

Friends of Squibnocket, LLC
PO Box 267
Chilmark, MA 02535

Mr. Jim Malkin, Chair
Town Committee on Squibnocket

October 24, 2014

Dear Jim And Committee Members:

At the September 14th meeting of the Squibnocket Committee, we presented a parking plan and reported that our geologist, coastal engineer, and civil engineer had met with the Squibnocket Farm (S/F) technical team. The goal of the technical meeting was to discuss our two proposals and to discover common ground. We were told that the meeting between the two teams was productive, but were discouraged by Mr. Lasser's interpretation about what had transpired. There appears to be a fundamental lack of understanding of the dune proposal by both Mr. Lasser and his technical team. The attached statement by LEC Environmental Consultants provides a response to the factual misstatements and the technical issues that Mr. Lasser and/or his technical team raised in his October 13th letter to your committee.

Mr. Lasser was apparently unaware that we had changed the route for the new section of roadway, from the backside of the dune to the edge of the pond. We presented this new route to the Squibnocket Committee at the 9/14 meeting. Additionally, this proposal was discussed at length at the combined technical team meeting and we understood that the S/F team preferred the alternate roadway location. This last iteration of our plan with the new roadway location is consistent with the proposal that we presented last spring. Squibnocket Farm and the Selectmen rejected it at that time because they contended we didn't have the consent of the property owners (Jeffers/Orphanos and Weldon). We had their support last spring and we have it today.

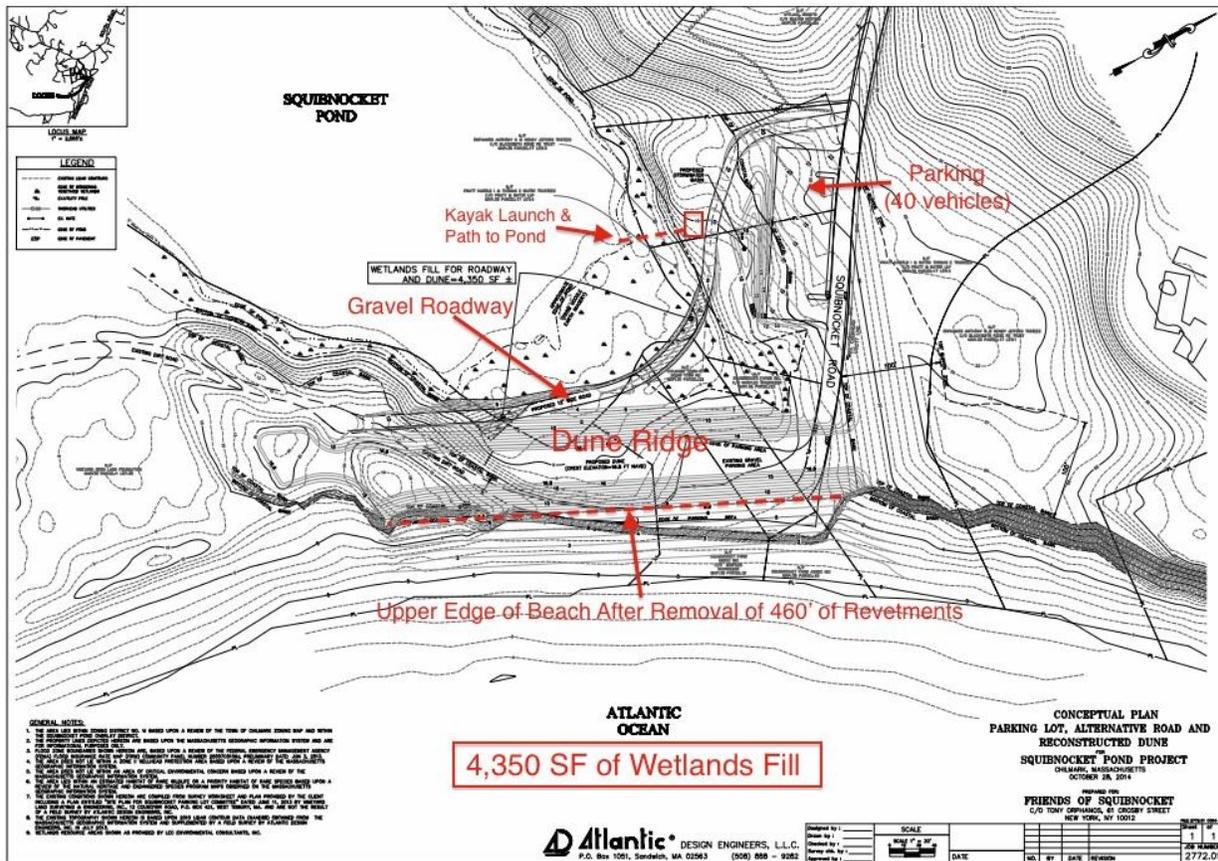
We believe that the Pond Route proposed to the committee on 9/14 is far preferable to the Dune Route and it addresses most if not all of S/F and Mr. Lasser's concerns:

