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Town of Chilmark
Board of Selectmen
P.O. Box 119
Chilmark, MA 02535

RE: Evaluation of the Town of Chilmark's '*Squibnocket Beach Access Parking Lot Relocation and Revetment Removal Project*'

Dear Selectmen:

The following is my evaluation of the Town of Chilmark's proposed 'Squibnocket Beach Access Parking Lot Relocation and Revetment Removal Project' as outlined in information provided to me by the Town and a June 11, 2013 existing site plan by Vineyard Surveying and Engineering, Inc.

Proposed Project (Figures 1 & 2)
As I understand, the Town of Chilmark's proposed project consists of:

- possibly removing the existing Squibnocket Town Beach parking lot and existing rip-rap revetment that protects the existing parking lot, and relocate a gravel beach parking lot to the west;
- construct a 'turnaround' at the seaward end of Squibnocket Road following possible removal of the parking lot and revetment;
- relocate the commercial skiff and recreational boat launch path leading to Squibnocket Pond from the existing parking lot and relocate a new path from the proposed new parking lot leading to Squibnocket Pond; and,
- restore the former (presently existing) parking lot area and re-nourish the barrier beach with sand to return it to its natural state.

The purpose of the project is to provide stable, long-term Town beach parking with recreational beach and small boat access.

Simultaneously, the Squibnocket Farm Association is proposing to abandon the current vehicle access to and from their residences along the back area of the existing Town Beach parking lot and construct an elevated roadway to provide long-term access to their properties as shown in mock drawings provided to me (**Figures 1 & 2**). The proposed elevated roadway is independent of the Town Beach parking lot relocation project proposal.

As a result of the Squibnocket Farm Association's project, the Town of Chilmark is considering entering into an agreement with the Association to lease approximately 10.5 acres of land to the west of the existing beach parking lot and construct a new Town Beach parking lot within those 10.5 acres. As part of the potential agreement, the Town's existing active recreational beach area will be expanded from 280' to approximately 1,405 linear feet within those 10.5 acres (see **Figures 2**).

Consultant's Project Analysis

As requested, my *analysis* includes:

- review of the 'existing conditions land survey' by Vineyard Surveying and Engineering, Inc., and integration of published shoreline change data and FEMA Flood Insurance Rate Map data;
- analysis of the existing and proposed parking area locations and potential project impacts due to future coastal erosion and sea level rise;
- the proposed project's potential effects on the barrier beach and adjacent Squibnocket Pond;
- possible alternatives to the current proposal; and,
- answers to the specific questions provided to me at our January 31, 2014 site visit as outlined in the 'Consultant's Assessment' memo.

Site Description

Location

The Squibnocket Beach Parking Lot and Revetment project site is located along the southwest shore of Chilmark, Martha's Vineyard (**Figure 3**).

Due to on-going beach erosion and the presence of the revetment protecting the existing beach access parking lot, high water is forced against the toe of the revetment resulting in the loss of the fronting dry beach (**Figure 4)**. A narrow dry beach may be present fronting the revetment at times during the summer months, but in the future no dry beach will exist year-round due to continuing erosional lowering of the fronting beach elevation. If the revetment is left in place, due to continuing beach erosion the inter-tidal (wet) beach will continue to narrow and eventually in the near future high water will be forced against the revetment at all times of the tide.

The revetment is holding the parking lot in place as the adjacent coastal bank to the east and barrier beach to the west continue to erode: the parking lot would not exist without the revetment in place. However, doe the revetment artificially holding the parking lot in place, this has created a significant shoreline off-set between the parking lot (located on a barrier beach) and the coastal bank to the east (**Figures 4 & 5**). The shoreline offset to the west is not as significant due to the small glacial deposit (Money Hill) and cobble lag deposit (**Figure 5 Insert**).

Geology and Coastal Wetland Resources

As shown on the *Surficial Geology Map* of Martha's Vineyard compiled by Stone and DiGiacomo, (USGS, 2009) (**Figure 6**) and the *DEP Wetlands and Wetlands Change Map* (**Figure 7**), the site contains portions of the Buzzard Bay/Gay Head Thrust/Squibnocket Moraine

deposits (*green color* on **Figure 8** which are coastal banks), as well as barrier beaches, beaches and dunes (*tan color* on **Figure 8** labeled BB/B/D). The Moraines contain a matrix of till, i.e. boulders, gravel, sand, silt and clay, while the barrier beaches, beaches and dunes consist of cobble, gravel and sand. The site also contains vegetated wetlands landward of the barrier beach (M: marsh). As can be seen on **Figure 7**, two barrier beaches -- one where the existing parking lot is located and the other where the 10.5 acres are located -- are separated by a small glacial deposit (Money Hill: coastal bank).

