow the trapped sand to move to the landward side of the WDS (Figure 12). Limited sand is able to be pushed by waves and tides through the panels, but this sand would have moved up the beach profile naturally if the WDS were not obstructing it (Figure 13). Where the WDS is present during storm conditions, scour on both sides of the WDS allows more water to reach the scarp and erode it when the scarp is not protected by sandbags. <u>Net accretion observed by GEL during their study at the WDS sites was always on the seaward side of the structure (not on the landward side). The WDS blocks the natural accretion of sand on the shoreline during calm conditions, and is ineffective without sandbags during storm conditions. Therefore, the WDS does not increase or retain sand on the landward side.</u>

Figure 12: Horizontal panels removed at the Ocean Club WDS in January 2016 to allow sand that was trapped on the seaward side of the structure to continue moving to the landward side of the structure.

Figure 13: Small mounds of sand that have been able to move landward through the Ocean Club WDS in December 2015.

The Ability to Minimize Trenching and Scour

- DHEC – OCRM staff observed persistent trenching and scour at the base of the structures at all sites except Seascape Villas (Figures 14 and 15).
- Trenching and scour was photo documented at the following locations and dates.
  - Ocean Club in April and May of 2016.
  - Beachwood East in September, October, November, and December 2015 and February, April, May, and June 2016.
  - Harbor Island in July, August, September, October 2015, and March and April 2016.

Figure 14: Scour (trenching) on the seaward and landward sides of the Beachwood East WDS.

Figure 15: Example of persistent scour (trenching) at the Beachwood East WDS. Similar effects were seen throughout the study at all WDS sites except Seascape Villas.

- The Citadel researchers installed "Vertical Porous Panels" (VPP's) at certain locations at Ocean Club and Beachwood East below grade as a means to reduce trenching and scour. DHEC-OCRM approved a conceptual drawing of slotted VPP's (Figure 16), but the installed VPP's had very small drill holes instead of slots, resulting in a sheet pile structure below grade with minimal porosity (Figure 17). Since the installed panels did not match the approved panel, DHEC-OCRM informed The Citadel researchers that those VPP's could not be installed at additional locations. DHEC-OCRM informed The Citadel researchers that the installed VPP's could remain in place due to the physical alterations to the beach that would occur if they were dug up and removed. After some VPP's were dislodged by wave action (Figure 18), The Citadel researchers voluntarily removed the VPP's that were still in place.

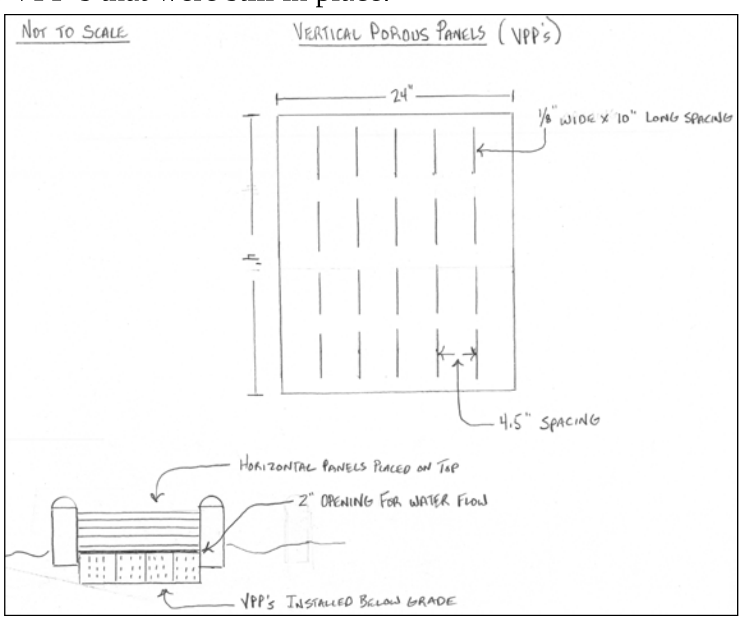


Figure 16: Conceptual drawing of Vertical Porous Panels that was submitted by The Citadel research team and approved for use in the study by DHEC-OCRM. Each vertical slot was intended to be 1/8" wide and 10" long.

Figure 17: The actual Vertical Porous Panels that were installed at the Ocean Club WDS (left). Note that very small drill holes were used instead of slots, resulting in a VPP with minimal porosity (right).


Figure 18: A Vertical Porous Panel that was dislodged by waves at the Ocean Club WDS in February 2016. Photo was taken by Stantec.

<u>Section 2: The WDS Results in Additional Impacts to the Beach</u>

The exception to normal permitting requirements found in S.C. Code Ann. § 48-39-130(D)(2) and S.C. Code Ann. Regulation § 30-5(A)(2) states that certain activities do not require a Critical Area Permit <u>"provided that such activities cause no material harm to the flora, fauna, physical or aesthetic resources of the area."</u> Additionally, Budget Proviso 34.48 Criteria 7 states that "A qualified wave dissipation device otherwise <u>prevents down-coast erosion, protects property, and limits negative impacts to public safety and welfare, beach access, and the health of the beach dune system</u>."

This section will review the impacts of the WDS to flora, fauna, physical or aesthetic resources, adjacent property, and beach access.

The Citadel

<u>Impacts to Flora and Fauna</u>

- "It is recommended that the system be installed with the horizontal panels fully in place during times outside of turtle season. During turtle season, it is recommended that the system be completely open (only vertical elements in place) except when the structure behind the system is in immediate danger of losing structural support" (The Citadel, pg. 37).

<u>Impacts to Physical or Aesthetic Resources</u>

- "The only major concern that the research team noted during the study is the temporary local trenching that occurred at times at each site….The trenching appears to be related to scour caused by extreme tides, significant erosion events, and the uncontrolled volume of water that is allowed to pass through the system (this same volume of water must escape as the tide goes back out)" (The Citadel, pg. 4).

<u>Impacts to Adjacent Property</u>

- At all sites, The Citadel stated that "our review of the surveys and the related data (sand volumes gained and lost over time) leads to the conclusion that there is no negative or significant impact by the WDS on the adjacent beach profile" (The Citadel, pgs. 16, 19, and 26).

<u>Impacts to Beach Access</u>

- No information provided.