- **Requirements to migrate the roadway are minimized.** Because the new Pond Route for the roadway is separated from the dune and moved further away from the shoreline, there is less exposure of the roadway to overwash events. Our original proposal included a 400' roadway on the back of the dune, all of which was subject to a relocation requirement over the next 50 years. By re-routing the roadway to the backside of the eastern edge of the pond (Pond Route), the length of the road near the shoreline is reduced in length by 50% and will not need to be relocated for 35-50 years. Of the remaining 200' of roadway, closer to the shoreline with the connection to the bank at Money Hill, half will not require migration for more than 25-35 years because it is separated from the dune. And, the last section that connects to Money Hill, which is the most vulnerable, should not require any migration for at least 15-25 years. (It should be noted that this last section is problematic for the bridge end-point.)
- **Overwash into the wetland:** Overwash across the dune and into the pond will provide a sufficient supply of new sediments for use in the eventual migration of the dune and the roadway. The evidence for overwash is apparent in the ½-acre accretion that has occurred over the past 50 years at the east end of the pond and the rate of accretion should increase after the revetments are removed and the dune ridge is created. Our proposal for the Pond Route does not require, and we would not advocate, any filling of defined wetland areas other than those wetland areas approved through a permit for this project. As overwash occurs, the additional area needed for eventual migration of the road will be naturally converted from wetlands to dune/barrier beach, as is happening in the area of the existing accretion. We do not anticipate other future requirements for wetlands fill, due to the natural overwash supply and the acceleration in that process and the resulting transition of the wetlands; however, if additional fill is needed, it would necessitate Conservation Commission approval, either through a new permit or through explicit permissions granted through the maintenance Order of Conditions.

- Better integration with the other components of the solution.** The Pond Route intersects Squibnocket Road at a location above our proposed parking area and eliminates any potential contention between vehicles traveling to S/F and other vehicles accessing the parking lot. And, because there is a dedicated walkway to the beach that avoids the S/F traffic, it is also safer. Traffic to S/F would turn off the road above the parking lot and would not interfere with people attempting to use the beach. This is a significant public safety advantage.

The Lasser letter and Haley & Aldrich Memorandum criticized FOS for not providing enough detail on our proposal. We disagree. Our proposal is very detailed. In fact, we have a far more detailed and comprehensive solution on the table at this point than S/F has offered with their bridge proposal. But, we want to be clear that we are not attempting to develop a final design. Our objective is to demonstrate to all stakeholders, including S/F and its supporters, members of the Committee, the Town, and regulatory authorities, that the dune ridge proposal deserves the full and serious consideration of S/F as the best way forward to accomplish S/F access and other public objectives. We have provided a framework for thinking about the options (e.g. mapped shoreline without revetments, erosion rate, etc.) and sufficient initial design, survey mapping, feasibility, and cost information to demonstrate the overall advantages that the dune ridge approach has over the proposed bridge. If the Committee and the Town agree, and S/F is willing to come to a consensus on that basis, we envision that S/F would complete the remaining design tasks to prepare a permit application for the Dune Ridge, just as it would have to do to advance the bridge or any other access proposal. If S/F decides to proceed with the dune solution, we would support that effort, as well as cooperate with S/F and the Town in relocating the road, beach parking, and the canoe/kayak launch to the ½-acre parcels.

