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November 1, 2013

Dr. Ernie Steinauer, Chair
Nantucket Conservation Commission
4 Bathing Beach Road
Nantucket, MA 02554

Re: NOI, Baxter Road Temporary Stabilization Project

Dear Commissioners,

The Nantucket Land Council, Inc. is a non-profit, environmental organization, which is supported by more than 1800 members. We have reviewed the Notice of Intent materials for the Town of Nantucket and Siasconset Beach Preservation Fund's application to temporarily stabilize a section of Baxter Road. We are providing comments and questions from our technical consultants, Applied Coastal Research and Engineering, Inc, to follow up on the comments they made at the first public hearing on October 30, 2013. Attached you will also find a copy of MA CZM's letter to the Commission dated August 26, 2013, the CP&E Sediment Budget from November 2006, and a copy of the proposed Sediment Template Volume calculated by SBPF's consultants in their 2012 Notice of Intent filing for gabion construction, that have been referenced in Applied Coastal's letter.

Thank you for your time,

Emily MacKinnon

Emily MacKinnon
Resource Ecologist

Enclosures

Applied Coastal Research and Engineering, Inc.
766 Falmouth Road
Suite A-1
Mashpee, MA 02649

MEMORANDUM

Date: **October 30, 2013**

To: **Emily MacKinnon and Cormac Collier, Nantucket Land Council**

From: **John Ramsey, P.E. and Trey Ruthven**

Subject: **Baxter Road Temporary Stabilization Application**

We have reviewed the Baxter Road Temporary Stabilization Application in conjunction with the additional information submitted by Milone & MacBroom, Inc. (MMI) in support of the application. Similar to the previous projects that have been proposed along Sconset Bluff, Applied Coastal is concerned with the inadequacies of proposed mitigation efforts. Another concern is the scale of the proposed project which has been characterized as temporary, but has several design features which are characteristics of permanent coastal engineering structures.

Mitigation

The proposed geotubes structure is designed to act in a similar manner to a revetment by isolating the coastal bank and beach from erosive forces. By cutting off the supply of material from the coastal bank to the littoral system the project will shift and magnify erosion onto adjacent Town owned beach and neighboring properties along the coastal bank which already face significant erosional concerns. Therefore the geotube structure should be accompanied by an appropriate mitigation plan to offset adverse impacts associated with the coastal engineering structure. MMI presents the following table to illustrate the volume of sand nourishment provided:

Placement Location	Rate of Placement (CY/LF)	Length of Placement (Feet)	Total Volume (CY)
Inside Geotubes	4.22 (each tube)	1,500	25,320
Leveling Sand	2.3	1,500	3,450
Nourishment Sand	14.3	1,500	21,450
		TOTAL VOLUME	50,220

*Reproduced from MMI's October 25, 2013 letter to the Conservation Commission

The first and largest volume listed within the table is the 25,320 CY of sediment contained within the geotubes. The sediment within the geotubes should not be considered mitigation nourishment, since the sediment is isolated from the littoral system within the geotubes and provides no mitigation value to the shorelines updrift and downdrift of the proposed structure. The leveling sand should also not be considered mitigation nourishment; the sediment is isolated from the littoral system behind the geotubes and the geo-textile scour apron. The remaining nourishment volume, 21,450 CY, equates to 14.3 CY/LF which is significantly below the volumes naturally contributed to the beach from the bluff as calculated by:

- Massachusetts Coastal Zone Management – 15 to 26 CY/lf/year (Letter to the Conservation Commission dated August 26, 2013)
- Coastal Planning & Engineering, Inc. (Siasconset Beach Preservation Fund (SBPF) engineering consultant) – 24.2 CY/lf/year from the sediment budget developed for the period 1995 to 2005 submittal on behalf of SBPF to Nantucket Conservation Commission in November 2006
- SBPF's 2012 Notice of Intent for gabion project (produced by SBPF consultant Epsilon Associates, Inc.) – 19.1 to 19.5 CY/lf/year (these values excluded 13% of the total volume eroding from the bank due to fines, with the inclusion of fines the erosion rate is 20.8 to 22.2 CY/lf/year).
- Ocean and Coastal Consults, Inc. (SBPF engineering consultant) – 20.7 CY/lf/year from the September 2010 Siasconset Coastal Bank Stabilization and Beach Preservation Project Alternatives Analysis submittal on behalf of SBPF to Nantucket Conservation Commission.