GEL Engineering

<u>Impacts to Flora and Fauna</u>

- "There have been false crawls caused by sea turtles encountering the WDS. Evaluation of false crawl data along Harbor Island and IOP indicates that there was a higher rate of false crawls along the segments of shoreline with the WDS than the remainder of the island. However, given the conditions of the shoreline on the landward side of the WDSs, there is no evidence that the WDSs caused a significant increase in the incidence of false crawls as compared to what may have occurred in the absence of the WDSs. The adverse effect on turtles associated with a false crawl at a WDS is uncertain. After returning to the water from an aborted attempt, the turtle typically returns to the same beach or area where they first emerged on the same or the following night (Miller 1997). Therefore, if a sea turtle makes a non-nesting emergence at a WDS location, it will most likely nest nearby on the same or following night. We found no evidence that the false crawls at the

WDS locations result in a decrease in the total number of nests on Harbor Island or IOP. The WDS was not observed to adversely interact with other fauna" (GEL, pg. 132).

Impacts to Physical or Aesthetic Resources

- At Harbor Island, "the erosion downdrift of the WDS, in the adjacent lot west of the WDS, is evident in Figures 4-33 and 4-34 (see changes at alongshore distances between 400 and 500 feet). The fraction of this erosion attributable to the WDS cannot be quantified, but the pattern suggests that the WDS may contribute to scarp erosion within a short distance (i.e., mostly within 100 feet) of the end of the structure (GEL, pg. 66).

Impacts to Beach Access

- "At Harbor Island, beach walkers cannot pass the WDS on dry beach more than 35 percent of the time…. Beach walkers at [Beachwood East] may not be able to pass seaward of the WDS more than 50 percent of the time…. In April, beach walkers at [Seagrove Villas] may not be [sic] have been able to pass seaward of the WDS more than 34 percent of the time, although this decreased to one percent by July due to accretion…. At [Ocean Club], beach walkers at [sic] may not be able to pass seaward of the WDS more than 58 percent of the time" (GEL, pg. 114).

DHEC-OCRM Observations

Impacts to Flora and Fauna

- Impacts to flora are undetermined, but data suggests that continued erosion of the scarp line landward of the WDS and increased erosion rates immediately adjacent to the WDS structure could impact flora in areas where dune vegetation is present.
- Nesting sea turtles interacted with the WDS twice at Ocean Club, once at Beachwood East, and four times at Harbor Island during the study period. In all cases, based on the tracks left in the sand, the sea turtles bumped into the WDS and eventually returned to the ocean without laying their eggs (Figure 19).

Figure 19: Examples of nesting sea turtle interactions with the WDS at Ocean Club (left), Beachwood East (middle), and Harbor Island (right).

- It can be debated whether these sea turtle interactions with the WDS were "false crawls," where the turtle would not have laid her eggs regardless of the presence of the WDS, or if the WDS interrupted a nesting attempt. It has been stated that nesting sea turtles are not negatively impacted by the WDS because the shoreline landward of the structures is heavily eroded and not conducive to sea turtle nesting. However, DHEC-OCRM has photographic evidence of sea turtle nesting in less than optimal areas, including at the base of erosional scarps (Figure 20). When a sea turtle nest is laid in an area with little chance for successful hatching, Nest Protection Project Leaders and volunteers (which are active on Isle of Palms and Harbor Island) relocate the eggs to a more ideal location along the shoreline. The sea turtle interactions that occurred at the WDS may have been false crawls or they may have been legitimate nesting attempts. Therefore, regarding impacts to fauna, the WDS presents a potential harm associated with continued nesting attempts of sea turtles.

Figure 20: Sea turtle nests that were laid in less-than-ideal locations in areas without a WDS. These are nests on Debidue Island, SC.

Impacts to Physical or Aesthetic Resources

- Regarding impacts to physical resources, the WDS results in impacts to the beach through 1.) Continued erosion of the scarp line landward of the WDS structures, 2.) Persistent scouring and trenching, 3.) Periodic excavations to adjust the system, 4.) Erosion of adjacent unprotected properties, and 5.) Similar impacts to those of seawalls. Scarp line erosion and scouring have been discussed previously. Impacts of periodic excavations, impacts to adjacent properties, and similar issues associated with seawalls are discussed below.
- Periodic Excavations: The WDS can be adjusted after initial deployment by lowering the pilings, lowering or raising the panels, adding spacers between panels, or temporarily removing the panels altogether. All of these adjustments were requested by The Citadel researchers and approved by DHEC-OCRM during the study period. These periodic excavations result in temporary impacts to the beach (Figure 21).
- Adjacent properties: The WDS does not prevent erosion of the shoreline on the "down-coast" side of the structure. In fact, where the WDS terminates, increased erosion was observed on unprotected properties immediately adjacent to the WDS (Figure 22).

Figure 21: Adjustments to the Ocean Club WDS being made by The Citadel research team after Hurricane Joaquin in October 2015.

Figure 22: Erosion at the northeastern end of the Beachwood East WDS (left) and the southwestern end of the Ocean Club WDS (right).

- Similar impacts to that of a seawall: S.C. Code Ann. Regulation § 30-1(D)(22)(a) defines a seawall as "a special type of retaining wall that is specifically designed to withstand wave forces". While not defined as a seawall or bulkhead, GEL notes that the WDS has similar negative effects on the beach as these traditional types of erosion control structures. In particular, when discussing seawalls, GEL states that "storms may cause localized scour in front of and at the lateral ends of the structure" and "as ongoing erosion continues, the dry-beach width accessible to the public in front of the structure will decrease because the landward limit of the accessible beach is held in place by the structure" (GEL, pg. 35). These observations of the effects of seawalls were also clearly observed during the WDS pilot project. Shore-parallel erosion control structures like seawalls and bulkheads are banned by the South Carolina Beachfront Management Act (S.C. Code Ann. § 48-39-250 et. seq). In writing that Act, the General Assembly found that "The use of armoring in the form of hard erosion control devices such as seawalls, bulkheads, and rip-rap to protect erosion-threatened structures adjacent to the beach has not proven effective. These armoring devices have given a false sense of security to beachfront property owners. In reality, these hard structures, in many instances, have increased the vulnerability of beachfront property to damage from wind and waves while contributing to the deterioration and loss of the dry sand beach which is so important to the tourism industry."

- Regarding aesthetic resources, aesthetics is a subjective criterion, and an eroding shoreline is not generally aesthetically pleasing when infrastructure and buildings are located immediately landward of it. The Citadel researchers sought to demonstrate that the WDS is a viable alternative to sandbags, but The Citadel's study and GEL's study both showed that the scarp landward of the WDS continued to erode when not protected by sandbags. Since sandbags are needed landward of the WDS to help minimize erosion of the scarp, DHEC-OCRM finds that the WDS is not an effective alternative to sandbags. The existing erosion mitigation techniques allowed under the Emergency Order process (sandbags, sand scraping, and minor beach renourishment) are effective at providing temporary protection by mitigating erosion and result in less harm to the beach dune system than the WDS.