***QUESTION #1*: What is the Estimated Annual Rate of Beach Erosion & Projected FEMA Flood Line for the Shoreline that is South of the proposed Location for the *New* Parking Area?**

***Shoreline Change* (Figure 9)**
Based on the state's most recent shoreline change data (MA CZM), the shoreline at the location of existing parking lot has the highest short- and long-term erosion rates of the entire project area.

The *long-term erosion rate* (1888-2009) at the ***existing parking lot*** at Transect #MV1659 is -1.35'/yr, while the *short-term erosion rate* (1979-2009) is -1.84'/yr. Due to the presence of the existing revetment, the future horizontal shoreline change rate will be zero, as the most recent shoreline was plotted against the seaward side of the revetment, i.e. the high water line can no longer move landward. However, importantly, although the horizontal erosion is halted due to the existence of the revetment, the beach fronting the revetment will continue to *lower* in elevation resulting in greater wave energy hitting the revetment more than likely resulting in more frequent damage to the revetment with concomitant higher maintenance costs to rebuild the revetment following coastal storms. In addition, end scour or flanking erosion due to the revetment will increase as well.

The area of the ***proposed parking lot*** on **Figures 1 & 2** (Transect #MV1662) has a *long-term erosion rate* of -0.89'/yr (1888-2009), with a *short-term erosion rate* of -0.75'/yr (1979-2009).

Importantly, the long- and short-term erosion rates become *lower* as one moves west along the project shoreline. For example, Transect #MV1664 to the west of the proposed parking lot location has a long-term erosion rate of -0.75'/yr, while the short-term erosion rate is 0'/yr or relatively stable.

Figure 15 shows the approximate location of the shoreline and seaward vegetated dune line in 100 years based solely on the present documented erosion rate at the site. As can be seen on **Figure 15**, the proposed parking area will still be available for use in 100 years, however, obviously the area – as all other adjacent areas – will be subject to more frequent overwash due to ongoing erosion and relative sea level rise.

Alongshore Sediment Transport
Due to westerly prevailing wind and wave direction, general sediment transport along the south shore of the Vineyard is from west to east. However, directional reversals in sediment transport

occur due to off-shore and near-shore bathymetric changes. This longshore sediment transport directional reversal occurs at the project site.

As shown on the aerial photograph in **Figure 3**, due to the presence of the cobble lag deposit in the inter-tidal and particularly the sub-tidal area it appears that waves are refracted around the cobble lag deposit creating a convergence of waves and, thus, a convergence of sediment transport. *This convergence of waves is more than likely the reason for the lower shoreline change rates in this particular area relative to the adjacent areas, as well the presence of cobble.*

FEMA-mapped Flood Zones (Figure 8)

There are two considerations when analyzing FEMA-mapped flood zones and Flood Insurance Rate Maps in considering present-day and future potential storm damage for the subject sites:

1. The **presently adopted and, thus, legal** *Flood Insurance Rate Maps (FIRMs)* published July 6, 2010; and,
2. The '***Preliminary**' (i.e. draft) Flood Insurance Rate Maps (FIRMs)*, which are the best available flood zone information: however, importantly, they have not been legally adopted by the Town of Chilmark and, thus, are not legally binding. In fact, several coastal communities in Massachusetts have appealed their 'preliminary' FIRMs due to questions about the methodology use to develop the new, proposed flood zones on the FIRMs. However, due to the long-tem nature of the proposal, the new, proposed flood zones for Chilmark should be, at least, considered in planning.

Presently Town-Adopted, Legal Flood Insurance Rate Maps

Based on the current legal, Town-adopted FEMA Flood Insurance Rate Map (#25007C0159), published July 6, 2010, the existing parking lot, the proposed parking lot, revetment and beach lie within several different FEMA-mapped flood zones with varying flood elevations (**Figure 8**).

The coastal beach and revetment fronting the existing parking lot on the *east end* are located within a FEMA-mapped Velocity Zone, elevation 16' NAVD, while the beach and revetment located along the *west side* of the existing parking lot are located within a Velocity Zone, elevation 12' NAVD. (*Velocity Zones* are defined as 'areas along coasts subject to a one percent or greater annual chance of flooding in any given year that include additional hazards associated with velocity wave action (3' or greater)).

The beach fronting the *west end* of the existing parking lot, and the entire beach fronting the 10.5 acres proposed to be leased lies within a present FEMA-mapped Velocity Zone, elevation 12'NAVD.

The *existing parking lot*, as well as the proposed location of the new parking lot are located within a FEMA-mapped *AO Zone*, depth 2'. (*AO-zones* are defined as 'areas subject to a one percent or greater annual chance of shallow flooding in any given year. Flooding is usually in the form of sheet flow ('overwash' in coastal areas) with average depths between 1 and 3 feet.)