The most recent map of the Dune Solution (below) and shows the key elements of our proposal: removal of the revetments (upper edge of new shoreline is illustrated), reconstructed dune ridge, new section of roadway, kayak/canoe launch, and a new parking area:



A second issue raised by Mr. Lasser involves migrating the road into the wetlands without a permit. As we do not depend on additional wetlands fill beyond what is specified in this proposal, this should not be a concern. As already mentioned, overwash and the landward expansion of the coastal dune and barrier beach (the evolution or transition of the wetland to barrier beach/coastal dune) will provide a platform for migrating the roadway (and the dune) when that becomes necessary without any intrusion into defined wetlands. Our overall approach is based on natural processes, for which there is a clear 50-year pattern at the east end of the pond. Additionally, we are recommending that the Town follow a practice used by other Massachusetts communities for similar projects and provide a flexible framework for maintenance and migration through 3-year, renewable permits.

Third, we have submitted a plan prepared by a civil engineer for parking next to Squibnocket Road for a maximum of 40 vehicles (current parking lot capacity). Mr. Lasser was not aware of this plan. The location is convenient to the swimming beach, and, unlike S/F's proposal, it does not require the use of the barrier beach or the removal of its vegetation. (Our parking plan is bundled with the Dune Solution and is not available if Squibnocket Farm decides to pursue the Bridge Solution). We have also provided a detailed plan for access to the beach, which should address the questions on 'public access'.

Fourth, we don't understand how Mr. Lasser's came to the conclusion that we want to retain the revetments. Our team is on record as committed to the removal of the revetments since last February. This is the most important aspect of our proposal because it enables restoration of the shoreline and the recreational beach itself.

Fifth, Mr. Lasser asserted that cost information provided by FOS is not "convincing." We have recent cost estimates of the dune ridge/road solution. The estimate was put together by professionals and provided a 30% margin as a cushion against whatever materials the Conservation Commission and the DEP requires. The project cost estimate will change as the proposal is refined. This is to be expected in any project of this type. We have also developed estimates for maintenance of the dune and the road. Mr. Lasser may not agree with the estimates or the thinking behind them but estimates have been provided.

Finally, Mr. Lasser mischaracterizes FOS objections to the bridge proposal as aesthetically based. This ignores the considerable information that FOS has documented and presented to the Town concerning the shortcomings of the bridge proposal from an environmental standpoint, including, among other things, its potential effects on public access to and enjoyment of Squibnocket Pond and Squibnocket Beach.

Thank you for your continued thoughtful attention to this issue on behalf of the Town and all of its residents and property owners.

Regards,

Wendy Jeffers
Tony Orphanos
Charles Parker
Doug Liman



MEMORANDUM

DATE: October 28, 2014
TO: Town Committee on Squibnocket
FROM: Stanley M. Humphries and Mark L. Manganello
RE: Response to the Lasser Letter and Haley & Aldrich Memorandum – Dated October 13, 2014

LEC has prepared the following memo in response to the Lasser Letter and Haley & Aldrich (H&A) Memo submitted to the Town Committee on Squibnocket (Committee) commenting on the ‘Dune Alternative’. Before responding to the comments, we would like to clarify the key elements of the ‘Dune Alternative’ as designed by our team on behalf of the Friends of Squibnocket, LLC (FOS).

The FOS proposal was designed to respond to both the elements addressed by the 2014 Annual Town Meeting vote that resulted in the Committee and its mission, and to the requirements of the Coastal Zone Management (CZM) grant.

The FOS ‘Dune Alternative’ proposal is depicted on the attached *Conceptual Plan, Parking Lot, Alternative Road, and Reconstructed Dune for Squibnocket Pond Project*, prepared by Atlantic Design Engineers, LLC, dated October 28, 2014.

The key construction elements of the proposal include:

- Removal of existing revetments;
- Reconstruction of a dune ridge;
- Re-construction/re-location of a gravel access road to Squibnocket Farms; and
- Re-construction/re-location of the municipal beach parking lot.

The key benefits of this approach include:

- Re-establishing a Coastal Dune on a Barrier Beach in area degraded by the existing parking lot and revetments;
- Expanding the width of the recreational Coastal Beach utilized by the residents;
- Re-locating the parking lot to an upland area above the 100-year floodplain.
- Implementation of Managed Retreat of a restored dune.

The following numerical list includes further detail on key concepts and elements that have been taken into consideration with the FOS proposal.