Impacts to Beach Access

- Throughout the study, DHEC-OCRM received complaints from members of the public regarding their inability to walk past the WDS structures at high tide. GEL's final report summarizes the percentage of time that lateral access along the beach is not possible due to the WDS. Although the WDS is placed mostly parallel to the shoreline, it is important to note that it extends a significant distance out onto the beach (approximately 40 feet seaward of the building at Ocean Club, approximately 30 feet seaward of sandbags at Beachwood East, and approximately 13 feet seaward of sandbags at Harbor Island) (GEL, pg. 114).

Section 3: The WDS Does Not Satisfy the Budget Proviso Qualification Criteria

1) A qualified wave dissipation device is placed mostly parallel to the shoreline.

The Citadel

- The Citadel did not specifically analyze how much of the WDS was installed parallel to the shoreline, but it is clear that the structures are mostly parallel to the shoreline.

GEL Engineering

- "The WDSs at all four locations are oriented parallel to the shoreline, with the exception of perpendicular segments that tie-back the WDS to the scarp or dune line, and perpendicular segments that connect parallel tiers in areas with multi-tier WDS designs. The fractions of parallel segments are 76%, 77% and 95% for the OC/SV, Harbor Island and BE sites, respectively" (GEL, pg. 123).

DHEC-OCRM Observations and Conclusion

- Since the structures are placed mostly parallel to the shoreline, DHEC-OCRM finds that the WDS **satisfies** this qualification.

2) A qualified wave dissipation device is designed to dissipate wave energy.

The Citadel

- "Although researchers are happy with the overall performance of the system and its ability to dissipate energy from waves, some concerns are expressed in the recommendations and conclusions section of this report. Readers should carefully note that unlike research at other universities where structures can be tested in a university wave pool where wave period, wave height, and tide levels can be controlled, these structures were completely loaded by whatever events God allowed to occur at each site over a one year period. As such, the now infamous 1,000 year storm, many nor'easters, and several tropical storms impacted the system. The WDS survived all the events, some of which were beyond levels considered in the original design of the system" (The Citadel, pg. 3).

GEL Engineering

- "In general, when a wave interacts with a coastal structure such as the WDS, some of the wave energy is dissipated through wave breaking or structure deflection, some of the wave energy is reflected, and some of the wave energy is transmitted landward of the structure. Wave interaction with the WDS is dependent on the water level and offshore wave conditions. As the tide rises and the stillwater level approaches the WDS, the WDS is within the swash zone, which is the area of the beach where waves run up the beach after breaking. During these conditions, the WDS is effective at blocking the uprush of the wave, either dissipating or reflecting all of the wave energy when there are no spacers between the horizontal members" (GEL, pg. 107). "When the WDS is in deeper water (e.g., at the seaward-most tier of the OC WDS, or during very high tide conditions at the other WDS sites), the fraction of transmitted wave energy increases. The amount of wave energy transmitted depends on the presence of spacers between the horizontal members, the water depth, the incident wave characteristics and the presence/absence of scour beneath the WDS" (GEL, pg. 107).

- "During energetic wave conditions, wave overtopping was observed (Figure 4-107). The return flow of water from wave overtopping likely contributes to the creation of scour holes beneath the WDS during high tides with energetic waves. The transport of overtopping water laterally along the shoreline can also contribute to erosion landward of the WDS" (GEL, pg. 109).

- "During the monitoring period, March through July, the scarp was stable in areas where the WDS was used in combination with sandbags (except where small sandbags or fill material were stacked at an excessively steep angle). In some areas fronted only by the WDS, scarp erosion was observed following the storm wave action that occurred between the March and April surveys. The survey data collected by The Citadel researchers shows large amounts of scarp erosion at the BE and OC/SV site following the initial installation of the WDSs" (GEL, pg. 124-127).

- At Harbor Island, "the wave activity between the March and April surveys caused recession of the [Mean High Water (MHW)] shoreline along the entire study area. The WDS did not prevent erosion of the MHW contour landward of the WDS. The MHW contour along the WDS receded by an average of 24 ft, a similar amount as the average recession to the east (24 ft) and the west (23 ft). During the subsequent survey periods, the wave climate was milder, and the MHW contour shifted seaward" (GEL, pg. 48). At lot 49 on Harbor Island, "there was erosion on the landward side of the WDS in this area during the March to April time period, but the sandbags and the top of the scarp remained stable. Small sand bags such as those deployed here do not remain stable when subjected to any significant wave action. The overall stability of the sandbags at lot 49 during the March to April timeframe demonstrates that the WDS was effective at attenuating wave action sufficiently such that there was only minimal, if any, erosion of the slope protected by the sandbags" (GEL, pg. 49). At lot 52 on Harbor Island, "the sandbags and underlying sand slumped because of the excessively steep slope at which these sandbags and underlying sand were initially placed" (GEL, pg. 49).

- At Beachwood East, "the wave action between the March and April surveys resulted in recession of the MHW contour along the WDS by an average of 8 feet. In contrast, the MHW contour to the east moved seaward by an average of 3 feet in this time period. Over the whole study period between March and July, the MHW contour along the WDS segment eroded by an average of 6 feet, while the MHW contour east of the WDS moved seaward by an average of 38 feet. The accretion pattern east of the WDS is the result of the spreading of sand from the attaching shoal east of the BE project site. Scarp lines experienced only minor changes during the monitoring period. The stability of scarp along the east end is due to the accretion from the shoal attachment and spreading. The stability of the scarp line on the landward side of the WDS despite the recession of the MHW contour in this area can be attributed to the combination of the WDS and the large sandbags that protect a majority of the scarp line along this segment of the beach (GEL, pg. 67).

- At Ocean Club and Seascape Villas, "the wave activity between the March and April surveys caused recession of the MHW shoreline along the entire study area…. The MHW contour along the WDS receded by an average of 32 feet. The areas to the east and west receded by 22 and 19 feet, respectively, on average. During the subsequent survey periods, the wave climate was milder, and the MHW contour shifted seaward" (GEL, pg. 80). "The landward most top-of-scarp line surveyed in March remained mostly stable throughout the study period. A small section of this scarp adjacent to the east side of the OC building receded about 4 feet over the course of the study" (GEL, pg. 82).