Preliminary (draft) Flood Insurance Rate Maps

Importantly, FEMA has recently released '*Preliminary* (draft) Flood Insurance Rate Maps (June 3, 2013) for Chilmark that significantly differ from the present Town-adopted FIRMs for the project site.

The Preliminary FIRMs (**Figure 8B**), show that most of the existing beach parking lot, all of the fronting beach, and all of the potential lease area, including all of the existing Roadway lie within a FEMA-mapped Velocity Zone, elevation 15' NAVD.

Thus, the Preliminary FIRMs show a higher degree of potential storm wave and flooding inundation relative to the existing FIRMs.

Based in these Preliminary FIRMs, it can anticipated that the proposed new area for the parking lot will remain in a coastal high hazard area, i.e. Velocity Zone, for the foreseeable future. It is odd that the extreme east area of the existing parking lot is mapped 'outside' of the FEMA flood zones. It is obviously subject to storm overwash resulting and coastal storm damage.

Coastal Processes: Discussion

A narrow dry beach may be present at times during the summer months, but in the future no dry beach will exist year-round due to continuing lowering of the fronting beach elevation as sea level continues to rise and erosion continues. If the revetment is left in place, the inter-tidal (wet) beach will continue to narrow as well and eventually high water will be forced against the revetment at all times of the tide.

The revetment is holding the parking lot in place as the adjacent coastal bank to the east and the coastal bank and barrier beach to the west continue to erode. This has created a significant shoreline off-set between the parking lot (barrier beach) and the coastal bank to the east (**Figure 4 & 5**). The shoreline offset to the west is not as significant due to the boulders fronting the glacial deposit and the cobble lag deposit.

There also appears to be an *overwash hot-spot* immediately to the west adjacent to the glacial deposit (Money Hill) separating the two barrier beaches and the cobble lag deposit (**Figures 3 & 10**). This is more than likely created as a result of storm wave focus between these two deposits. This overwash hot-spot is directly seaward of the location of the 'proposed' new parking lot and is addressed below.

QUESTION #2: **If the *New* Parking area is installed at the currently proposed location, will it be protected from severe storm activity; *and*, how long will it take for the shoreline to reach the south border (ocean side edge) of the parking area?**

Parking Area

Proposed *New* Parking Area Location: Duration (Shoreline Change and Flooding)

As cited above, the best available shoreline change data indicate that the shoreline fronting the area of the *proposed* parking lot (**Figures 1 & 2)** has a short-term erosion rate of -0.75'/yr (1979-2009). Based on this documented erosion rate and the new parking lot proposed to be located

approximately 120' from the seaward edge of the vegetated dune, the approximate high water line will not reach the proposed parking lot location for approximately 160 years. However, relative sea level rise induced erosion will lower that prediction, as described below.

At the present time, the proposed parking lot is located within a FEMA-mapped AO-Zone (**Figure 8**). The Velocity-/AO-Zone line is located at the seaward edge of dune vegetation.

With on-going erosion and relative sea level rise, the AO-/Velocity-Zone interface will migrate landward and flooding will become more frequent. In addition, with the new draft *Preliminary Flood Insurance Rate Maps* designating the area as a coastal high hazard Velocity Zone, flooding and storm wave inundation will become more frequent in the future as a result of on-going coastal erosion and relative sea level rise. Many coastal technical specialists, e.g. U.S.G.S. and NOAA, suggest planning for a 3' rise in sea level over the next 100-years is reasonable for long-term planning.

However, due to the proposed *new* parking area location being significantly more landward than the *existing* lot, and dense salt-tolerant dune vegetation separating the proposed new lot location from the active beach, overwash sediment and damage to the proposed new parking lot will be significantly less frequent than experienced recently with the existing parking area.

*In considering alternative new proposed parking lot locations, however, it is important to note that an overwash hot-spot exists seaward of the proposed parking lot location (**see Figures 1, 3 & 10**).*

Sea Level Rise

At the present time based on the documented rate of sea level rise and predictions of a future acceleration in the rate of sea level rise, it is reasonable to suggest planning for at least a 3' rise in sea level by the year 2100.

With the present documented rate of relative sea level rise at approximately 1 vertical foot per 100 years and a predicted (and possibly presently documented) acceleration in the rate of sea level rise, it is difficult to predict with any level of certainty the increased rate of coastal erosion and frequency of overwash at the project site. Detailed topography and cross-sections of the proposed parking area would permit a simplistic evaluation of the influence of sea level rise on the location of the high water line and flood zones into the future at the proposed new location. As suggested above, a 3' rise in sea level to the year 2100 is reasonable for planning purposes: this is supported by the USGS and NOAA.

Thus, the most simplistic and effective approach for longevity and the least maintenance frequency for the new parking lot is to locate the facility as far landward as possible and on the highest available topography. Coupled with avoiding areas susceptible to overwash and other energetic coastal processes will provide a location meeting these criteria, i.e. longevity and less frequent maintenance, as described below.