- 1. Managed Retreat:** A framework that is based on scientifically-accepted principles of Adaptive Management, also referred to as Managed Retreat, is an approach to coastal and shoreline management which includes the avoidance of the use of hard structures when other methods are available. The concept of Managed Retreat is referenced within the CZM grant documentation as being an important component of the project.
- 2. Removal of Revetments:** The FOS proposal involves removal of all 450' of existing revetments from the eastern corner of the parking lot to the west end of Money Hill. *This has been a key element of our proposal since Town Meeting* and is fully documented as Base Map Zero Years, which established the new shoreline following revetment removal. Removing the revetments is a key objective for the town, for the Commonwealth and for the FOS proposal.
- 3. Reconstructed Dune Ridge:** The ability of the original dune ridge to withstand storm events has weakened through extensive human activity in the area of the current parking lot over many years, including the four different roads intersecting at that location, historic commercial fishing activity and life-saving operations, and the construction of the parking lot, not to mention several iterations of revetments in several different locations over the years as the beach receded. The proposed reconstructed dune ridge would not be a “mega” dune. It would replicate the original primary frontal dune with a new dune ridge that links the bank on Money Hill to the bank on the east side of the parking lot. It will protect the interests of storm damage prevention and flood control, consistent with state and local wetlands regulations, and will help re-establish a sediment source for an expanded recreational Coastal Beach.
- 4. New Section of Roadway:** The proposal includes reconstruction of a new section of road to connect the existing, asphalt Squibnocket Road to the unpaved Squibnocket Farm Road at Money Hill. The proposal is for a gravel road of the same or better quality with similar base and construction as the existing Squibnocket Farm Road. It should be noted that the entire roadway that has served Squibnocket Point is built on top of a Coastal Dune on a Barrier Beach system that stretches from the existing parking lot to the developed portion of Squibnocket Farm. This does not mean that either the existing roadway or the new section is ‘built on sand’ (as implied in the H&A Memorandum). There is presumably a gravel base under the existing road and the proposed roadway would also be built on a gravel base.
- 5. Utilities:** The utilities will be routed from an area next to the Vytlacil property on the Orphanos/Jeffers property, under the pond, to an area beyond Money Hill. The incremental cost should be minimal as horizontal drilling is not expensive and the utilities need to be re-routed for either strategy. This approach is more secure than attaching the conduits to the bridge.



- 6. Permitting Implications:** As the H&A Memorandum states: "...the Dune Alternative could be designed such that it could be permitted under applicable local and state requirements. In fact, the basic concept of shoreline restoration by dune construction is likely to be well received by MassDEP and the Office of Coastal Zone Management." We agree that the FOS proposal is likely to be well received by MassDEP and can be designed to comply with the Performance Standards of the *Massachusetts Wetlands Protection Act Regulations*. We disagree however that the alternative "encounters daunting regulatory problems when a Relocation Event becomes necessary". DEP is actively permitting several projects in Westport, Mashpee, Harwich and Provincetown where erosion and flooding problems have resulted in relocating roads and parking. The state environmental agencies that understand, support and encourage relocation projects are going to make sure future permitting is consistent with their positions. H&A's speculation that "Relocation Events will be difficult or impossible to permit" is unsupported and without merit.
- 7. Procedures-Based Approach to Maintenance Permits:** We believe the best approach to permitting on-going maintenance is through a 3-year renewable permit from the Conservation Commission. Rather than requesting new permits for each maintenance activity, including road relocation, this approach allows for maintenance under a single permit using defined procedures that provide notification to the Conservation Commission of required emergency fixes and plan documentation. This allows maintenance activities to proceed as needed, without requiring a separate new permit or permit amendment each time. An Order of Conditions of this type can be renewed for additional 3-year periods with the provision that a comprehensive management plan has been submitted and approved. Relocation Events and related actions will be well-defined in an Order of Conditions.
- 8. Parking:** The FOS proposal includes convenient parking for a maximum capacity of 40 vehicles (same as current parking capacity). This proposed parking area is 15'-16' elevation (above mean sea level) at its lowest point and is protected by the higher bank to the east. As such, this area will not be in a FEMA flood hazard zone and should be fully functional for many more than 50 years. This is a clear advantage over a replacement parking area on the barrier beach itself where over ¼ acre of vegetation would be removed and lead to instability of the coastal dune.
- 9. Beach Restoration & Beach Access:** This proposal provides two key restorative features. First, the revetments are removed which opens the way for natural sand deposition onto the beach rather than the scouring that is currently ongoing. Second, the new dune will be a direct sediment source for the beach and reestablishes a recreational beach at high tide. Beach access is convenient via a roll-out board walk on the east end of the public beach. It should also be noted that this access is direct and convenient to the historic swimming beach and is consistent with the recommendations from the Beach Committee.
- 10. Access to the Pond:** This approach provides easy access to Squibnocket Pond via a kayak or canoe access point to the pond that is both direct and convenient. The kayak/canoe drop-off area allows sufficient space on the bank of Squibnocket Pond, above the delineated wetland, to