DHEC-OCRM Observations and Conclusion

- The WDS did not maintain the scarp line or MHW positions. While the scarp line position did not change drastically during GEL's study, which covered the time period between March and July 2016, the scarp did erode significantly at each WDS site after the structures were installed and before GEL began their study. This earlier scarp line movement was documented by The Citadel. Severe scarp erosion led to property owners requesting emergency sandbags for scarp protection at different times during the study at all four WDS locations. The sandbags at Harbor Island were already present prior to installation of the WDS at that location, but several renewals of the sandbag Emergency Orders were issued by DHEC-OCRM during the study to allow property owners to continue to protect their property from erosion (Figure 3). At Beachwood East, sandbags have been on the beach landward of the WDS since Fall of 2015 (Figure 4). At Ocean Club Villas, the sandbags were cut open after the broken slab beneath the building was repaired to allow the sand to be added landward of the WDS (Figure 5). The sandbags were subsequently removed from the site. At Seascape Villas, the sandbags were also cut open to allow the sand to be added landward of the WDS. The sandbags were cut open and removed after the second tier of the WDS was installed (Figure 6).

- The WDS dissipates wave energy to an extent, but the effectiveness is greatly reduced when scour appears on both sides of the structure. In some cases, DHEC-OCRM staff observed that the pooling of water on the landward side of the WDS allowed waves to re-form and break higher up on the beach, thus impacting the sandbags or eroding the scarp line. Although the structure itself dissipates some wave energy, the scarp line landward of each WDS installation continued to erode when not protected by sandbags. Therefore, DHEC-OCRM finds that the WDS **does not satisfy** this qualification.

3) A qualified wave dissipation device is designed to minimize scouring seaward of and adjacent to the device by permitting sand to move landward and seaward through the device.

The Citadel

- "To help minimize the negative side effects of hardened structures, the WDS allows water to move behind the system. However, the amount of water allowed through the system should be controlled by renourished sand placed behind the system and dune rebuilding which the system allows via natural accretion needed for such activities" (The Citadel, pg. 3-4).

- "The only major concern that the research team noted during the study is the temporary local trenching that occurred at times at each site….The trenching appears to be related to scour caused by extreme tides, significant erosion events, and the uncontrolled volume of water that is allowed to pass through the system (this same volume of water must escape as the tide goes back out)" (The Citadel, pg. 4).

- "Removing just the horizontal panels in areas of local trenching almost immediately restores the beach profile by eliminating the trenching effect and the horizontal panels are easily removed for this purpose" (The Citadel, pg. 4).

- At all WDS sites, "Trenching, caused by significant erosion events, and related to the system's allowance of rising tide levels (with moving water) behind the WDS can, when deep enough, become a concern. The study has shown that the system is always self-healing and that the trenching is always temporary. On the contrary, deep trenching on site should not be allowed and must be mitigated anytime it appears on site" (The Citadel, pgs. 16, 19-20, 26).

- At Harbor Island, "Although at first, there was some accretion, the wave energy was not strong enough to push it more than three ft or so beyond the WDS. This led to an unacceptable low space (relative to the accreted area) beyond the accreted sand. It should be noted that the horizontal panel system at Harbor Island was designed to be over two times as flexible as the one installed at Ocean Club (and Seascape in 2013-2014). This flexibility alone did not provide adequate 'breathing' of the ocean such that a more uniform distribution of accreted sand fell behind the system. For that reason, the research team added some trial spacers to encourage more natural sand accretion behind the system. The initial result of the added spacers was an improved distribution of sand behind the system. Soon after, the site developed what has been the biggest issue at Harbor Island. As the beach lowered and the added spacer elevations became too high (relative to the beach profile) to allow for exit water to efficiently leave the area behind the WDS, a trench developed directly under the system. Spacers were located at several locations during the second quarter of this study and it was determined that they are not the ideal solution to trenching. They help at times but they must be constantly adjusted with changing elevations." (The Citadel pgs. 21-24).

GEL Engineering

- "During the typical storm wave conditions that occurred during this monitoring study, the WDS allowed erosion of sand from the landward side of the WDS. In areas where the WDS was at relatively high elevations on the beach, scour holes did not develop that extended below the horizontal members. In these scenarios, transport of sand seaward through the WDS was minor. Figure 5-5 shows an example of erosion on the landward side of a section of the Seascape Villas WDS that occurred after the March through April period when waves caused large amounts of erosion of the entire beach. Areas with the greatest amount of erosion during storm events occurred in areas where the scour passed beneath the WDS, or the entire beach profile was lowered beneath the WDS, which allowed sand to be transported seaward. When this occurs, large volumes of sand were transported seaward underneath the WDS horizontal panels. During the subsequent natural beach recovery, large volumes were also observed to move landward underneath the WDS horizontal panels" (GEL, pg. 124).

- "Scour occurred at all four WDS sites prior to the April survey, and the beach in these areas subsequently accreted" (GEL, pg. 101). "High tide observations of wave action at these sites confirmed that if the scour hole is deep enough to allow free flow of water beneath the horizontal members, the WDS becomes less effective at attenuating waves (GEL, pg. 107). "Based on our field observations, scour can occur at the WDS when subjected to erosive wave action. This scour is limited to a temporary localized effect that allows greater wave energy to be transmitted to the landward side of the WDS. There is no evidence of adverse impacts other than reduced WDS performance (i.e., reduced wave attenuation" (GEL, pg. 107).

- At Harbor Island, "the WDS allows some transport of accreting sand through the WDS. However, given the buildup of sand observed on the seaward side of the WDS, it appears that the WDS can inhibit the amount of natural landward migration of sand during mild wave conditions" (GEL, pg. 55).

- At Harbor Island, "The fact that the upper beach showed a small net loss of sand behind the WDS (-0.2 cy/ft) while the entire beach down to the low tide line showed accretion (1.1 cy/ft), indicates that the accretion in the WDS beach segment shown in Table 4-3 and Figure 4-33 occurred on the seaward side of the WDS" (GEL, pg. 65).

- At Beachwood East, "Similar to the observations at Harbor Island, the upper beach showed a small net loss of sand on the landward side of the WDS over the March to July period (-0.6 cy/ft) while the entire beach down to the low tide line for the same segment showed accretion (1.4 cy/ft) (compare Table 4-5 to Table 4-6). This indicates that the accretion in the WDS beach segment occurred on the seaward side of the WDS" (GEL, pg. 79).