***Question #3*: Is there a Better Location on the South Side of Squibnocket Farm Road on the 10.5 acres of newly leased land for the parking area: One that is More Protected from Erosion and Storm Activity? If so, please explain the reasons for suggesting a different location.**

***Consultant 'Suggested' Alternative* New Parking Location for Discussion (Figure 11)**
As outlined above, coastal erosion rates *decrease* towards the west (**Figure 9**). The *proposed* parking lot location has a higher erosion rate than areas within the 10.5 acres to the west. In addition, overwash appears to be less active in areas west, adjacent to the 'proposed' area. Furthermore, the cobble lag deposit on the beach that exists to the west of the proposed parking lot location is a natural coastal storm, overwash and erosion protection landform (**see Figures 3 & 10**).

Thus, it is suggested to consider locating the new proposed parking area along Squibnocket Road landward of the cobble lag deposit, slightly to the west of the *proposed* location (**see 'suggested' location on Figure 11**). The benefits of this location to consider are:

1. the storm, erosion and overwash protection provided to the area by the cobble lag deposit;
2. this location may provide a slightly greater distance between the lot and the presently mapped FEMA Velocity Zone possibly less frequent overwash and storm water inundation which will provide a bit more longevity and less frequent maintenance;
3. dense vegetation exists between this site and the active beach which will reduce overwash material reaching the parking area location; and,
4. it was noted that higher trees and shrubs exist on the Squibnocket Pond (north) side of the roadway that may provide a greater vista buffer for houses on the slope west of the Pond.

In considering this suggested location (or the existing proposed location), it is also suggested that the pedestrian beach access pathway from the lot to the beach be angled slightly to the southeast away from the prevailing wave direction. This may reduce the potential of the pedestrian beach access pathway becoming a sluiceway for overwash sediment, and will also allow beach goers to enter the beach in an area with fewer cobbles and denser sandy deposits (**Figures 11 & 14**).

***Question #4:* How Vulnerable is the existing Understory Vegetation to Storm Erosion and Ocean Overwash South of the Proposed New Parking Area and How Long Will it Remain Healthy?**

As suggested above, moving the proposed parking area slightly to the west (**see Figure 11**) will provide a bit more longevity and lower frequency of overwash to this suggested parking area. The swath of salt-tolerant dune vegetation is greater in this suggested location than the presently proposed parking area. Salt-tolerant dune vegetation will diminish with on-going erosion and landward movement of the high water line; however, following coastal storms and overwash salt-tolerant dune vegetation usually re-establishes itself naturally shortly following coastal storms.

Question #5: What Impact has the Current Revetment and Parking Lot had on Beach Erosion in Front (South) of the Parking Area, and Up and Down Tide of the Structure?
Based on the DEP Wetlands Map, the location of the current parking lot and revetment is a barrier beach, which consists of coastal dune and coastal beach (**Figure XX**). Without the revetment and accompanying fill, the parking lot could not exist: a coastal dune would be in its place.

As cited above in the Shoreline Change section, the *long-term erosion rate* (1888-2009) at the ***existing parking lot*** at Transect #MV1659 is **-1.35'/yr**, while the *short-term erosion rate* (1979-2009) is **-1.84'**/yr.

Due to this erosion, the dry beach has eroded and high water is presently forced against the revetment, thus, eliminating the fronting dry coastal beach at high tide during most of the year. Although horizontal (landward) erosion is halted due to the existence of the revetment, as the erosion process continues the beach fronting the revetment will continue to *lower* in elevation. As a result, in the future the fronting inter-tidal beach will eventually be eliminated and high water will be forced against the revetment at all times of the tide.

During storms, the revetment also creates 'end scour' or 'flanking erosion' to the coastal bank area immediately adjacent to the revetment on the east end, i.e. downdrift.

If the revetment was not present, the mean high water line would more than likely be in-line with the high water line fronting Money Hill and the high water line fronting the coastal bank to the east. This is a configuration that more than likely will result if/when the revetment is removed as well.

Money Hill is a glacial deposit (moraine) that consists of consolidated, naturally compacted sediment. Although it is adjacent to the revetment, because it is updrift of the predominant wave direction, the revetment does not appear to be adversely impacting it to any significant degree.

The following questions provided by the Town of Chilmark are answered within the followingsections below.

Question #6: What section(s) of the existing revetment that is located south of the current parking lot should be removed - if any - and why?

Question #7: What section(s) of the same revetment should remain in place or be reorganized (if any) to protect any existing roadway or other planned structural features?

Question #8: What is the best land, vegetation, and beach restoration plan for the removed revetment and existing raised parking area?

Question #9: what are the projected changes to this re-nourished section of barrier beach will take place after the revetment is removed and the land and beach re-nourished?

