SCONSET BEACH NOURISHMENT PROJECT

Proponent Responses Following Conservation Commission Meeting #7 (held November 19, 2007)

The information included herein is intended to directly respond to questions asked at the Nantucket Conservation Commission meeting held on November 19, 2007 regarding the Sconset Beach Nourishment Project. At that meeting the Proponent, the Siasconset Beach Preservation Fund, and Project Team members were able to respond directly to many questions from the Commissioners. Meeting constraints, however, prevented the Proponent from directly responding to many questions asked by the public and some of the questions from the Commission itself. Although many answers could have been provided at the meeting had there been sufficient time available, the Proponent hopes that these responses are helpful and informative.

In an effort to be thorough and comprehensive, this document includes responses provided at the meeting itself as well as responses to questions that were left unanswered or required follow-up information. This information is organized according to the order in which questions were raised at the meeting. Where possible, the Project Team has identified the individual asking the question; we apologize if any names are incorrectly recorded here.

PRESENTATION 1: Cobble Impact Analysis (Rits and Vaccaro)

1. Question (Rudin): Since cobble density increases offshore, what is the percent error in the calculation of the equilibrium fill?

As Mr. Thomson explained at the Commission meeting, there is no specific error range associated with the position of the equilibrium toe. It is important to note, however, that Project engineers used several methods for calculating the position of the toe and ultimately selected the most conservative output to err on the side of caution. Cross-shore modeling was performed with the U.S. Army Corps of Engineers' (USACE's) SBEACH numerical model; results suggested that in the vicinity of Sankaty Head Lighthouse, sand is transported 300-600 feet offshore.

The typical (i.e., most commonly-applied) method for determining the location of the equilibrium toe of fill is "Dean's method". An analysis using Dean's "A" factor shows that the equilibrium toe of fill in front of the lighthouse would be located 820 feet offshore. In comparison, the CEM method of profile translation indicated the equilibrium toe would occur approximately 1,140 feet offshore. The CEM method outputs are conservative (i.e., outputs show a more seaward location of the toe of fill) when compared with the analysis using Dean's "A" factor.

While the USACE does not define a method for determining a percent error in calculating the equilibrium toe of fill using the CEM method, one way to assess potential error is to vary the grain size input and perform a sensitivity analysis. Project engineers performed this analysis along profile line 93, directly in front of the lighthouse, by varying the grain size from 0.86 mm to 0.98 mm (i.e., ±6.5% relative to the mean grain size of 0.92 mm). With these variations, the offshore distance of the modeled equilibrium toe of fill ranged from 1,134 to 1,141 feet. This tight range encompasses the output of 1,140 feet that was obtained using the mean grain size of 0.92 mm, thus demonstrating that selecting a specific modeling methodology (i.e., Dean's equilibrium curve, SBEACH modeling output, or CEM method) has a greater influence on the predicted location of the equilibrium toe of fill than does the amount of variation within the model.

Section 10 of FEIR Attachment A contains a complete discussion of the methodology used for evaluating the equilibrium fill footprint.

Furthermore, as Mr. Rits indicated, the Board of Selectmen contracted with Applied Technology and Management, Inc. (ATM) to perform a technical review of the comprehensive Project and the Proponent's Final Environmental Impact Report (FEIR). The conclusion of this independent evaluation was that the modeling was scientifically sound and valid. In its April 30, 2007 *Review of Proposed Sconset Beach Preservation Fund Beach Nourishment Project*, ATM clearly verified the Project's scientific viability:

> *"The information, analysis and data provided within the document [FEIR] are consistent with accepted practice for beach nourishment design and evaluation. The level of care and due diligence delineated within the FEIR is to accepted standards. The beach and borrow area designs have sufficient technical basis."*

2. (Rudin): In this cobble habitat, what is most important for fish breeding? We know large game fish are not necessarily the most important species; what is important for baitfish?

(Vaccaro): Low-energy environments such as salt marshes and estuaries generally support the largest breeding populations. Habitat complexity (as determined by percent cobble coverage, vertical relief, etc.) equates to shelter and is therefore important for breeding populations. In the nearshore Project area, the very sporadic cobble cover does not create prime breeding habitat because complexity and associated shelter are relatively low.

3. (Bennett): Do you know how quickly the equilibrium toe will advance seaward?

Project engineers have assumed that the nourishment toe will reach its maximum seaward extent within approximately one (1) year of fill placement. The actual duration over which a profile reaches equilibrium depends on the wave climate. A one-year equilibration period is a conservative assumption, which means it assumes a rate of change in the Project profile that is more rapid than what will likely occur. Guidance from the USACE Coastal Engineering Manual (EM 1110-2-1100, Part V-4-84) verifies the conservative nature of this assumption:

> *"The nourished profile will adjust to a shape that is much closer to the equilibrium shape during the first winter season, at least on the portions of the profile that are shallower than the typical wave breaking depth. However, unless very severe storms are experienced during that first winter season, the fill material may not adjust to elevations equal to the depth of closure."*

During Hurricane Wilma, which was a 1-in-3-year storm, the significant wave height measured offshore was 22.7 feet while the significant wave height in the nearshore was 7.0 feet. Such a wave will break in water depths of approximately nine (9) feet. Thus, even the passage of a storm resembling Hurricane Wilma would be unlikely to cause the Project to reach equilibrium. If it takes more than one year for equilibration to occur, natural longshore sand losses may theoretically prevent the toe of nourishment fill from extending as far seaward as the conservative predictions associated with more rapid equilibration suggest; theories vary, however, regarding how significant such a difference might be.

4. (Bennett): Do you have a profile showing how deep the burial will be?

As Mr. Rits explained at the Commission meeting, the Proponent has provided a number of profiles showing the thickness of sand all the way out to the equilibrium toe. Specifically, information regarding the equilibrium profile can be found in the following Project materials: (1) September 9, 2007 Nourishment Characteristics & Construction presentation, slides 70-73; and (2) October 1, 2007 Cobble Impact Analysis and Mitigation presentation, slide 62.

Considering the complexities of sediment transport and the fact that seaward areas of the equilibrium profile will only contain a thin layer of nourishment material, it is difficult to precisely delineate specific zones of fill thickness. However, in an effort to provide the Commission with additional information, Project engineers have prepared a graphic (see Figure 4A) illustrating varying zones of equilibrium fill thickness at the time of the toe's most seaward extent. This graphic reflects the revised 1.8-million-cubic-yard Project design.