- At Ocean Club and Seascape Villas, "The net change over the study period showed a small amount of accretion to the west of the WDS (0.3 cy/ft, on average), erosion landward of the WDS (-0.7 cy/ft at SV and -0.9 cy/ft at OC, on average), and a small amount of erosion east of the WDS (-0.2 cy/ft, on average)". (GEL, pg. 100).

DHEC-OCRM Observations and Conclusion

- As noted by GEL, "sand often migrates onshore through a process of landward movement of ridge-and-runnel features that gradually merge onto and widen the dry beach" (GEL, pg. 96). Figure 9 is an example of a ridge-and-runnel feature moving onto the beach in November 2016 northeast of the Ocean Club WDS on Isle of Palms. The ridge of accreting sand is the light colored smooth surface to the right of the photograph. Another example from Folly Beach in December 2015 is also shown in Figure 9. The Folly Beach photograph was taken around the same time that several horizontal panels were removed from the Beachwood East WDS to allow the naturally accreting sand to move landward of the WDS. The landward movement of ridge-and-runnel features occurs during calm conditions and is a natural process.

- Figure 10 compares typical beach cross-section profiles during storm conditions, after storm conditions, and during calm conditions. During storm conditions, the beach profile lowers and the berm (dry sand beach) erodes as waves and currents transport sand seaward. After a storm, the eroded sand has been deposited just offshore or in the intertidal zone as sand bars. During calm conditions, the sand that has been deposited on the sand bars is gradually pushed back towards the beach by gentle wave action, forms ridge-and-runnel features, and then fully welds onto the berm and widens it. Again, this process of beach erosion during storm conditions followed by accretion during calm conditions is a natural phenomenon and cannot be attributed to the presence of the WDS.

- Where the WDS is present during calm conditions, sand that is naturally moving landward (up the beach profile) becomes trapped on the seaward side of the WDS. This results in the need for spacers and periodic panel removal to allow the trapped sand to move to the landward side of the WDS (Figure 12). Limited sand is able to be pushed by waves and tides through the panels, but this sand would have moved up the beach profile naturally if the WDS were not obstructing it (Figure 13). Where the WDS is present during storm conditions, scour on both sides of the WDS allows more water to reach the scarp and erode it when the scarp is not protected by sandbags. Net accretion observed by GEL during their study at the WDS sites was always on the seaward side of the structure (not on the landward side). Since the WDS blocks the natural accretion of sand on the shoreline during calm conditions and is ineffective without sandbags during storm conditions, DHEC-OCRM finds that the WDS **does not satisfy** this qualification.

4) A qualified wave dissipation device has horizontal panels that can be deployed within one-hundred twenty hours or less and can be removed within one-hundred twenty hours or less.

The Citadel

- The Citadel documented the dates on which installation of each WDS began and the dates on which installation was completed.

GEL Engineering

- “GEL did not directly observe horizontal panels deployed or removed, although GEL did observe trenching in preparation for panel installation. During the monitoring period, segments of the WDS at Ocean Club and the WDS at Beachwood East were lowered 2 feet in response to decreasing beach elevations. This involved removal of the horizontal panels, lowering the piles, trenching the beach and reinstalling the horizontal panels. This process required about one work week (about 5 days) to lower the landward tier of the OC installation. Given that horizontal panel removal, vertical pile lowering, trenching and horizontal panel redeployment of 13 horizontal panel segments required about one week of on-site work, then certainly some horizontal panels can be deployed or removed within 120 hours or less, assuming a contractor can be mobilized to the site within this time frame and assuming the vertical piles are already in place. The exact number of horizontal panels that can be installed in this time frame is unknown. The time required to deploy or remove horizontal panels for an entire WDS is dependent on the total length of the system" (GEL, pgs. 130-131).

DHEC-OCRM Observations and Conclusion

- Since all components of the WDS structures, including vertical pilings and horizontal panels, were installed at once and have not been removed, it is difficult to assess whether the horizontal panels alone can be deployed or removed within one-hundred twenty hours or less. One-hundred twenty hours is the equivalent of five 24-hour days. The entire structure at Ocean Club took approximately 40 days to install (4/27/2015 to 6/5/2015), the entire structure at Harbor Island took approximately 24 days to install (5/11/2015 to 6/3/2015), and the entire structure at Beachwood East took approximately 45 days to install (7/28/2015 to 9/10/2015). DHEC-OCRM finds that **it has not been demonstrated whether or not the WDS satisfies** this qualification.

5) A qualified wave dissipation device does not negatively impact or inhibit sea turtle nesting or other fauna.

The Citadel

- "It is recommended that the system be installed with the horizontal panels fully in place during times outside of turtle season. During turtle season, it is recommended that the system be completely open (only vertical elements in place) except when the structure behind the system is in immediate danger of losing structural support" (The Citadel, pg. 37).

GEL Engineering

- "There have been false crawls caused by sea turtles encountering the WDS. Evaluation of false crawl data along Harbor Island and IOP indicates that there was a higher rate of false crawls along the segments of shoreline with the WDS than the remainder of the island. However, given the conditions of the shoreline on the landward side of the WDSs, there is no evidence that the WDSs caused a significant increase in the incidence of false crawls as compared to what may have occurred in the absence of the WDSs. The adverse effect on turtles associated with a false crawl at a WDS is uncertain. After returning to the water from an aborted attempt, the turtle typically returns to the same beach or area where they first emerged on the same or the following night (Miller 1997). Therefore, if a sea turtle makes a non-nesting emergence at a WDS location, it will most likely nest nearby on the same or following night. We found no evidence that the false crawls at the WDS locations result in a decrease in the total number of nests on Harbor Island or IOP. The WDS was not observed to adversely interact with other fauna" (GEL, pg. 132).

DHEC-OCRM Observations and Conclusion

- Nesting sea turtles interacted with the WDS twice at Ocean Club, once at Beachwood East, and four times at Harbor Island during the study period. In all cases, based on the tracks left in the sand, the sea turtles bumped into the WDS and eventually returned to the ocean without laying their eggs (Figure 19).