temporarily park one vehicle and to unload the boat before returning the vehicle to the parking lot. The access to the pond is via a simple, short path with a gradual slope.

How Will the Dune Ridge/Road Actually Work?

Several design considerations were not properly articulated in the H&A Memorandum. (For additional discussion, refer to the attached memorandum from John Ramsey, Coastal Engineer from Applied Coastal, dated September 9, 2014).

- 1. Barrier beach migration:** First, the Dune Ridge Solution is aligned with what is known about the landward migration of barrier beaches. The dune is designed to naturally function in a way that is consistent with existing and projected beach migration dynamics. It will move landward at the same rate and will behave in the same way as the existing barrier beach system southwest of Money Hill. The overall longevity of this solution is related to the amount of land available for the migration. If one calculates the number of years for the back edge of the dune to reach the northern extremity of the land that can be used for the access road, the solution will last 90 years based on our projected erosion rate.
- 2. Dune designed to withstand powerful storms without breaching:** A coastal engineer designed the dune, using established design parameters to dissipate wave energy and to withstand the impacts of major storm events. The width, slope of the sides, and height is sufficient to handle a 75-year storm and is not designed for the 100-year event for two important reasons: (a) the height of the dune is designed to match the surrounding land forms and to function in a way that complements the other banks, and (b) managed overwash is desirable.
- 3. Maintenance of the dune system:** The dune will be subject to erosion each year and some replanting of beach grass may be necessary. The front slope will naturally respond and adjust to erosion caused by wave run-up, wind and rain. Any replenishment of the migrating dune will be done on the crest or back slope and only every 10 years, unless there is a major weather event. As the shoreline retreats over the course of any 10-year period, the front of the dune will be reduced in volume and after 10 years an equivalent amount will need to be added to the rear of the dune, less any material that has accumulated naturally due to overwash.
- 4. Overwash into the pond and wetlands:** Overwash will occur naturally across the top of the dune during major weather events. This process, along with wind erosion, will deposit material into the wetland and pond resulting in a natural evolution of the wetland into the upland. Areas that were wetlands previously may be used for relocation of the roadway and will enable better separation between the roadway and the shoreline. The H&A Memorandum asserts that the dune ridge will not allow overwash. We disagree. Erosion will degrade the dune between major dune maintenance events and as the dune changes in form, it will allow more overwash. Additionally, if it is determined that there is not enough overwash, major maintenance events can be postponed to allow more sediments to overwash the dune.



- 5. Separation of roadway and utilities:** Separating these two elements allows for less complex and more responsive maintenance. Separating the utilities from the roadway makes it possible to repair the roadway without concern for conduits running under the road.

The Route for the Roadway

We have realigned the proposed roadway away from the dune ridge and closer to the edge of the pond as presented to the Committee on October 14th. The new route has two key advantages over a route that hugs the back of the dune ridge, and also over the bridge proposal: (a) it eliminates conflict between vehicles traveling to Squibnocket Farm and people parking or walking to the beach; and, (b) it reduces maintenance and relocation requirements for the new roadway section. The roadway located behind the dune was 400' long, all of which would require relocation as the dune moved toward the upland. With the new route, 200' of the roadway is subject to relocation from 35-50 years. The section of this new road that will need to be relocated over the next 25-35 years is reduced to 100' because of the direction the new route takes away from the shoreline. For the last 100' section, as the overwash proceeds on either side of the roadway, it can be relocated within 15-25 years to a more secure area on the barrier beach/coastal dune.