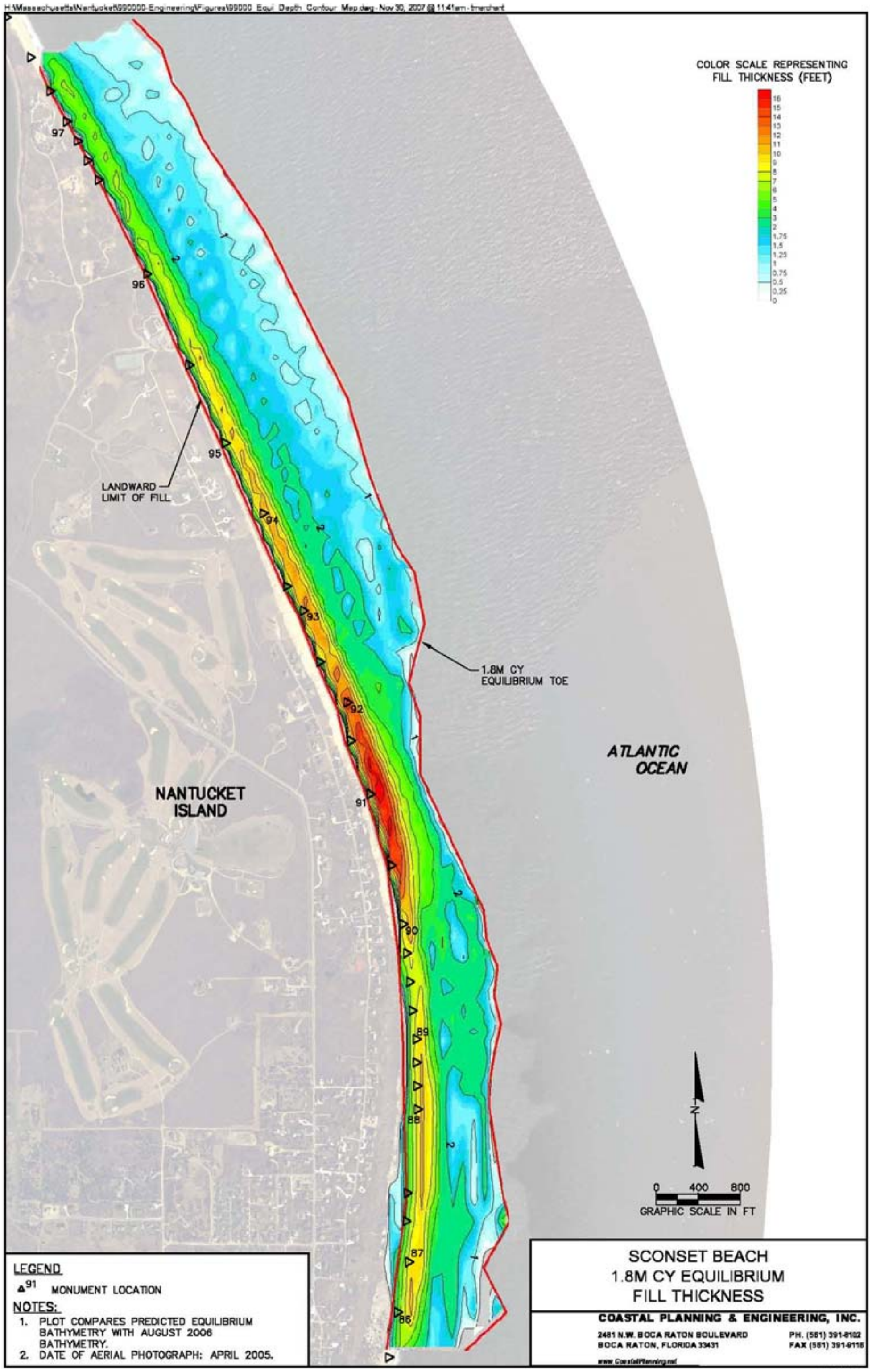

Figure 4A. Estimated equilibrium fill thickness associated with the 1.8-million-cubic-yard Project design.

5. (Bennett): Macroalgae seem to be dominant around the toe; I am curious about water depths in that area. Will those conditions shift seaward with the placement of nourishment fill?

As shown in Figure 4A (above), the swath of relatively thick sand burial will occur immediately adjacent to the Project shoreline where the nourished beach will be constructed. In this area, water depths will be significantly altered. These changes have been shown on the typical cross section profiles provided by Project engineers and presented during the Commission meetings. Further offshore, the thickness of nourishment material will be approximately two feet or less, which will not have a significant impact on the overall bathymetry in the offshore area and is within the range of natural variability in the offshore system. Sandy offshore areas commonly exhibit natural seasonal or storm-induced bathymetric variability on the order of 4-10 feet, and post-storm beach monitoring at Sconset has revealed storm-induced changes in beach elevation of as much as 6-12 feet. The two-foot (or less) bathymetric change expected to occur in the offshore zone of the nourishment footprint is not likely to alter light penetration, water temperature, or other environmental factors. Aside from the immediate swash zone directly adjacent to the beach (which will be widened by 200-250 feet), the Project is not expected to significantly shift any habitats seaward.

6. (Oktay): On slide 64 (acreage summary), how did you perform your calculations? Habitat and surface area are two different things.

(Rits): We ran a grid model for the data with 1-square-meter cell size; each cell was assigned percentages of exposed cobble coverage. The cobble was further assessed to determine the amount of coverage by macroalgae and sponge species. We then determined those percentages for each individual cell and summed up areas within the entire footprint for cobble, cobble covered with macroalgae, and cobble covered with sponge. The purpose of these calculations was to define a total cobble area that will be covered by nourishment material. Cobble density was bundled into 10% intervals, and total acreages of coverage were presented for each bundle. The mitigation plan will address efforts to replicate the variability of the impacted cobble habitat offshore of Sconset, including different community types and cobble densities.

7. (Oktay): I am surprised the estimates did not more closely mirror the cobble density percentages.

The Proponent has reevaluated the cobble coverage estimates and verified the calculations. Results indicate that the 1.8-million-cubic-yard BNP design has an equilibrium footprint covering approximately 275 acres. The average cobble coverage density for the entire BNP equilibrium toe is approximately 9.58%, with the following break-down of varying densities of exposed cobble for the entire 275-acre footprint: less than 5% cobble (~168 acres); 5-10% cobble (~59 acres); 10-20% cobble (~37 acres); 20-30% cobble (~10 acres); 30-40% cobble (~2 acres); and 40-50% cobble (<1 acre) (see Table 7A).

Table 7A: Total acreage of varying percentages of exposed cobble and total surface area of cobble impacted by the 1.8 MCY BNP equilibrium toe.