Question #10: What impact will normal tidal action and storm surge activity have on the re-nourished barrier beach, Squibnocket Pond water quality and level to the north and the abutting properties up and down tide of the current revetment?

Question #11: What do you estimate will be needed to maintain the re-nourished beach on an annual basis? Will this re-nourished section of barrier beach eventually stabilize and if so, where will the shoreline be located and what will the beach become?

Question #12: If there is a water exchange with the Pond how will this affect the water level of the Pond – during normal tidal actions and during significant storm events?

Question #13: Will the paved Squibnocket Road that leads to the current parking area be exposed to excessive erosion or storm surge impacts if the revetment s removed and the land and barrier beach re-nourished?

Question #14: What protective measures should be taken (if any) for Squibnocket Road after the revetment is removed?

Proposed Abandon Use of Existing Parking Lot & Relocate a New Squibnocket Beach Access Parking Lot: Alternatives

There are several *potential alternatives* to abandoning use of the existing parking lot and relocate a new beach access parking lot as described below:

1. do nothing & continue use of the existing Parking Lot;
2. raise the existing revetment to provide additional short-term protection;
3. completely remove the existing revetment and parking lot material and restore the area;
4. remove only selected sections of the revetment; or,
5. leave the existing revetment and parking lot in-place and allow the revetment to dishevel and the parking lot to erode on their own due to coastal storms.

Alternative #1*:* Do Nothing & Continue use of the Existing Parking Lot

The existing parking lot and revetment are continually subject to coastal storm waves and overwash with concomitant restoration and clean-up funds necessary to provide safe use: which is the impetus for discussing the current proposal.

High water is currently forced against the revetment at high tide during much of the year; eventually, high water will be forced against the revetment at all times of the tide and no wet (inter-tidal) or dry beach will exist fronting the revetment.

This will result in storm damage and overwash becoming more frequent, intense and costly in the future as on-going erosion continues to lower the fronting beach substrate, sea level continues to rise and accelerate, and more intense coastal storms make landfall. Acceleration in sea level rise has already been documented by USGS.

Furthermore, the coastal bank to the east will continue to erode landward (**Figures 4 & 5**), ultimately requiring an extension of the revetment along the east side of Squibnocket Road and the parking lot.

Alternative #2: Raise the Existing Revetment and Parking Lot to Provide Additional Protection
Effects will be similar to Alternative #1 above. Raising the existing revetment and parking lot will reduce overwash frequency: however, unless the entire revetment stones are replaced with larger, heavier boulders, revetment maintenance frequency will remain and become more frequent as erosion continues to lower the fronting beach and sea level continues to rise and more intense coastal storms make landfall. A revetment extension will be required along the east end as erosion of the coastal bank continues.

***Alternative #3*: Current Proposal** to Completely Remove the Existing Revetment and Parking Lot Material (**Figures 1 & 2**)
The current proposal under discussion, as presented to me, includes potentially removing the existing beach parking lot and the rip-rap revetment that is protecting the lot; restore the beach with beach nourishment; construct a turn-around; and relocate small boat access to Squibnocket Pond.

There is potential to lease 10.5 areas of beach-front land and beach area to establish a new Squibnocket Beach access parking lot, if the elevated roadway being proposed by the Squibnocket Farm Association is permitted and constructed (**Figure 2**).

As noted on **Figures 4 & 5**, there is a significant shoreline off-set between the existing beach parking lot and revetment and the adjacent coastal bank to the east due to continuing erosion of the unarmored coastal bank to the east. The parking lot and roadway revetment is in alignment with the coastal bank to the west (Money Hill), except for off-site boulders that were previously placed that are now strewn on the beach fronting the glacial deposit.

As noted on the Vineyard Surveying and Engineering existing topographic site plan (**Figure 12**), the parking lot is much higher in elevation than the landward and adjacent area between Squibnocket Pond and the parking lot and armored roadway.

Vegetated wetlands exist between the parking lot and the Pond indicative of saturated soils, as well as AM Beach Grass (**Figure 13**). Invasive *Phragmites* is also present in this area. Overwash deposits (cobble) have also been deposited in this area between the existing parking lot and the Pond, indicative of the high storm wave and surge energy along this reach of shore (**Figure 13**).

With the parking lot and revetment removed the area will be significantly lowered in elevation allowing frequent storm waves and overwash deposits to cascade through the area into Squibnocket Pond (**see Figures 3 and 12**).

This may be considered an adverse impact to the existing protected wetland vegetation, *however*, the area will return to what would have been its natural state if the fill for the beach parking lot

and revetment were not constructed: this is an environmental benefit and should be considered 'environmental resource restoration'.

The existing vegetation between the existing parking lot and the Pond will more than likely be eroded and an overwash fan consisting of sand, pebble and cobble will more than likely become more densely established. Vegetation may eventually become established along the edges of the overwash fan.