It should also be noted that this strategy of using man-made dunes to protect the roadway access for S/F could be replicated in other places where S/F is vulnerable further to the west. The most pronounced issue that will need to be addressed is a 300' long section of the barrier beach that is at an elevation of 4'–5' starting from a point immediately beyond the first Money Hill 'knob'. Would S/F use a constructed dune to maintain access when its access along that road segment is threatened, or is S/F's longer term plan to extend its bridge along that stretch as well?

The Bridge Proposal

We can only provide a cursory review of the Bridge Proposal because there are no engineered plans to compare with the plans we provided for the Dune Alternative. The Bridge is not a reasonable alternative for several reasons as discussed below. This is also a rare and unusual case where a bridge is being proposed over land, not water. A summary of our view on the Bridge Proposal (based on the limited materials that have been provided by Haley and Aldrich) follows:

- 1. Revetment removal and other important design details:** The H&A Memorandum is short on details while making explicit claims about the longevity of the bridge. The S/F consultant's technical memo did not support the removal of the revetments; rather, the consultants were emphatic about the need to retain the parking lot and causeway revetments to ensure longevity for the bridge. This is at odds with the goals of the Town and the premise of the CZM grant. Additionally, H&A has not provided information about the erosion rate assumptions used in making its claims about the longevity of the bridge. Contrary to the comments in the H&A Memorandum, we have been *explicit* in all of our presentations and documents that the revetments must be removed and we have provided

a thoroughly researched erosion rate. Other prominent details that are missing from the bridge proposal even at this late date include the design of the abutments (they have provided vague references to ‘tipping slabs’). The exact proposed location of the bridge has not been documented either (except for its northeast corner). For a planning and design effort that is said to have been underway for several years, it is very surprising that these important design parameters remain well-kept secrets.

- 2. Longevity and 25 year rebuild cycle:** The bridge is designed to withstand the 100-year return frequency storm but it will only be in service without major modifications for 25 years. (Note: the 50-year commitment by Haley & Aldrich does not include any references to underlying assumptions on revetment removal or erosion rate.) Assuming the revetments are removed and based on the projected erosion rate of 2.3’ per year, the bridge is ‘out-of-service’ at its west end-point in less than 25 years and at its east end-point in 35 - 40 years. Within that timeframe, the town’s recreational beach would be located under the bridge and a whole list of public safety issues would arise. Failure in 25 years is consistent with the history and longevity of hard structures at Squibnocket. Both sets of revetments lasted 25 years and the same is applicable to the bridge. In 20 years, Chilmark will be asking the same questions again: What do we do with our hard structures? How do we resolve access to Squibnocket Point?
- 3. The more likely need is for a 700’ bridge; not 400’:** When the west endpoint is exposed in 20 - 25 years (life span of existing revetments), the only viable option will be to extend the bridge to the west by another 300’ or so. In other words, the only response to problems with the bridge at the west end is more bridge. It is not likely that H&A and S/F are unaware of this fact. The Town should assume, and S/F should acknowledge, that the current proposal for a 400’ bridge is really a stalking horse for proposing a 700’ bridge.
- 4. Stranding at the northeast end-point:** The problems at the northeast end-point are equally severe and provide few options for responding to erosion. Assuming Squibnocket Farm is able to obtain permission to build its bridge as close as 6’ from a private abutter’s property line, the top edge of the coastal bank will reach that end-point in 35 years. At year 25, the Town should expect to see another request for a major revetment building exercise to protect this end-point. It seems unlikely that the Commonwealth would be willing to allow a new revetment for that purpose, unless there is a reversal of long-established regulation. An additional problem that will arise with such a proposal is that Squibnocket Farm doesn’t own the land to the east of this end-point so it would have no place to put such a revetment unless abutting property owners were accommodating. Furthermore, Squibnocket Farm does not own the land going up Squibnocket Road, which they would need in order to extend the bridge across the chasm between the end-point of the bridge and the road. We have discussed the need for a ‘bridge to get to the bridge’ after the end-point is eroded but even that may not be possible without control of the land itself.



5. **Maintenance:** Little has been said about maintenance of the bridge over the 50-year period. It would be helpful to enumerate these costs and to compare them with the maintenance of the dune ridge and roadway in light of S/F's expressed concern about the latter.