% Cobble Coverage	Total Area within BNP EQ Toe (Acres)	Total Cobble Surface Area (Acres)
0-5	167	8.44
5-10	58	5.91
10-20	37	7.53
20-30	10	3.02
30-40	2.5	1.01
40-50	0.74	0.37
>50	0.15	0.09
Total	***~275***	***~26.37***

8. (Oktay): There is an entire regime of small fish, larval species, etc. living in this habitat. Habitat value extends between cobbles, and is not entirely determined by the cobbles themselves. It appears your estimates of area impacts are very low. You may be covering 275 acres of cobble habitat varying from 0-65% cobble cover, and yet you are only talking about mitigating for 31 acres (for the 2.6-MCY design).

The Proponent agrees that habitat value is determined by more than individual cobbles, but rather must be assessed in the context of the surrounding benthos. As Mr. Rits explained to the Commission, this is partially why the data analysis was broken into 10% bundles of cobble density. A detailed mitigation proposal will be presented at one of the next Commission meetings, and that presentation will define the targeted amount of mitigation based on direct cobble coverage of the 1.8-million-cubic-yard nourishment template (i.e., 26 acres). While this spatial extent may initially seem low, a critical element of the mitigation design is how the cobble will be distributed. Not only is the Proponent's mitigation intended to prevent a net loss in habitat functions and values, but it is also meant to replicate the characteristics of cobble habitat within the impact area. This means the mitigation design will be consistent with habitat features in the impact area relative to cobble size, wave and tidal energy, bathymetry, water depth, temperature and light penetration, and cobble density (i.e., percent cobble coverage). By considering all of these habitat characteristics, the Proponent acknowledges the importance of the entire habitat assemblage and contributing conditions. Total surface area of cobble is merely a starting point in designing a suitable mitigation plan; as presented to the Commission, the Proponent's mitigation plan is designed to appropriately replicate the varying characteristics of cobble habitat within the impact area.

9. (Oktay): Can you discuss baitfish rather than just the larger predatory species?

(Vaccaro): Many of your macroscopic invertebrates reproduce in the millions, and impacting a small portion of the population will not threaten the viability of the species in the area. Small baitfish tend to reproduce in sheltered estuarine areas and then migrate to areas such as

Sconset. The limited effects from the Project will not impact large portions of these populations, and the species will be able to recover quickly from what impacts are incurred.

10. (Oktay): Seals and bass herd baitfish toward shore; did you see any baitfish in your survey?

(Vaccaro): As we explained last week, the purpose of the video survey was to assess and characterize habitat, not identify or quantify mobile species. Other Project documents contain extensive fisheries data.

11. (Oktay): It is my experience working in the harbor looking at tunicate recruitment that these species are rapid colonizers. Do you think that changing the patterns of cobble cover might selectively benefit tunicates? Recovery can sometimes be accompanied by changes in species composition, thus affecting habitat value.

As Ms. Vaccaro explained at the Commission meeting, the Proponent's upcoming dive survey will analyze some of these ecological patterns to assess whether Project impacts and proposed mitigation will support recolonization and recovery of similar ecological conditions. Considering the high-energy conditions that exist in the Project area, the species that are present are naturally exposed to regular scour and disturbance; in fact, this is likely why the benthic community in the area contains many resilient species with effective dispersal capabilities. Although colonial tunicates such as *Didemnum sp.* tend to be rapid colonizers, numerous studies provide evidence showing this species is not tolerant of sand burial and will not attach to moving sand or to substrate subjected to frequent sand scour (Bullard et al., unpublished[1]; Valentine et al., 2007[2]). Since the nearshore Project area is characterized by dynamic sand transport, *Didemnum sp.* is not likely to opportunistically colonize the Project's impact or mitigation areas. Survey data support this contention, since *Didemnum sp.* was only observed in the cobble video survey transects performed furthest offshore (i.e., more than 2,500 feet offshore). It is likely that recolonization of replicated cobble habitat will follow patterns similar to existing conditions.

12. (Oktay): Do you think recovery is similar post-scour versus post-burial?

As explained at the Commission meeting, recovery occurs after both types of events. Many of the scientific studies on recovery are associated with scouring and sometimes prolonged burial events, as the two phenomena typically occur in conjunction. Several studies have

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[1] Bullard, S.G.; Lambert, G.; Carman, M.R.; Byrnes, J.; Witlatch, R.B.; Ruiz, G.; Miller, R.J.; Harris, L.; Valentine, P.C.; Collie, J.S.; Pederson, J.; McNaught, D.C.; Cohen, A.N.; Asch, R.G.; Dijkstra, J.; and Heinonen, K. The colonial ascidian *Didemnum sp.* A: current distribution, basic biology, and potential threat to marine communities of the northeast and west coasts of North America. Unpublished.

[2] Valentine, P.C.; Carman, M.R.; Blackwood, D.S.; and Heffron, E.J. 2007. Ecological observations on the colonial ascidian *Didemnum sp*. in a New England tide pool habitat. Journal of Experimental Marine Biology and Ecology. Volume 342. Pp. 109-121.

demonstrated survival by macroalgae and sponges following sand deposition and subsequent scouring action (Sears and Wilce, 1975[3]; Daly and Mathieson, 1977[4]; Littler, Martz, and Littler, 1983[5]; Joint Nature Conservation Committee of the UK, 2007[6]). In general, species recover from sand burial and scour by regenerating lost blades or other pieces during a single growing season.

13. (Oktay): It appears some equilibration will occur quickly during the summertime; one of your slides showed 4 inches of coverage around December. Will it be more difficult for macroalgae if they are buried during the summer?

Equilibration will be an ongoing process extending from the initiation of construction in late summer, through the conclusion of nourishment in late fall, and continuing for approximately one year to the maximum seaward extent of the toe of fill. Construction phasing will likely proceed from southern to northern portions of the Project area as the season progresses, so cobble habitat in northern reaches of the profile will not be impacted until later in the year. Furthermore, it is important to reiterate that equilibration will occur gradually, dictated by natural wave- and tide-induced sedimentary processes; the entire area within the equilibrium profile will not receive a rapid delivery of nourishment material similar to the construction footprint. As the Proponent has presented throughout the Commission meetings, existing scientific literature indicates relative rapid recovery within hard bottom habitat on the order of 1-3 years.

14. (Andrews): Where in the Project area was the wrack line you surveyed post-storm?

(Rits): We performed wrack line observations in relation to the existing terrace project. We went from the lighthouse down to 51-53 Baxter Road (i.e., the central portion of the Project).

15. (Andrews): Sandy margins of the Project area fluctuate in distance from shore (slide 42). In your modeling, how do you quantify sediment transport and identify where the edges of habitats will occur?