Beach (and dune) restoration are being proposed in conjunction with this alternative. However, that the existing revetment and parking lot are presently subject to storm damage and overwash and frequent maintenance demonstrates that this is a high energy site: this is confirmed as it is a FEMA-mapped Velocity- and AO-Zone as described above.

While beach and dune nourishment are an environmental and recreational enhancement and a benefit to the Town and coastal system, beach nourishment *may not have longevity* due to the high energy nature of the site. Frequent re-nourishment would more than likely be required to maintain a dry beach. To approximately predict the longevity of a beach and dune nourishment project and predicted re-nourishment intervals, modeling must be conducted. As examples, several small to mid-sized beach nourishment projects have taken place along the south shores of Cape Cod where a much lower storm wave environment than Squibnocket Beach exists, and initial beach nourishment lasted, as predicted, <10 years. With the significant shoreline off-set to the east of the existing Parking Lot with no terminal structure to hold any nourishment sediment and the net longshore sediment transport direction to the east, beach nourishment sediment would be rapidly moved from the area fronting the revetment towards the east. It is highly questionable whether beach nourishment fronting the exiting parking lot would be cost-effective or have any acceptable degree of longevity. Modeling would need to be performed to predict longevity.

With the revetment and parking lot completely removed, frequent inundation of saline waters will enter Squibnocket Pond with each storm overwash; however, the volume of overwash and coastal storm inundation will be episodic and short-term based on the intensity of each coastal storm. The existing salinity in the Pond is approximately 10-12/000 based on existing literature (MVC, 2001). This salinity may temporarily slightly increase with each storm overwash and inundation episode; however, the salinity would more than likely be restrained in the immediate vicinity of the overwash entering the Pond. The effects of this increased salinity will more than likely be negligible, however, this would have be modeled to gain more accurate predictions. There may also be a slight temporary increase and decrease in the Pond elevation following storm overwash and inundation. This potential temporary increase and decrease in elevation will more than likely be small and based on the elevation of the resulting overwash fan and tidal elevations. A narrow tidal inlet may form during a major storm, however, it more than likely would be short-term and temporary.

The proposed 'turn-around' (**see Figures 1 & 2**) in the area of the offset between the coastal bank to the east and the existing parking lot will also be a near-future area of concern. If the Turn-around is to have any longevity, protecting it from storm waves and surge should be

considered, e.g. revetment, as the coastal bank to the east will continue to erode landward and as storm overwash occurs on its west side. With the parking lot and revetment completely removed the turn-around will be exposed to storm waves and erosion immediately. Under the state Wetlands Regulations, constructing a new revetment is allowed only to protect a building built prior to August 10, 1978, without a variance. Thus, it may be difficult to construct a revetment. However, in this circumstance it would be considered a revetment 'extension' to protect a portion of the sole access to existing houses, and thus, may possibly be considered. The possibility of being able to permit a revetment to protect a turn-around should be discussed accordingly before final plans are drawn.

Based on available shoreline change maps (**Figure 9**), the long-term erosion rate in that location seaward of the proposed turn-around is -1.41'/yr, while the short-term erosion rate is -1.61'/yr. Based on these data and the approximate seaward southeast side of the proposed turn-around, the high water line will reach the turn-around in approximately 40 years on the east side. However, importantly, if the parking lot and revetment are completely removed storm waves will reach the location of the turn-around immediately following removal on the west side. In addition, with relative sea level rise, the 40 year time frame of the coastal bank to the east eroding and the high water line reaching the turn-around will be significantly less.

Thus, a revetment to protect and add longevity to the turn-around should be considered, if it is proposed in this location. Moving it farther landward should be considered. This will also be an issue to be addressed by the proponents of the elevated roadway as the seaward end of the proposed elevated roadway is only slightly farther landward than the location of the proposed turn-around.

Alternative #4: Remove only Selected Sections of the Revetment

The proposed turn-around and the *eastern end* of the proposed elevated roadway will be subjected to erosion and potential storm damage shortly after the revetment is completely removed, if it is removed.

The *west end* of the exiting roadway and the proposed elevated roadway (see Figure 1) will need storm and erosion protection, as well, as these are close to the shore with an erosion rate of approximately 1'/yr and in area subject to storm overwash and storm waves.

Thus, keeping the section of the revetment on the west end and connecting the landward and seaward sections on either side of the roadway may be necessary.

The same holds true for the proposed turn-around: a section of revetment will need to be removed and relocated and constructed around the turn-around to provide storm and erosion protection. If this new section of revetment is not constructed, the end of Squibnocket Road will eventually need erosion and storm protection in the not too distant future.