6. **Parking:** Other than incorrectly stating that we have not submitted a parking plan (the FOS parking plan was submitted to the Committee on Oct 10th), the H&A Memorandum is silent on the subject of parking. As mentioned above, we have submitted a complete parking plan with the associated engineering details and survey mapping. The FOS plan is at a minimum elevation of 15' and would not be inundated by the 100-year flood. (One alternative is the plan for parking on the barrier beach in a high hazard flood zone at 4' – 5' elevation that resulted from the initial private meetings between Town officials and S/F representatives. This location would damage the barrier beach and is not likely to be allowed by permit. Additionally, that plan is inconvenient to the swimming beach and requires a two-lane access over the barrier beach.).

In conclusion, we believe that the H & A plan is a short-term, high-risk fix to the Squibnocket Farm access problem that fails to address the other managed retreat issues identified by the Town. While the bridge has a small wetlands footprint, this solution fails the broader test of environmental soundness and common sense. Building an overly engineered structure parallel to the coastline in an area used for public recreation is simply not in the best interests of the environment, the public, or Squibnocket Farm. This solution leaves Squibnocket Farm open to the same access problems within 25 – 35 years. And, the only viable parking solution is on the barrier beach, which results in further environmental damage to the area. In contrast, the Dune Solution puts forth the short and long-term solutions that are consistent with managed retreat. A small portion of a low value wetland is proposed as roadway fill but the total area is less than that allowed by regulation. Public recreation is restored with the removal of revetments. Barrier beach characteristics are also restored with the construction of a dune that will not only provide a sandy beach for many years to come, but protect access to Squibnocket Pond. Parking for Chilmark residents is relocated to an upland area and separated from the impact of shoreline erosion for the next 75 years. Finally, the goal of having Squibnocket Pond cited as a “model project” can be achieved with the Dune Alternative.



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766 Falmouth Road
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TECHNICAL MEMORANDUM

Date: September 9, 2014
To: Charles Parker, Friends of Squibnocket, LLC
From: John S. Ramsey, P.E.
Subject: Squibnocket Dune Design

According to the Office of Massachusetts Coastal Zone Management (MCZM) “Storm Smart Coast Fact Sheet 1: Artificial Dunes and Dune Nourishment”, an artificial dune is a method of shore protection where a mound of compatible sediment (material similar or slightly coarser than the native sediments) is built along the back of the beach and seaward of the infrastructure to be protected. In the case of constructed dunes, the “soft” shoreline stabilization technique dissipates wave energy and, if designed properly, can withstand the impacts from major storm events. MCZM states that “dune projects are appropriate for almost any area with dry beach at high tide and sufficient space to maintain some dry beach even after new dune sediments are added to the site.” Countless dune nourishment projects for storm protection have been performed along the East Coast of the U.S., with Massachusetts examples including Revere Beach, Sandwich Beach, Duxbury Beach, Dead Neck (Barnstable), and Winthrop Beach.

For Squibnocket Beach, the barrier beach width landward of the dune toe is approximately 115 feet, which is sufficient space to construct a shore protection dune and one-lane roadway. Moreover, the existing coastal banks both east and west of the barrier beach area in the vicinity of the parking lot allow the constructed dune to “tie-in” to these higher elevation features to form a contiguous shore protection regime.

Design of the dune system required (a) prediction of the shoreline position after revetment removal, (b) determination of dune volume above predicted flood elevations, and (c) determination of expected wave run-up during storms. In addition, it is understood that this portion of the Martha’s Vineyard south shoreline has a ‘natural’ retreat rate of approximately 2.3 feet per year and this long-term rate of shoreline retreat can be expected to continue over the life of any project constructed at this location.

The predicted shoreline shape subsequent to revetment removal was based on the work of Gonzalez and Medina (2000) for Development of equilibrium bay plan shape, as described in ERDC/CHL CHETN-IV-36 (2001) entitled "Chronic Beach Erosion Adjacent to Inlets and Remediation by Composite (T-Head) Groins" (Hanson and Kraus). Although the wave angle

defining the bay shape could not be determined without a substantial numerical modeling effort, an approximation was developed based on the observed shape of adjacent shorelines controlled by updrift “headlands” (e.g. the beach east of Mussel Shoal, approximately 900 feet west of the site). Based on this information, the wave angle relative to the bay shape was determined to be between 3° and 5° relative to the shoreline. The shoreline shape following revetment removal is shown on the ‘Base Map – Zero Years - After Revetment Removal’, where the model predicts the shoreline position of high water including typical wave uprush which is the approximate location of the dune toe. It should be understood that this shoreline will retreat landward at the rate of 2.3 feet per year.