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[3] Sears, J.R. and Wilce, R.T. 1975. Sublittoral, benthic marine algae of southern Cape Cod and adjacent islands: seasonal periodicity, associations, diversity and floristic composition. Ecological Monographs. Volume 45, Number 4. Pp. 337-365.

[4] Daly, M.A. and Mathieson, A.C. 1977. The effects of sand movement of intertidal seaweeds and selected invertebrates at Bound Rock, NH, USA. Marine Biology. Volume 43. Pp. 45-55.

[5] Littler, M.M.; Martz, D.R.; and Littler, D.S. 1983. Effects of recurrent sand deposition on rocky intertidal organisms: importance of substrate heterogeneity in a fluctuating environment. Marine Ecology Progress Series. Volume 11. Pp. 129-139.

[6] Joint Nature Conservation Commission. 2007. Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock. www.jncc.gov/uk/marine/biotopes/biotope.aspx. Accessed in October.

Coastal beaches often contain small-scale cuspate features created naturally by coastal processes related to wave refraction, shoreline currents, etc.; small ridges extend seaward and other areas cut landward, creating an undulating morphology. This pattern extends offshore as well as a natural function of sand, water, and wave angle. Aside from widening the beach itself and converting isolated areas of cobble habitat to sandy bottom, the Project will not alter the locations of habitat types or the edges of habitats.

16. (Andrews): Will the depth of nourishment material be relatively consistent, or will it be quite deep in some areas and shallower in others? I am wondering about toe extension, depth of fill, and exposure of hard bottom.

(Thomson): To calculate the position of the equilibrium toe, we model along each profile line to determine where we expect the toe to occur, and then join those points. Therefore, the position of the equilibrium toe is calculated along each individual profile line. There is some margin for error in these calculations, but we have used the most conservative estimate (i.e., furthest seaward position of the toe) for each profile line. Determining the position of the equilibrium toe does not involve an assessment of the presence or absence of cobble.

In terms of the depth of nourishment fill, it will be thickest closer to the beach and progressively thinner as you move offshore, ultimately pinching out at the equilibrium toe. Please refer to Figure 4A, which illustrates expected equilibrium fill thickness.

17. (Andrews): I would think that the presence or absence of cobble would affect currents?

(Thomson): Cobble will affect the profile shape, and we translate that data into the modeling.

(Rits): At the tail end of last week's meeting, we explained how lag deposits form. A bank with cobble, sand, clay, etc. will erode, providing material to the beach and ultimately to the nearshore area. As this process continues, the shoreline retreats landward and cobble is left offshore. Therefore, bank composition is a controlling factor for cobble density, and it is important to note that the Coastal Bank composition in the Project area is not uniform. When surficial material like that in the bank was deposited, finer-grained material was carried away from areas of high-energy flow, leaving relatively more cobble, while lower-energy areas retained more fine material. Therefore, cuspate variability in cobble density can result from variability in the composition of Coastal Bank.

Currents can be affected by any solid object that interacts with water flow. The majority of cobble found offshore from Sconset is relatively low-relief (i.e., significantly less than 3 feet high) and sits directly on the sandy bottom. Most of this cobble sits at or near the surface of the seafloor and does not significantly impede water flow; there are no piles or other aggregations of cobble which would otherwise act as a barrier to flow. The proposed mitigation is designed to replicate the cobble bottom within the impact area, and thus will have similarly low relief and will interact with currents in a manner consistent with the existing cobble bottom.

18. (Andrews): Regarding recovery, how much of the equilibrium toe will contain 4 inches of sand and how much of the area will contain a thicker layer?

(Rits): We have provided burial profiles previously, but can re-present some of this information. See Question/Response #4.

19. (Andrews): Does burial depth directly relate to recovery time?

Depth of burial is one factor which affects species and habitat recovery because it affects the mode and method of recolonization and regrowth. In soft sediments, mobile species will be able to repopulate impacted areas quickly by either avoiding burial or by burrowing up through nourishment material. Sessile species living on hard bottom will recovery slightly more slowly because they will need time to regenerate to previous sizes and/or migrate into the area. Upcoming dive surveys, which will occur as soon as weather permits, will assess cobble areas, ground-truth video data, and identify features such as holdfasts. Survey data will generate additional information regarding the size of cobble and characteristics of existing benthic organisms, which will further inform the impact assessment in terms of effects on existing individuals and how populations will recover.

20. (Andrews): When you say species recover from periodic disturbance, is the disturbance from a storm similar to the disturbance from beach nourishment?

The intermediate disturbance hypothesis pertains to a variety of ecosystems and types of events. Following any disturbance event, populations and individuals will recover and that recovery will tend to enhance community diversity. One important distinction is that disturbance from the proposed nourishment will be extremely localized, with adjacent areas remaining unaffected. Organisms from these adjacent areas will, therefore, remain healthy and capable of migrating into the Project area to recolonize and repopulate the habitat. Impacts from a severe storm may be more widespread, affecting a larger area of habitat and, by association, the organisms that reside there.

21. (Andrews): So your recovery information does not relate specifically to nourishment?

The Proponent has reviewed a breadth of scientific literature that includes, but is certainly not limited to, nourishment and its effects (see Question/Response 12). One relevant study is associated with the New York District of the Army Corps of Engineers' erosion control project from Asbury Park to Manasquan, New Jersey (Burlas, Ray, and Clarke, 2001[7]). Results from the biological monitoring of beach nourishment along the New Jersey coast indicate that benthic flora and fauna recover from the effects of beach nourishment in a relatively short

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[7] Burlas, M.; Ray, G.; and Clarke, D. 2001. The New York District's biological monitoring program for the Atlantic coast of New Jersey, Asbury Park to Manasquan section beach erosion control project. Final Report. U.S. Army Corps of Engineers. www.nan.usace.army.mil/business/prjlinks/coastal/asbury/index.htm.

period of time: impacts to benthic assemblages and juvenile fish were minor and short-term, and the biomass of most species returned to pre-project abundance within 2-2.5 years. No detectable changes in species composition or feeding habits were observed.

In addition, scientific data and hypotheses related to a variety of topics (e.g., fisheries, coastal processes, habitat characteristics, benthic recovery, etc.) are useful for informing this Project even if they are not specifically related to nourishment. Regarding recovery, organisms in the nearshore environment are naturally subjected to regular disturbance, resulting in a community that is typically characterized by relatively low diversity. Offshore areas are often more sheltered from disturbance, and the diversity of these more stable communities is affected by larger periodic disturbances. As a result of these characteristics, these communities may likely recover through different means but neither is a stranger to the type of disturbance created by nourishment. It is also important to note that after reaching its maximum seaward extent, the equilibrium fill will erode and retreat landward again.