These sections of revetment will need to be constructed on both sides of the west and east roadways and connected at the terminal ends, or flanking erosion around these isolated revetment

sections would eventually erode the sediments behind the sections, ultimately exposing the turn-around and roadways on the east and west ends.

Alternative #5: Leave the Existing Revetment and Parking Lot in-place and allow the Revetment to Dishevel and the Parking Lot to Erode on their own due to Coastal Storms
If the revetment and parking lot are left in place to dishevel on their own due to coastal storms, the parking lot would still be off-limits for use as beach access, as it will erode slowly and not necessarily be safe for pedestrian use. The revetment and parking lot will remain for environmental restoration as the revetment rip-rap dishevels and the boulders becomes inter-tidal habitat and the parking lot material erodes and feeds downdrift beached and dunes.

This alternative depends on the material/fill that underlies the existing parking lot surface. If this material is *clean*, and consists of beach/coastal bank *compatible sediment* this alternative could be considered.

The advantage of this alternative is that – if the underlying sediment is clean & compatible – the disheveled rip-rap will act as a boulder platform breaking waves and reducing wave energy, similar to the beach fronting the Buzzards Bay Moraine (coastal bank) area to the west which consists of beach and inter-tidal boulders, cobble, and sand.

The parking lot sediments – if clean and compatible – would also act as a sediment source to adjacent area as they slowly erode due to coastal storms.

These actions would still allow storm-induced natural overwash landward and saline water to inundate Squibnocket Pond during coastal storms, however, the frequency of overwash and volume of inundation would be introduced more slowly, relative to completely removing the revetment and parking lot.

Ancillary benefits would be realized in the form of some level of storm wave and surge reduction and concomitant reduction of impacts to the turn-around, and elevated roadway if permitted.

Summary and Recommendations
Existing Parking Lot and Revetment Maintenance
In its existing location, the present parking lot maintenance frequency and revetment reconstruction following coastal storms will undoubtedly become more frequent and costly as erosion continues and sea level continues to rise (and accelerate) and the fronting beach elevation continues to lower.

The Town's proposal to remove the existing beach parking lot and revetment and relocate a beach access parking lot and small boat access to Squibnocket Pond to the west will significantly reduce the maintenance frequency and costs relative to the existing beach parking lot and revetment.

Proposed New Location of the Beach Access Parking Lot (**Figure 11**)
Due to the proposed new parking lot location being significantly more landward than the existing lot and dense salt-tolerant vegetation separating the new lot location from the active beach, overwash sediment and damage to a new beach access parking lot will be significantly less frequent, and occur only as a result of major coastal storms.

Based on existing shoreline change data, concern for loss of the proposed location of the Parking Lot itself due to shoreline erosion should not be a concern for well over 100 years (160 years based on current data). With sea level rise and a predicted acceleration in the rate of rise, that loss prediction will obviously be less; however, a prediction of loss due to sea level rise-induced erosion can only be provided with qualitative certainty. A detailed topographic site plan of the proposed location would be necessary to make this qualitative prediction.

The proposed location for a new parking lot is located landward of an overwash area **(Figure 10)**. Moving the proposed location of the new parking area to the west would move it away from the seaward overwash area.

*A consultant alternative location for the beach access parking lot that may provide enhanced longevity is suggested for discussion as shown on **Figure 11**, with the access leading to the beach shown on **Figure 14**.*

It is suggested that a discussion locating the new proposed beach access parking lot a bit more to the west than presently plotted on the proposed Plan, along the side of the roadway landward of the cobble lag deposit be considered (**labeled 'suggested' new parking lot area on Figure 11**). The seaward cobble lag deposit will provide additional protection and longevity to a new parking lot relative to chronic erosion and overwash compared to the location presently plotted on the proposed plan: the present proposed location of a new parking lot is located landward of an overwash area (**Figure 10**).

Although the location for the new lot on the existing proposed plan may last approximately 160 years based on current erosion rates as described above (and less years considering relative sea level rise), moving it a bit to the west will provide additional longevity as the documented erosion rates are less to the west and the cobble lag deposit will provide additional erosion and overwash protection.

It is important to keep in mind that with documented relative sea level rise and a predicted (and possibly presently documented) acceleration in the rate of sea level rise these longevity years for the parking lot will be significantly less; however, longevity predictions under a scenario of sea level rise and accelerated sea level rise are difficult to predict with any degree of accuracy.

Beach Access Pedestrian Pathway from the New parking Lot
A beach access pathway should be as narrow as possible in order to reduce impacts to existing stabilizing salt-tolerant dune vegetation and reduce the potential of the pathway becoming a sluiceway for overwash.

The beach access pathway from the new parking lot could be orientated south towards the beach and then be angled to the south-southeast in order to avoid overwash potential in the new pedestrian path **(see Figure 11)**.