Based on annual bank and beach sediment contribution rates previously provided by SBPF, it appears that the mitigation nourishment volume should be closer to 22 CY/lf/year (33,000 CY per year) which is the average of the three sediment contributions presented previously by SBPF consultants. The purpose of mitigation nourishment is to maintain the sediment supply that naturally erodes from the coastal bank system that is impounded by the structure. Once the proposed geotube revetment prevents erosion of the coastal beach and bank, coastal beach and bank materials are no longer available to supply downdrift beaches which in turn increase erosion on adjacent shorelines. Therefore an appropriate mitigation volume should be required on an annual basis to mitigate for the sediment lost from the littoral system. This mitigation volume would be based on long-term historical rates (see bullets above) and would be supplied regardless of monitoring results.

The placement protocol provided for the mitigation nourishment calls for the covering of the geotubes with a minimum of two feet of cover in addition to creating a bench that extends approximately 20 feet from the bank and slopes down the beach at 2.5 : 1 (horizontal : vertical). The placement of mitigation nourishment over the top of the geotubes up to an elevation of +28 feet (16 feet above the 100-Year base flood elevation) places a significant volume of the mitigation outside of the active littoral zone, thereby reducing the effectiveness of the mitigation to moderate the downdrift impacts associated with the construction of a coastal engineering structure on neighboring coastal beaches and banks. The mitigation nourishment should be placed in a sacrificial berm at the back of the beach to keep sediment within the littoral system. If there is not sufficient room for a sacrificial berm, the mitigation could be placed north and south of the geotube revetment structure. If a layer of sediment is required to cover the geotubes due to engineering/material constraints or for aesthetic concerns, then an additional volume of sediment should be provided for separately in a similar fashion to the sediment required to fill the geotubes and level the coastal bank during construction. This aesthetic coverage should not be considered mitigation.

The applicant should provide clarification to the Conservation Commission about the intended use of the excavated beach material associated with the placement of the fourth geotube below the existing beach face. The utilization of the fourth geotube will displace approximately 7,200 CY of beach material. That beach material is currently available to updrift and downdrift beaches within the littoral system should erosion occur, if the displaced beach material is utilized for

geotube filling, leveling of bank, mitigation nourishment, etc. it would represent a loss of beach material and hence should be appropriately mitigated for with additional beach nourishment.

Temporary Geotube Revetment

The scale of the proposed geotube revetment structure appears to be uncharacteristic of the design goal stated below,

> *Work under this application is specifically proposed as temporary and intended to provide a minimum but adequate level of protection for the short term while long term solutions are explored and implemented (*MMI's October 25, 2013 letter to the Conservation Commission)

The Alternatives Analysis excludes two geotube options that clearly meet the stated design goal more appropriately then the selected Four-Geotextile-Tube Configuration that was selected. Geotube Alternative 1 – Jute Fiber Logs have been shown to work over a number of years at 79 Baxter Road. A quick glance at any recent aerial photograph shows that the Jute Logs and terracing have minimized the loss of coastal bluff relative to adjoining lots. This is further confirmed in Figure XX from Epsilon Associates, Inc. which shows the bank at 79 Baxter Road did not erode over the April 2003 to March 2012 time period (the figure was submitted in conjunction with July, 2013 NOI for Baxter Road And Sconset Bluff Storm Damage Prevention Project). The key disadvantage listed in the exclusion of this alternative is degradation of the material over time; however, the proposed project is temporary, not permanent, thus degradation of the jute material over time should not be an exclusionary criteria for rejecting the Jute Fiber Log alternative. The Jute Fiber Log alternative appears to offer the least detrimental solution for protecting the coastal bank while maintaining littoral transport and minimizing the adverse impacts to adjacent properties.

The second excluded option, Geotube Alternative 2- Three-Geotextile-Tube Configuration was the preferred alternative in October 4, 2013 submission to Conservation Commission by MMI. The three geotube alternative eliminates the significant excavation of the coastal beach that is required with the four geotube alternative. To place the fourth geotube below the beach face, the contractor will have to excavate into beach approximately 10 feet in depth and greater than 30 feet in width. Once the geotube is in placed beneath the beach, it will displace approximately 7,200 CY of beach sediment. If the proposed project were not temporary in nature, such design details may be warranted; however, for a temporary project that seeks to provide the minimum level of protection the inclusion of the fourth geotube is does not appear warranted.

The overall height of the geotube options that are being evaluated is also excessive. The still water elevation for the FEMA predicted 100-Year Event is 10.2 feet, the top crest of the geotubes extends to elevation 26.0 with an additional two feet of sand cover over that. This project is a temporary solution, not a permanent coastal engineering structure. The overall structure height should be reduced to reflect the temporary nature of the project and reduce the overall impacts to the coastal bluff. If additional protection is required over the short design life of the project, it is recommend that additional sand nourishment be provided to dissipate wave and storm energy.