22. (Andrews): As the fill erodes, will it erode from the seaward end or at the landward end of the Project?

Once the Project profile reaches equilibrium, the toe of fill will tend to retreat back toward the shoreline. Since the beach is thicker near the shoreline than at the toe of fill, longshore sediment transport near the shore will involve a higher volume of material. The maximum amount of sediment transport occurs within the wave-breaking zone.

23. (Oktay): Going back to slide 73, you did five stations in the nearshore? What time of year? Have you filled in the gaps?

As Ms. Vaccaro explained at the Commission meeting, that information is in the FEIR, and she recalled the sampling occurred in May. Additional benthic grabs are being performed now to obtain additional replicates and expand the dataset. Sampling is still occurring randomly within the Project area, but there is more replication than with the previous sampling. Ten additional sampling stations are spread along the length of the Project from Sesachacha Pond to Codfish Park. Five of these are located near the mid-portion of the equilibrium toe approximately 800 feet offshore, and five are located 1,200 feet offshore just seaward of the equilibrium toe. Approximately five replicates are being collected at each sampling station. Once all samples are collected, the Proponent will analyze the data and then repeat the sampling process during the spring season. Different locations within an area as small as the Project generally exhibit consistent physical conditions (e.g., wave exposure and sand scour). For this reason, benthic populations within such a small area are not expected to vary considerably and thus randomized spot sampling is an effective and accepted method for assessing the status of existing epifaunal and infaunal populations.

24. (Oktay): Are you going to present infaunal data for the borrow site?

The Proponent will be presenting data obtained from benthic grabs and video transects performed in the Borrow Site earlier this year.

25. (Oktay): For the areas dominated by macroalgae and/or sponges, were you able to assess current velocities? That information may be important for assessing recovery rates, although recovery may be more light-dependent (i.e., depth-dependent). We need to assess whether the Project might induce a shift in species dominance.

Current velocities were recorded during the recent video survey, and flow speeds were generally 1-2 knots within the survey area. In addition, video transects contained similar numbers of frames and were each of comparable length, indicating that current speeds were fairly consistent. As for species diversity and community structure, the dominance of macroalgae versus sponges is a function of water depth, light penetration, and disturbance (i.e., energy) regime. As the Project places nourishment material in the surf zone and the fill equilibrates, the surf zone and other areas will shift seaward. Community composition, including species assemblages, should shift accordingly.

26. (Oktay): Was there any reason for choosing 5 frames for analyses of the video survey?

As Mr. Rits explained at the Commission meeting, it was necessary to choose a reasonable number of frames that would effectively synthesize data to reflect existing conditions while at the same time keeping the data analysis to a realistic scope. Producing meaningful information from such a large volume of data is an extremely time-consuming process, and selecting five video frames for analyses provided sufficient data coverage to thoroughly characterize the cobble habitat without being overwhelming.

27. (Edie Ray): I know you are looking at the percentage of surface covered by cobble, but I do not think that is a true representation of cobble habitat. Cobble is not a flat rock sitting on a flat area of sand, and by towing the video 1 meter from the bottom you are losing the three-dimensional aspect of that structure.

The Proponent agrees that a habitat assessment must consider the aggregate of habitat characteristics and not merely a two-dimensional analysis of individual cobbles. For this reason, dive surveys have been scheduled to ground-truth the cobble video in a few locations; these surveys will assess vertical relief and provide oblique photographic data of the cobble and colonizing species. The Proponent's impact assessment and corresponding mitigation plan take into consideration not only the density of cobble coverage but also the size and vertical relief of cobbles themselves. The next Commission meeting will include a presentation of the mitigation strategy that accounts for area and vertical relief of cobble.

28. (Ray): What season was your video survey? We know winter beaches are smaller, so there is more sand in the system. It would be interesting to survey the area again in a different season so we could see how much rock is exposed.

The video survey was performed September 20-21, which was just prior to the end of the growing season and before the recent storms. In the winter months, sand moves from the beach into the nearshore area, forming low-relief sand bars that bury cobble and actually decrease the amount of exposed cobble bottom. Therefore, the Proponent's video survey actually occurred at a time of year when cobble bottom exposure is likely at its maximum.

29. (Bob Rank): You keep emphasizing the low percentage of cobble that will be covered. The important thing to consider is the importance of the specific zone that will be covered, and that area is very productive (particularly for bass fishing). Your coverage area is where I catch 95% of my fish.

The Proponent appreciates this comment from Mr. Rank and recognizes his first-hand knowledge of local fishing conditions.

Striped bass occur in a variety of habitat areas along the coastline: smaller bass more frequently use sheltered bays and estuaries, while larger bass typically use open waters. Along the open coast, striped bass occur along sandy beaches, rocky shorelines, and among submerged rocks and boulders; the habitat preference is primarily governed by the availability of prey and the time of day. Striped bass also have a relatively wide tolerance for a variety of water temperatures, with the preferred temperature range for adults being 6-25° Celsius (Sertzler et al., 1980[8]; Coutant, 1986[9]). As described above, striped bass are voracious feeders, with large bass preying upon fish and macro-invertebrates. This species' occurrence near the Project area is a product of several factors: (1) cobble bottom is present, which provides habitat for striped bass' prey; (2) strong longshore currents move schooling baitfish along the shoreline; and (3) offshore shoals and sporadic boulders provide bass with locations from which to ambush prey. Information available in the breadth of scientific literature reviewed by the Proponent does not suggest that striped bass have any specific narrow water depth or temperature requirements; indeed, this wide tolerance of a variety of habitat conditions is typical of a predatory pelagic fish, which must pursue multiple types of prey to obtain sufficient energy resources.

Although the Project will have some unavoidable impacts to a limited area of exposed cobble bottom, this habitat impact should be assessed in context and with the acknowledgement that the Proponent is committed to providing successful replication as mitigation. Indeed, extensive cobble habitat assessments, including the recently-presented video survey and accompanying habitat characterization, have shown there is an abundance of excellent cobble habitat outside of the Project footprint. These data indicate that similar, and sometimes superior, cobble habitat occurs adjacent to the Project's equilibrium toe footprint in nearby offshore waters. This means the localized area provides ample cobble bottom habitat to maintain local populations of fish and other marine species independent of the Project's impact area. Furthermore, the abundance of adjacent high-quality habitat in such close proximity to the Project area will promote rapid colonization of the proposed mitigation cobble bottom. Furthermore, the Project will have no adverse effect on longshore currents or any shoals.