- It can be debated whether these sea turtle interactions with the WDS were “false crawls,” where the turtle would not have laid her eggs regardless of the presence of the WDS, or if the WDS interrupted a nesting attempt. It has been stated that nesting sea turtles are not negatively impacted by the WDS because the shoreline landward of the structures is heavily eroded and not conducive to sea turtle nesting. However, DHEC-OCRM has photographic evidence of sea turtle nests being laid in less than optimal areas, including at the base of erosional scarps (Figure 20). When a sea turtle nest is laid in an area with little chance for successful hatching, Nest Protection Project Leaders and volunteers (which are active on Isle of Palms and Harbor Island) relocate the eggs to a more ideal location along the shoreline. The sea turtle interactions that occurred at the WDS may have been false crawls or they may have been legitimate nesting attempts. Since the WDS presents a potential harm associated with continued nesting attempts of sea turtles, DHEC-OCRM finds that the WDS **does not satisfy** this qualification.

6) A qualified wave dissipation device can be adjusted after initial deployment in response to fluctuations in beach elevations.

The Citadel

- “The main issue to note is that the WDS is a dynamic system that must be configured appropriately for optimal performance and that its use will require modifications and some degree of sand replenishing after severe erosion events. OCRM did not allow most of the recommendations presented in this report to be applied or adhered to during the study since they claimed the results (to be reflected in the surveys) would be affected. As a result, optimal performance could not be maintained throughout the study” (The Citadel, pg. 2).

- “It is also important for the reader to note that Citadel researchers were not permitted by OCRM to optimize the system’s performance and that the way the systems were tested over the last year is in no way indicative of how they should be used in practice. On the other hand, even though not optimize for performance, the WDS did protect the structures behind the systems for the duration of the study period described in this report” (The Citadel, pg. 3).

- “The research team has always stressed that the WDS is dynamic and needs to be built and modified as often as necessary to address changing beach elevations and dune situations behind the system” (The Citadel, pg. 3).

- “The Citadel researchers want to make it very clear, as they always have, that the system is not a one-size fits all solution and that it is a dynamic system that must be designed separately for each particular site, and monitored/adjusted as necessary to optimize its performance” (The Citadel, pgs. 4, 36).

- “The [Vertical Porous Panels] VPPs are experimental prototypes that must be studied to determine their optimal configuration, hole pattern, length, etc. and the typical sketch given to OCRM was intended to provide an idea of what the panels should like [sic] during the first installation. During construction of the panel, the research team found that drilling slots was too difficult (and was damaging the panel) and that holes would work better. Hence the team made the decision to move forward with holes instead of slots. In addition, the actual as constructed version of the panel was actually more porous than the proposed version considering its overall purposely placed installation configuration. The goal of studying the vertical panels was to determine the optimal porosity and configuration. The research team spent hours designing different details for the porosity prior to OCRM saying that the VPPs could no longer be tested. We are very disappointed that the research team's main proposed method (prior to the expensive option of lowering of the system) for removing the team's one major concern from the study at Ocean Club and Seascape was not allowed to be studied for stated technical reasons that are not justified nor based on engineering mechanics, coastal engineering, or coastal geology principals" (The Citadel, pg. 10-11).

- At Ocean Club, "although the system is extremely self-healing after significant erosion events, around mid-April 2016 and mid-May 2016 the piles in the row closest to the ocean in front of the building and much of the entire back row (around the building corner) were lowered 2 ft to improve performance" (The Citadel, pg. 12).

- "It has always been known that flooding the system using isolated panel removal can easily remove trenching and is almost instantaneous" (The Citadel, pgs. 16, 20).

- At Beachwood East, "noticing the enormous level of accretion the research team forecast for several more weeks of accretion, Dr. Mays acted quickly and notified OCRM that the team wanted to test (as shown clearly during the previous Seascape study) that the sand accreting behind the system could be pushed back to allow the homeowners to reclaim the sand they lost from the 1,000 year event, to rebuild the dune to its initial configuration prior to the 1,000 year event, and to allow the removal of sandbags (which served no purpose) that the homeowners bought as added protection after the 1,000 year event damage to their property. It seemed like a perfect win-win for the research team and the community. However, OCRM did not allow the research team to prove that it could function in this capacity. This was disappointing since it is very important to prove that the system can perform as advertised" (The Citadel, pg. 19).

GEL Engineering

- At Ocean Club, "the waves between March and April eroded and lowered the beach profile in this area to the point that the bottom of the WDS horizontal members were above the beach. In response, sections of the OC WDS system were lowered by 2 feet in April. Additional sections were lowered in May…. Typically, during lowering of the WDS, a trench is excavated along the WDS, and the sand is placed on the landward side" (GEL, pg. 82).

DHEC-OCRM Observations and Conclusion

- The WDS can be adjusted after initial deployment by lowering the pilings, lowering or raising the panels, adding spacers between panels, or temporarily removing the panels altogether. All of these adjustments were requested by The Citadel researchers and approved by DHEC-OCRM during the study period. Making these kinds of adjustments results in temporary impacts to the beach (Figure 17 and Figure 21).

- The Citadel researchers installed "Vertical Porous Panels" (VPP's) at certain locations at Ocean Club and Beachwood East below grade. DHEC-OCRM approved a conceptual drawing of slotted VPP's (Figure 16), but the installed VPP's had very small drill holes instead of slats, resulting in a sheet pile structure below grade with minimal porosity (Figure 17). Since the installed panels did not match the approved panel, DHEC-OCRM informed The Citadel researchers that those VPP's could not be installed at additional locations. DHEC-OCRM also informed The Citadel researchers that the installed VPP's could remain in place due to the physical alterations to the beach that would occur if they were dug up and removed. After some VPP's were dislodged by wave action (Figure 18), The Citadel researchers voluntarily removed the VPP's that were still in place.

- The Citadel researchers also requested to bulldoze sand on the landward side of the WDS at Beachwood East to build a dune, but DHEC-OCRM denied the request for two reasons: 1.) Bulldozing the sand would have altered the study data. Beach profile data (elevations and scarp line positions) were collected monthly throughout the study by both The Citadel and by GEL to determine the effects of the WDS on the beach. Artificially altering the beach profile by bulldozing or minor renourishment would have resulted in an inconclusive study, and 2.) During the first WDS study at Seascape Villas in 2014, The Citadel researchers bulldozed the sand behind that WDS installation without prior DHEC-OCRM authorization, and the piled up sand eroded away in a matter of days (Figure 11). Lowering the beach profile landward of the WDS by bulldozing allowed the waves to reach higher up the beach and erode the sand more quickly.

- As acknowledged by The Citadel, the WDS would require continual maintenance and attention to ensure that it is configured optimally. The structure can be adjusted. However, it requires these adjustments to allow sand to move landward up the beach profile and to reduce the effects of scouring. Since spacers between horizontal pipes are needed during calm conditions to allow sand to pass through the WDS, and gaps from the spacers are not desirable during rough conditions, the WDS requires almost daily attention to ensure that the necessary components are in place to respond to daily changes in tides, waves, and wind speeds and directions. DHEC-OCRM finds that the WDS **satisfies** this qualification but is concerned that the need for frequent adjustments to the system would be difficult to anticipate and manage.