Design of coastal dunes for shore protection requires both sufficient elevation and volume to resist the impacts of coastal storms. FEMA developed guidelines regarding the required cross-sectional area of a dune needed to survive a 100-year storm and determined that approximately 540 ft² is required based upon erosion data related to 46 historical storm events. Figure 1 illustrates the cross-sectional area of dune required above the 100-year still water elevation necessary to withstand various return-period events. The initial dune design developed for Squibnocket Beach consists of approximately 490 ft² above the 100-year storm level and 555 ft² above the 50-year storm level. Based on Figure 1, the initial dune volume can withstand a storm less than ~75-year return frequency event.

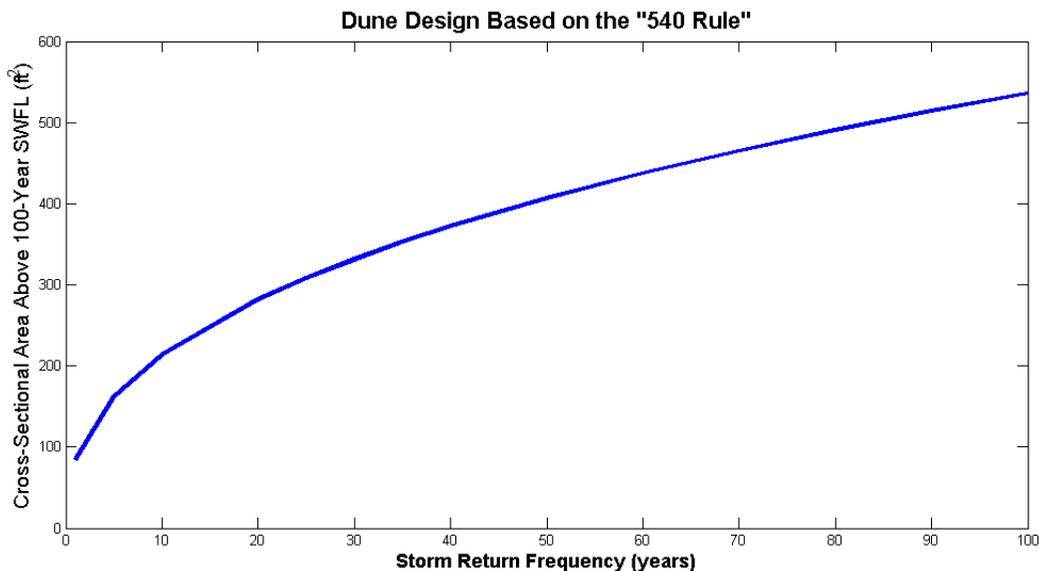


Figure 1: Dune cross-sectional area required above the 100-year still water flood level (SWFL) to protect against various return period storm events.

An independent method for determining the influence of wave setup and runup on a shoreline can be utilized to determine whether the dune will be overtopped during a severe storm event. Similar to the analysis above, the 100-year SWFL was used as the baseline water level for the computation technique developed by Stockdon, *et al.* (2006). Based on the storm wave information derived from the most recent USACE Wave Information System (WIS) hindcast data set, the 100-year offshore wave height south of this area is 34.4 feet, where the two largest wave events in the 33-year record are Hurricane Bob (1991) and Hurricane Sandy (2012). The

WIS data indicates that the wave runup will reach 9.7 above the 100-year SWFL, which is below the 10-ft height of the dune above the 100-year SWFL (or 16.8 feet NAVD).

It should be noted that the design calculations are based upon the initial volume and height of beach compatible material placed. As ongoing erosion reduces the volume of the dune, its ability to withstand storm events is reduced (as shown in Figure 1). It is anticipated that dune repair/replenishment will be required approximately every 10 years to (a) allow the shoreline to migrate landward naturally by periodically 'repositioning' the dune and roadway, and (b) replenishing the eroded dune volume to ensure it provides the level of protection desired.

Based on the design criteria described above, the plan and section provided by Atlantic Design represents the proposed dune reconstruction and at-grade roadway connecting Squibnocket Road with Money Hill.

References

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