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[8] Sertzler, E.; Boynton, W.; Wood, K.; Zion, H.; Lubbers, L.; Mountford, N.; Frere, P.; Tucker, L.; and Mihursky, J. 1980. Synopsis of biological data on striped bass, *Morone saxatilis* (Walbaum). NOAA Technical Report. NMFS Circulation Number 433. 69 pp.

[9] Coutant, C. 1986. Thermal niches of striped bass. Scientific American. Volume 255. Pp. 98-105.

30. (John Ramsey): Have there been any studies of how much burial the psammophytic species likely to be impacted can withstand?

In California, Littler, Martz, and Littler (1983[10]) experimentally demonstrated population survival after periodic sand inundation of related species with the same genera as *Ahnfeltia plicata* and *Polyides*, two common psammophytic species at Sconset. The accumulation of sand in the rocky intertidal zone was highest from December-February, with approximately 35% population coverage up to four inches deep. Daly and Mathieson (1977[11]) found similar patterns of sand burial and species survival at Bound Rock, New Hampshire: areas subjected to period sand inundation and abrasion were dominated by psammophytic species such as *A. plicata*, but *C. crispus* and another red alga, *Gigartina stellata*, were also observed to withstand heavy sand abrasion. Additionally, *C. crispus* was found to be entirely absent during the winter months but over the course of the study showed approximately equal abundance before and after sand burial events (Daly and Mathieson, 1977); this indicates either regeneration following sand burial or potential survival by dormancy during inundation. These studies are discussed in the Proponent's Cobble Bottom Video Survey and Habitat Assessment report, which was submitted to the Commission in November 2007.

In addition to these past studies, the Pilot Mitigation Project and monitoring will provide some empirical data from the eastern shore of Nantucket that can further inform on this issue.

31. (Ramsey): Sediment transport will potentially occur outside the Project area, burying other cobble areas.

Data from offshore sidescan and additional video surveys show the cobble area is largely located seaward of the Project. These previous sidescan surveys show that areas north and south of the Project template are dominated by sand, so diffusion losses into these areas are not expected to bury additional cobble habitat.

32. (Ramsey): With a 3-5-year recovery rate and a 3-year renourishment interval, it appears these impacts will be permanent.

This issue will be addressed in the Project's mitigation design. Briefly, however, scientific literature indicates that colonization and recovery in disturbed soft sediment habitats occur in 1-3 years. These data, coupled with the fact that subsequent renourishment events will be designed for a projected 5-year renourishment interval, means the soft sediment impacts from nourishment will not be permanent.

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[10] Littler, M.M.; Martz, D.R.; and Littler, D.S. 1983. Effects of recurrent sand deposition on rocky intertidal organisms: importance of substrate heterogeneity in a fluctuating environment. Marine Ecology Progress Series. Volume 11. Pp. 12-139.

[11] Daly, M.A. and Mathieson, A.C. 1977. The effects of sand movement on intertidal seaweeds and selected invertebrates at Bound Rock, New Hampshire, USA. Marine Biology. Volume 43. Pp. 45-55.

PRESENTATION 2: Pilot Mitigation and Monitoring Study (Rits and Vaccaro)

33. (Rudin): You are not using railroad ties?

As Mr. Rits explained at the Commission meeting, the Proponent has eliminated railroad ties from the mitigation proposal. The pilot study, therefore, will be performed using natural rock cobbles and a limited number of reef balls.

34. (Rudin): Colonization rates of benthic organisms have been variously stated as 1-3 years and 3-5 years. Will a pilot program duration of a single year be adequate for monitoring colonization?

The 1-3-year and 3-5-year recovery rates pertain to full habitat recovery for soft sediments and hard sediments, respectively. In contrast, the pilot mitigation project is intended to assess the progress of initial colonization of a disturbed area. Obviously the Proponent does not expect to observe full growth within one year of pilot deployment, but a single year of monitoring should be sufficient to assess the extent of early colonization by organisms that make the substrate suitable for a more complex community. With successful colonization, community development is essentially ensured and ongoing monitoring will document this process.

35. (Rudin): You said the next meeting would include the full mitigation proposal. How can you present a full mitigation proposal without knowing what the pilot study will demonstrate?

As explained at the Commission meeting, the Proponent will present a mitigation proposal that assumes a certain success rate of the pilot mitigation project. The pilot will be installed and monitored to determine whether those criteria of success have been met. Ultimately, it is important to emphasize that the Project will not occur without appropriate mitigation; the Proponent is clearly dedicated to ensuring that mitigation is successful and that the Project does not permanently reduce habitat functions or values. Our objective is to present a feasible mitigation plan that we are confident can succeed based on best available scientific data and anecdotal information; to legitimize this confidence in the mitigation design, the pilot mitigation will field-test the concept and generate tangible analytical data.

The proposed pilot mitigation project is *not* a requirement of the regulations nor is it needed to demonstrate compliance with any performance standards. Instead, the Proponent has proposed the pilot as an additional means of providing data regarding early habitat colonization and to serve as a “safety check” to provide concerned interests with some confidence about the nourishment. If, for example, the pilot does not meet expectations, the Proponent will be able to re-evaluate and refine the mitigation design prior to implementing the comprehensive Project.

36. (Smith): How large will the reef balls be for the pilot?

Since the objective of mitigation is to replicate habitat that is permanently impacted by the Project, the Proponent intends to incorporate reef balls that are similar in size to the largest natural cobbles present in the offshore area. These reef balls will only be placed in the experimental plots located in Treatment Area II (i.e., the treatment area further offshore), and will be roughly 2 feet in diameter.

37. (Oktay): Is the size of the pilot under DMF's limit for reef structures? The agency's draft *Marine Artificial Reef Plan* is based on years of study and can provide some guidance.

The pilot program and larger-scale plan are clearly for habitat mitigation, and the Proponent does not consider them to be artificial reefs. With that said, the Proponent has considered the potential guidance value of DMF's draft document. It is important to emphasize that the pilot will largely consist of native rock, and will only contain a limited number of reef balls sufficient to provide empirical data regarding colonization success. More specifically, the proposed pilot is consistent with DMF's draft document in three fundamental ways: (1) site selection has occurred with site-specific data and input from local experts; (2) pilot materials are the same as those employed by DMF in state-sponsored projects elsewhere in Massachusetts; and (3) the pilot includes an extensive monitoring program that will generate data from which to evaluate "success".

38. (Oktay): You will not be assessing recovery/recruitment of baitfish, etc.?