7) A qualified wave dissipation device otherwise prevents down-coast erosion, protects property, and limits negative impacts to public safety and welfare, beach access, and the health of the beach dune system.

The Citadel

- "At all sites, the WDS protected the structures behind the system and when used as recommended (not as detailed in this study) the results will be even better" (The Citadel, pgs. 4, 36).

- At all sites, The Citadel stated that “our review of the surveys and the related data (sand volumes gained and lost over time) leads to the conclusion that there is no negative or significant impact by the WDS on the adjacent beach profile” (The Citadel, pgs. 16, 19, and 26).

GEL Engineering

- At Harbor Island, “the erosion downdrift of the WDS, in the adjacent lot west of the WDS, is evident in Figures 4-33 and 4-34 (see changes at alongshore distances between 400 and 500 feet). The fraction of this erosion attributable to the WDS cannot be quantified, but the pattern suggests that the WDS may contribute to scarp erosion within a short distance (i.e., mostly within 100 feet) of the end of the structure (GEL, pg. 66).

- “At Harbor Island, beach walkers cannot pass the WDS on dry beach more than 35 percent of the time…. Beach walkers at [Beachwood East] may not be able to pass seaward of the WDS more than 50 percent of the time…. In April, beach walkers at [Seagrove Villas] may not be [sic] have been able to pass seaward of the WDS more than 34 percent of the time, although this decreased to one percent by July due to accretion…. At [Ocean Club], beach walkers at [sic] may not be able to pass seaward of the WDS more than 58 percent of the time” (GEL, pg. 114).

DHEC-OCRM Observations and Conclusion

- The WDS does not prevent erosion of the shoreline on the “down-coast” side of the structure. In fact, where the WDS terminates, increased erosion was observed on unprotected properties immediately adjacent to the WDS (Figure 22).

- When used as the sole erosion mitigation technique, the WDS does not protect property landward of it either. At Beachwood East and Harbor Island, sandbags were requested and employed by property owners for the duration of the study to stabilize the scarp line and protect their property. At Ocean Club, sandbags were deployed for part of the study. When sandbags were not present at that location, the three-walled system of the WDS was sufficient to break enough wave energy to minimize damage to the building. However, the parking slab beneath the building collapsed and had to be replaced, and the scarp continued to move landward beneath the building (Figure 8).

- No injuries were reported to DHEC-OCRM as a result of the WDS being located on the active beach. Warning signs were erected by The Citadel research team in the vicinity of each WDS indicating the potential danger of venturing too close to the structures, and some members of the public voices their concerns to DHEC-OCRM staff regarding the potential hazard that the structures presented. The Citadel did not assess impacts of the WDS on public safety and welfare.

- Throughout the study, DHEC-OCRM received complaints from members of the public regarding their inability to walk past the WDS structures at high tide. GEL’s final report summarizes the percentage of time that lateral access along the beach is not possible due to the WDS. Although the WDS is placed mostly parallel to the shoreline, it is important to note that it extends a significant distance out onto the beach (approximately 40 feet seaward of the building at Ocean Club, approximately 30 feet seaward of sandbags at Beachwood East, and approximately 13 feet seaward of sandbags at Harbor Island) (GEL, pg. 114). The Citadel did not assess impacts of the WDS on beach access.

- The WDS causes additional impacts to the health of the beach dune system that would not occur if the structure was not present. In particular, the WDS results directly in persistent scouring (trenching) of the beach at all locations. Excavations to periodically lower pilings or panels also results in negative impacts to the health of the beach dune system.

- Since the WDS does not prevent down-coast erosion, protect property, or limit negative impacts to public safety and welfare, beach access, and the health of the beach dune system, DHEC-OCRM finds that the WDS **does not satisfy** this qualification.

Current Emergency Order Options

The term "emergency" is defined in the S.C. Coastal Tidelands and Wetlands Act as "any unusual incident resulting from natural or unnatural causes which endanger the health, safety, or resources of the residents of the State, including damages or erosion to any beach or shore resulting from a hurricane, storm, or other such violent disturbance" (S.C. Code Ann. §48-39-10(U)). Emergency situations, either prior to or after a storm event, may prompt local governments or DHEC-OCRM to issue Emergency Orders, which allow property owners to construct temporary barriers against wave uprush through sandbagging, sand scraping, or minor renourishment (S.C. Code Ann. Regs. 30-15.H). Regarding sandbags, the owners of property being protected by sandbags are responsible for the maintenance of the bags to ensure that they remain in place and in good repair, and they are also responsible for the complete removal of the bags when so ordered by the Department (S.C. Code Ann. Regs. 30-15.H(1)(f)). Historically, the use of sandbags in South Carolina has presented some management challenges including increased loss of public access, recreational beach, and habitat over time, debris at the site and along both adjacent and far-off shorelines from structural failure, and a lack of incentives to fully consider and devise a long-term erosion control plan due to practically unlimited sandbag use. Recognizing these challenges, a State-supported Shoreline Change Advisory Committee, and later, a Blue Ribbon Committee on Shoreline Management recommended a number of changes to the sandbag regulations. The Blue Ribbon Committee was a bipartisan group consisting of State legislators, mayors, attorneys, legal and scientific professors, real estate interests, and environmental interests who gathered over two years to review the recommendations of the Shoreline Change Advisory Committee and make final recommendations to the State Legislature. The Blue Ribbon Committee unanimously decided to recommend to the Legislature to adopt the Shoreline Change Advisory Committee's process for issuing Emergency Orders for sandbags to include sole issuance authority by the Department, bonds for sandbag removal, and discretion by the Department for determining size and material of sandbags.

In the 2015-2016 Legislative Session, Bill R211/S139 was ratified and included a new requirement that property owners must now provide a bond that is reasonably estimated to cover the cost of removal of sandbags before the sandbags may be placed on the beach. The bonding requirement will help ensure that sandbags are maintained and removed from the beach when the shoreline is no longer experiencing an emergency situation due to erosion. Sandbags are intended to be a short-term solution to provide temporary protection while a long-term plan to deal with the erosion issue is being developed. Sandbags are not intended to remain on the beach for years at a time.