The Turn-around

Due to the future susceptibility of the proposed turn-around at the seaward end of Squibnocket Road, a revetment may be needed to provide protection and longevity in that location (**Figure 1**). In this location of high wave energy and storm surge with the parking lot revetment partially removed, non-structural erosion and storm damage prevention alternatives would not have longevity and would require frequent maintenance, possibly subjecting the Road to occasional storm damage.

Remove Selected Sections of the Revetment and Re-use the Revetment Boulders

Removing only sufficient parking lot revetment boulders to connect the roadway revetments on the seaward and landward sides of the west end of Squibnocket Farm Road at Money Hill, and construct a revetment on the seaward end of the proposed turn-around area, and allowing the parking lot material to naturally erode and supply sediment to downdrift areas will allow the central area of the parking lot to naturally equilibrate with coastal processes. Eventually the area will return to a more natural condition absent the parking lot and revetment.

However, there will be a time of transition, and overwash of marine water and sediment into Squibnocket Pond will be more frequent. This is not necessarily an adverse impact; the site will equilibrate to a natural condition based on the energy regime present. The overwash area will eventually serve as habitat and areas will naturally re-vegetate.

The salinity and elevation of the Pond may temporarily increase and decrease during and immediately following coastal storms due to inundation and overwash, but will also equilibrate to natural conditions. Salinity increase should be slight and remain localized.

Restoration: Dune Nourishment

Beach and dune nourishment is a Town benefit and environmental enhancement. However, due to the high storm wave and surge energy nature of this location, indicated by a FEMA-mapped Velocity- and AO-Zone (Velocity Zones on the Preliminary FIRMs), to conclusively gain predicted longevity of a beach and dune nourishment project and re-nourishment intervals, modeling must be conducted. It is generally understood that short beach nourishment projects do not have cost-effective longevity. Due to the location (as described above) it is suggested that beach nourishment may not be cost effective or have longevity. However, modeling would be more conclusive.

If central sections of the revetment are removed and the parking lot is allowed to erode naturally, dune building/restoration could take place after the area has equilibrated. With subsequent dune nourishment the elevation of artificial dunes may eventually reduce the frequency of overwash landward towards the Pond. Based on visual observations at the site visit, there does not appear to be a substantial natural source of dune sands to naturally build the dunes in the location of the

existing revetment and parking lot, if they were removed, so re-nourishment may be necessary to maintain the dunes. The overwash fan will become wildlife habitat.

Consideration of Incorporation of Alternatives #4 and #5

If the underlying parking lot material/sediments are clean and coastal bank and/or coastal beach compatible, a consideration to allow the remaining revetment boulders to dishevel and the parking lot sediments erode naturally due to coastal storms and be a source of sediment to downdrift and adjacent beaches could be considered.

Recommendations

1. Due to predicted significant increased storm damage and overwash and concomitant increased expenses to repair the parking lot and revetment, both could be considered to be abandoned, if the alternative 10.5 acres for a new parking lot and beach are available. The revetment boulders can be re-used and the parking lot material allowed to naturally erode providing source sediment to downdrift beaches (as described below).

2. The *eastern side* of Squibnocket parking lot is presently in need of erosion and storm wave protection; if not now, in the very near future action will be necessary, possibly in the form of a revetment extension. Non-structural coastal erosion control alternatives in that high energy location will not have longevity. Thus, both the seaward end of Squibnocket Road where the turn-around is proposed and the eastern end of the proposed elevated roadway, if permitted, will need erosion and storm wave protection in the future, whether the existing revetment is removed or not. A revetment to protect this turn-around area should be considered, if the plan moves forward.

3. The revetment on both sides of Squibnocket Farm Road at the *western end* of the parking lot where the road meets Money Hill should be considered to be connected and that section of roadway elevated to protect that vulnerable area of roadway, if the revetment is removed or allowed to dishevel and the parking lot is allowed to naturally erode.

4. The boulders in the existing parking lot revetment can be re-used to construct the revetment extensions described in #s 2 & 3 above. Remaining revetment boulders, if any, could be considered to be allowed to naturally dishevel and become rocky inter-tidal shore habitat.

5. Following construction of #s 2 & 3 above, the parking lot area where the revetment boulders are suggested to be removed could be allowed to erode naturally, if the underlying parking lot sediments are clean and beach and/or coastal bank compatible. This would create a temporay source of sediment to downdrift beaches.

6. Following natural erosion of the underlying parking lot sediments, a coastal dune could be built in the overwash area reducing the frequency of overwash into the Pond, however, overwash is a natural process and not necessarily an adverse impact. The dune would also provide wildlife habitat.

I hope this evaluation is helpful in designing a final plan that provides longevity to a beach access proposal.

Feel free to contact me at any time to discuss any content of this report, or request further analyses.

Thank you for the opportunity to participate in this interesting project.

Very Truly Yours,

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