Monitoring of the pilot mitigation will assess early colonizers (i.e., organisms that initially cover the substrate). This pilot is intended to quantify and characterize the benthic coverage that occurs in a disturbed area within the first year of that disturbance, and it is likely that larger macroalgae will appear later. Video, dive surveys, and benthic grabs will all be helpful for assessing recovery. Eventually, monitoring the pilot mitigation area will include characterizing fish activity and ichthyoplankton in the vicinity of the pilot substrate.

39. (Oktay): I can understand waiting 3 months after deployment before beginning the pilot monitoring, but I might recommend you monitor monthly to capture successional changes. Three snapshots may not provide a sufficient temporal resolution.

The pre-deployment and quarterly post-deployment surveys will be very extensive and will involve video, dive surveys, benthic grabs, trawls, etc. The frequency and thoroughness of the proposed surveys will enable the Proponent to capture and assess successional changes on a seasonal basis. The objective of the Pilot Mitigation Project is to demonstrate the effectiveness of the method of cobble bottom replication proposed in the mitigation plan based on the extent of colonization. The proposed schedule for Pilot deployment is in mid-March, prior to the release of spores and larvae. Since the "growing season" ends in mid-late fall, the 9-month monitoring survey will provide the crucial data allowing the beach nourishment Project to proceed to bidding for 2009 construction. Ongoing monitoring will continue to assess community characteristics.

40. (Oktay): Why would monitoring be triggered by storm events?

Post-storm monitoring of the pilot mitigation is crucial for placing the success of recolonization in context. Since we believe significant sand scour occurs naturally in this area, we would like to quantify the extent to which storms remove benthic cover. Monitoring control sites as well as experimental plots will enable the Proponent to compare the pilot mitigation's success to the performance of the benthic community in a natural area. If, for example, experimental plots do not show significant colonization, it will be important to evaluate whether that deficiency might be due to natural storm impacts (in which case the control sites may show similar distress) or whether it is associated with the mitigation design and/or failure of organisms to settle.

41. (Oktay): Are there trawlers you should be concerned about, either in terms of equipment damage or increased fishing activity around the pilot?

Since the pilot mitigation will deploy relatively small cobbles and reef balls to replicate natural conditions in the area, the Proponent does not expect any impacts to fishing gear; likewise, the Proponent does not expect any newly-established benthic communities to be impacted by fishing gear. As Mr. Rits explained, it is important to place this effort into the context of the larger area: the pilot will create 6 acres of varying cobble densities immediately adjacent to hundreds of acres of natural cobble. Therefore, the pilot mitigation area should not establish conditions that would be uniquely attractive for fishing activities.

42. (Andrews): Do you know how deep the sand is in the proposed pilot location?

(Rits): We have preliminary bathymetry and reconnaissance-level survey data, and more detailed surveys are planned for the next week or two.

43. (Andrews): I am sure you will provide us with greater detail about criteria for success. How will you determine success if, for example, a substantial quantity of the material you place becomes buried?

(Rits): One of the objectives of the pilot is to assess burial and re-exposure of the material. We would like to determine whether sand is regularly burying this type of cobble bottom, both in the nourishment area and also in the mitigation area. The majority of the area is sand with varying percentages of cobble overlying it; there is no fine-grained silty substrate in the Project area.

44. (Oktay): I wanted to reiterate the importance of identifying very specific criteria for success. Current measurements near the cobble could be very useful, because this could directly affect burial and re-exposure. One year of monitoring may not be enough to generate data between experimental and control plots in terms of storm damage.

It is certainly true that a single year of monitoring will not generate a significant storm dataset unless there are atypical conditions; however, one year of monitoring should enable the Proponent to assess how dynamic the benthic habitat is and how it can be impacted by storm events. The primary objective of the pilot mitigation is to assess early recolonization rates, and the pilot is proposed in close proximity to the Project area to minimize other variables. The Proponent's mitigation plan will incorporate conservative assumptions for colonization rates, and pilot monitoring will provide valuable data.

45. (Pete Kaiser): How old are the sponge and macroalgae?

As explained at the Commission meeting, some of the surveys presented in the FEIR estimated that offshore areas with denser cobbles contained organisms that were perhaps three years old. Any population can have significant age variations, however, which result in complex age structures. Many of these species will re-grow fronds over a nine-month period. Macroalgae tend to grow in rocky intertidal areas undergoing regular disturbance, which maintains genetic diversity. Prince and Kingsbury (1973)[12] report a growth rate of 0.37 mm per day in *Chondrus crispus* growing in Maine, and they postulate the typical frond life is 2-3 years; however, fronds may live up to six years in sheltered waters (Harvey and McLachlan, 1973[13]). This is consistent with the data showing that following disturbance, these plants regenerate from longer-lived tenacious holdfasts (Pringle and Mathieson, 1986[14]; Mathieson and Burns, 1975[15]; Dudgeon and Johnson, 1992[16]). It is also important to note that an individual's size is often limited by its environment and does not necessarily provide a clear indication of the age of blades or holdfasts. Especially in the nearshore, macroalgae are subject to disturbance and will re-grow to a maximum size at varying rates depending on environmental factors such as nutrient supply, light penetration, and currents. Regardless of age, *C. crispus* typically grows to an average height of seven inches.

The lifespan of sponges varies considerably, but four years is typical of most encrusting species (Konnecker, 2003[17]). Observations by Nicol and Reisman (1976)[18] at Gardiner's Island, New

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[12] Prince, J.S. and Kingsbury, J.M. 1973. The ecology of *Chondrus crispus* at Plymouth, Massachusetts: effect of elevated temperature on growth and survival. Biology Bulletin. Volume 145. Pp. 580-588.

[13] Harvey, M.J. and McLachlan, J. 1973. *Chondrus crispus*. Proceedings of the Transactions of the Nova Scotian Institute of Science. Volume 27, Supplement 1. Pp. 1-155.

[14] Pringle, J.D. and Mathieson, A.C. 1986. *Chondrus crispus*: Case Studies of Seven Commercial Seaweed Resources. FAO Fisheries Technical Paper. Volume 281. Pp. 49-122.

[15] Mathieson, A.C. and Burns, R.L. 1975. Ecological studies of economic red algae: Growth and reproduction of natural and harvested populations of *Chondrus crispus* in New Hampshire. Journal of Experimental Marine Biology and Ecology. Volume 17. Pp. 137-156.

[16] Dudgeon, S.R. and Johnson, A.S. 1992. Thick vs. thin: thallus morphology and tissue mechanics influence differential drag and dislodgement of two co-dominant seaweeds. Journal of Experimental Marine Biology and Ecology. Volume 165. Pp. 23-43.

[17] Konnecker, G. 2003. Sponge Fields: Offshore Features Report. United Nations Environment Program. Pp. 87-94. www.ngo.grida.no/wwfneap/Projects/Reports/Offshore_Features/sponge_fields.pdf.