The Citadel research team sought to demonstrate that the WDS is a viable alternative to sandbags in emergency situations. However, as discussed in this document, sandbags were employed at each study site to keep the scarp from continuing to erode landward of the WDS. The WDS is not an alternative to sandbags because sandbags were used in conjunction with the WDS during the study. If the sandbags were not requested by property owners and issued by DHEC-OCRM, data suggests the scarp line would have continued to erode further landward of the WDS.

DHEC-OCRM Staff's Recommendation to the Board

Due to the fact that the Wave Dissipation System has not been successful in addressing an erosional issue, and results in negative impacts to the beach, DHEC-OCRM Staff's Recommendation to the Board is to not approve the WDS for future use and to require the existing structures to be removed from the beach following the Board's final decision. DHEC-OCRM is committed to working with property owners during the WDS removal process to continue to afford erosion protection under existing Emergency Order provisions.

To ensure that the general public and potential affected parties have the opportunity to provide input to the Board regarding the Staff Recommendation, DHEC-OCRM also requests that the Board grant approval to publish the Staff Recommendation for a 45-day public comment period. Following the public comment period staff requests that the Board conduct a public hearing to receive additional information for consideration in determining a final agency decision.

Appendix A

Relevant Authorities

Per S.C. Code Ann. § 48-39-130(D)(2) and S.C. Code Ann. Regulation § 30-5(A)(2), the WDS did not require a permit because The Citadel is a State educational institution and the WDS study was considered a research activity, which is exempt from the typical permitting requirements.

Statutes

- S.C. Code Ann. § 48-39-130(D)(2) provides, "(D) It shall not be necessary to apply for a permit for the following activities: (2) Hunting, erecting duckblinds, fishing, shellfishing and trapping when and where otherwise permitted by law; the conservation, replenishment and research activities of state agencies and educational institutions or boating or other recreation provided that such activities cause no material harm to the flora, fauna, physical or aesthetic resources of the area."

- S.C. Code Ann. § 48-39-320(C) provides, "(C) Notwithstanding any other provision of law contained in this chapter, the board, or the Office of Ocean and Coastal Resource Management, may allow the use in a pilot project of any technology, methodology, or structure, whether or not referenced in this chapter, if it is reasonably anticipated that the use will be successful in addressing an erosional issue in a beach or dune area. If success is demonstrated, the board, or the Office of Ocean and Coastal Resource Management, may allow the continued use of the technology, methodology, or structure used in the pilot project location and additional locations."

Regulations

- S.C. Code Ann. Regulation § 30-5(A)(2): Exceptions (to permitting requirement). Provides that (2) Hunting, erecting duckblinds, fishing, shellfishing and trapping when and where otherwise permitted by law; the conservation, replenishment and research activities of State agencies and educational institutions; or boating or other recreation provided that such activities cause no material harm to the flora, fauna, physical, or aesthetic resources of the area.

Budget Provisos

- *Budget Proviso 34.51 of the 2014-2015 General Appropriations Act*
  (DHEC: Wave Dissipation Device) From funds appropriated to the department for the Coastal Resource Improvement program, the department shall permit a Wave Dissipation Device pilot program to be initiated.

  The deployment of a qualified wave dissipation device seaward of the setback line or baseline pursuant to a study conducted by the Citadel or a research university is not construction and meets the permitting exception contained in Section 48-39-130(D)(2). Prior to deploying or expanding a qualified wave dissipation device, a person proposing to deploy or expand the device must pay the department a fee of ten cents per linear foot of the proposed deployment or expansion. The department may order the removal of all or any portion of a qualified wave dissipation device that the department determines causes material harm to the flora, fauna, physical or aesthetic resources of the area under Section 48-39-130(D)(2) of the 1976 Code.

A ‘qualified wave dissipation device’ is a device that:

(1) is placed mostly parallel to the shoreline;
(2) is designed to dissipate wave energy;
(3) is designed to minimize scouring seaward of and adjacent to the device by permitting sand to move landward and seaward through the device;
(4) can be deployed within seventy-two hours or less and can be removed within seventy-two hours or less;
(5) does not negatively impact or inhibit sea turtle nesting or other fauna;
(6) can be adjusted after initial deployment in response to fluctuations in beach elevations; and
(7) otherwise prevents down-coast erosion, protects property, and limits negative impacts to public safety and welfare, beach access, and the health of the beach dune system.

- *Budget Proviso 34.48 of the 2015-2016 General Appropriations Act*

  (DHEC: Wave Dissipation Device) From funds appropriated to the department for the Coastal Resource Improvement program, the department shall permit a Wave Dissipation Device pilot program to be initiated.

  The deployment of a qualified wave dissipation device seaward of the setback line or baseline pursuant to a study conducted by the Citadel or a research university is not construction and meets the permitting exception contained in Section 48-39-130(D)(2). Prior to deploying or expanding a qualified wave dissipation device, a person proposing to deploy or expand the device must pay the department a fee of ten cents per linear foot of the proposed deployment or expansion. The department may order the removal of all or any portion of a qualified wave dissipation device that the department determines causes material harm to the flora, fauna, physical or aesthetic resources of the area under Section 48-39-130(D)(2) of the 1976 Code.

  A ‘qualified wave dissipation device’ is a device that:

  (1) is placed mostly parallel to the shoreline;
  (2) is designed to dissipate wave energy;
  (3) is designed to minimize scouring seaward of and adjacent to the device by permitting sand to move landward and seaward through the device;
  (4) the horizontal panels designed to dissipate wave energy can be deployed within one-hundred twenty hours or less and can be removed within one-hundred twenty hours or less;
  (5) does not negatively impact or inhibit sea turtle nesting or other fauna;
  (6) can be adjusted after initial deployment in response to fluctuations in beach elevations; and
  (7) otherwise prevents down-coast erosion, protects property, and limits negative impacts to public safety and welfare, beach access, and the health of the beach dune system.

The South Carolina Legislature ratified the 2015-2016 General Appropriations Act on June 23, 2015. Budget Proviso 34.48 of that Act altered qualification number 4 above. This change is significant because the initial proviso contemplated an entire structure that could be deployed or removed in seventy-two hours or less, whereas the new proviso only specified deployment or removal timeframes for the horizontal panel components.

As previously stated, the Department is tasked with determining whether the Wave Dissipation System (WDS) has been successful in addressing an erosional issue and whether it is qualified for future use in emergency situations, pursuant to S.C. Code Ann. Regulation § 30-15(H). In order to be a qualified device, the WDS must meet the criteria spelled out in the above Statutes, Regulations, and Provisos.