York, suggested the sponge *Cliona celata* ranged 2-3 years in age, but that larger sponges were most likely older and formed when two or more sponges fused together.

46. (Kaiser): What minimum cobble size were you surveying for?

(Rits): We did not account for anything smaller than 1-1.5 inches, because that material is more gravelly and is frequently transported by currents; thus, it does not support benthic growth.

47. (Kaiser): Were you implying in your presentation that bluefish and bass are the only species occurring in the cobble areas?

(Vaccaro): Not at all. Those species are simply two examples of highly-migratory fish that occur in the area and may pursue prey that forage in cobble habitat.

48. (Kaiser): You say there is no cobble inside of 300 feet, which is totally wrong.

Ginger Andrews interjected here and explained that Mr. Kaiser will have an opportunity to present his information at a later hearing; this meeting was solely for asking questions. All information will be considered in the Commission's decision.

49. (Ray): You mentioned the existing cobbles are 2-20" in diameter. What is underneath that material? How do you know the 2-inch stone is not actually the tip of a much larger boulder?

(Rits): As discussed, we will perform dives to look at representative areas and assess cobble size. What is currently providing cobble habitat is the exposed portion of cobble; if only the top of a boulder is exposed, it is only the tip of that boulder that is providing habitat for benthic organisms. One of the purposes of this pilot is to assess burial and re-exposure and evaluate organisms' responses to these processes. It is impossible to confirm the sizes of every particle on the seafloor, but what is feasible is to assess exposed cobble and evaluate the processes of burial and re-exposure.

50. (Ray): When you were explaining that the cobbles originated in the bank, that implies the bank is providing a supply of cobble to the system. When you perform your mitigation, you will provide cobble but will not keep going back to provide additional cobbles the way the bank would.

(Rits): As the bank retreats, it drops cobble and that cobble remains where it is deposited. This process does not replenish cobble in offshore areas as the bank retreats.

51. (Ray): If your Project is successful, there will no longer be erosion from the bank to produce cobble.

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[18] Nicol, W.L. and Reisman, H.M. 1976. Ecology of the boring sponge (*Cliona celata*) at Gardiner's Island, New York. Chesapeake Science. Volume 17, Number 1. Pp. 1-7.

(Rits): The bank will not be eroding any more, but there will be maintenance of the existing habitat that is out there as it exists now. We will not be losing any cobble that is not part of the Project; any cobble buried by the Project will be mitigated for. Offshore cobble will stay as it currently is now.

52. (Ray): But it is possible that your cobble will become covered over entirely.

Monitoring is a crucial component of the Project's impact assessment and mitigation proposal. Mitigation will account for the portion of existing cobble that will be buried by nourishment material, and post-construction monitoring will verify the accuracy of impact predictions to ensure that mitigation is sufficient. Monitoring of the mitigation areas will ensure they are not buried and instead remain exposed for adequate mitigation of buried cobble. If the Project is ultimately abandoned, there will be no additional renourishment and erosion will re-expose buried cobble. As long as the Project continues, the nourishment will not result in a net decrease in cobble.

53. (Bam LaFarge): For your proposed pilot, if you have 10-20% cobble, have you calculated how many tons of cobble that is? How will you lay out the cobble to replicate natural habitat?

We have calculated the tonnage of cobble needed to replicate varying densities of cobble coverage, and these calculations appear in Table 53A below. Mitigation materials will be delivered by a barge equipped with high-precision GPS that will slowly navigate through the area while dropping small quantities of rock. This rock will slightly disperse and settle to the bottom to replicate the targeted percentages of coverage. Post-deployment dive surveys will assess the actual coverage attained to ensure the mitigation appropriately replicates habitat conditions within the impact area.

Table 53A: Volume and tonnage of cobble required to replicate varying densities of exposed cobble.

Target Cobble Density	Cubic Yards/Acre	Tons/Acre*
100%	1,613.4	2,218.4
50%	806.7	1,109.2
40%	645.3	887.3
30%	483.9	665.4
20%	322.7	443.7
10%	161.3	221.8

*Note: 1 cubic yard of cobble equals approximately 1.375 tons (2,750 pounds).

54. (Ernie Steinauer): Is the existing cobble randomly-distributed within a given 1-acre area? Is a random 1-square-meter area likely to have cobble in it?

(Rits): Yes. The 1-square-meter areas will be randomly selected, but if an initially-selected area has no cobble in it, we will obviously have to re-select a survey area to assess colonization.

We do not want a diver to hand-pick a survey area, however, in order to minimize any possible bias.

55. (Steinauer): It seems that three 1-square-meter plots is a pretty small-scale monitoring effort. Will those small sample quadrats be permanently marked?

Video surveys will cover the entirety of each 1-acre plot, while focused dive surveys will be performed in the smaller quadrats to ground-truth the data; these quadrate will be permanently marked. A sample size greater than two is needed for adequate sub-sampling, so we selected three of these smaller quadrats.

56. (Mark Gunther): Could you transplant any existing cobbles that already have vegetation attached?

(Rits): It is difficult to harvest cobble material on a large scale without destroying existing vegetation. This is why we would like to perform the pilot to assess how these organisms recolonize bare cobble on their own.

57. (Andrews): Will you be monitoring the shoreline near the pilot? I presume that shoreline is not eroding? How will sand transport affect your pilot, if longshore drift encroaches into the pilot area?

The Proponent has been monitoring that shoreline and will continue to do so throughout the proposed Pilot Mitigation project. The shoreline landward of the pilot mitigation area is currently undergoing moderate accretion, and the coastal bank has significantly lower relief than in the beach nourishment project area and is not currently providing any sediment or cobble to the nearshore system. Mitigation cobble will be placed 400-600 feet offshore at its closest, and the bulk of sand transport, which occurs closer to shore in shallower water, is not anticipated to impact the Pilot. It is important to note that this is distinct from the active sand transport regime discussed in the context of the Borrow Site, since that offshore area contains a larger amount of sand that is subject to different tidal currents and wave dynamics.

58. (Bennett): Would it be a good idea to place some cobbles in your pilot area that have highly-stressed organisms, since one of the primary questions is how damaged organisms may recover?

The purpose of the Pilot Mitigation Project is to demonstrate the effectiveness of a method of cobble habitat replication based on colonization and community development of a bare substrate. As such, the Proponent intends to replicate cobble habitat using clean, natural rocks and a limited number of reef balls. The Pilot Project's design is consistent with the context of Mr. Bennett's suggestion, however, since monitoring will assess natural successional changes as well as the benthic community's response to natural disturbances such as storms.