Monitoring and Maintenance Requirements

The Conservation Commission should require additional transects be added to the current Shoreline Monitoring conducted by SBPF. A revised monitoring plan should be submitted which includes additional transects on regular intervals (50-100 foot intervals) immediately updrift and downdrift of the proposed project to monitor the project for end effects and increased erosion along the adjacent shoreline and coastal bank. The monitoring survey should be conducted pre- and post-

nourishments to allow for quantification of shoreline variations and movements after the revetment is constructed. This near-field monitoring is critical to ensure that the structures are not having adverse impacts on adjacent properties due to 'end effects'.

The mitigation plan should be conservative; the purpose of mitigation nourishment is to maintain the sediment supply that naturally erodes from the coastal bank. Once the geotube revetment prevents erosion of the coastal bank, coastal bank materials are no longer available to supply downdrift beaches. Therefore, the minimum annual mitigation should be based on the historic erosion rate rather than monitoring results. Monitoring should only be utilized to indicate where placement of mitigation material is critical. The placement of beach nourishment mitigation should not be limited to the area of the project. Due to the large volume of annual mitigation that would be required for this project, it is likely that the beach fronting the revetment will not be able to hold the volume of annual nourishment required; therefore, the Town should consider placement of nourishment both north and south of the proposed geotube limits.

Due to the large volumes of sediment associated with the construction of the geotubes, it is critical that the sediment associated with the mitigation nourishment not potentially be misplaced or redirected during the construction of the project. The mitigation nourishment needs to be placed on the beach to maintain the sediment supply that naturally erodes from the coastal bank. It is recommended that Conservation Commission require truck delivery slips stating the weight of sediment delivered be complied into an engineering report illustrating the sediment requirements for each phase of the project and then stamped and certified by the design engineer to attest that the prescribed mitigation volumes have been placed.

Failure Criteria and Removal

The failure and removal criteria lack the necessary clarity and detail to evaluate the possible failure of the geotube structure in the future. For instance, *complete loss of one or more tubes*, what does *complete loss* mean? Would differential settlement along the structure length which results in the displacement/twisting of a geotube and results in a rupture of the geotextile fabric to an extent that it must be replaced or be partially emptied of sediment to be repaired represent a complete loss? If a geotube is flanked, what is the length of time that should be allowed to mitigate for the flanking, is a period of 7 days sufficient? In general the failure criteria presented is not quantitative. In addition the monitoring requirements associated with the application do not provide for quantitative assessment of the failure criteria. Therefore, there should be specific monitoring requirements associated with the failure criteria.

Conclusions

Reviewing the narrative presented within the NOI for the 2013 Baxter Road Temporary Stabilization Application illustrates that regardless of the stated temporary and minimal nature of the proposed project, the proposed geotube structure will cut off the supply of material from the coastal bank to the littoral system. Failure to adequately mitigate for the project will shift and magnify erosion onto adjacent Town owned beach and neighboring properties along the coastal bank. Analysis provided by SBPF, indicates that the minimum annual mitigation nourishment should be on the order of 22 CY/lf/year or approximately 33,000 CY per year. That mitigation volume would provide for one-to-one mitigation of the material that is currently being provided from the coastal bank to the littoral system. It is important to note that the one-to-one mitigation does not account for any additional erosion which is likely to occur due to end effects, wave reflection, and disturbance of the coastal bank and beach during construction. The goal of mitigation is not to prevent erosion in front of the proposed structure, but to prevent the acceleration of erosion on adjacent shorelines.

Baxter Road and Sconset Bluff Storm Damage Prevention Project Nantucket, MA

Figure XX

2003-2012 Coastal Bank Retreat (Average of 3.18 Feet/Year)

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS
OFFICE OF COASTAL ZONE MANAGEMENT
251 Causeway Street, Suite 800, Boston, MA 02114-2136
(617) 626-1200 FAX: (617) 626-1240

August 26, 2013

Dr. Ernest Steinauer, Chairman
Nantucket Conservation Commission
2 Bathing Beach Road
Nantucket, MA 02554

Re: Notice of Intent for Baxter Road and Siasconset Bluff Storm Damage Prevention Project; DEP File # SE 048-2581

Dr. Steinauer,

At the request of the Nantucket Conservation Commission ("Commission") for technical assistance from the Office of Coastal Zone Management (CZM) concerning the Notice of Intent and supporting information submitted to the Commission for the Baxter Road and Siasconset ("Sconset") bluff storm damage prevention, CZM is providing the following feedback. CZM's comments on the proposal are based on information submitted to the Commission through August 15, 2013, including the Notice of Intent, Sconset Bluff Erosion Control Alternatives and Recommendations report by the Siasconset Beach Preservation Fund (SBPF), and revised plans prepared by Ocean and Coastal Consultants (dated August 14, 2013). As you are aware, regulatory decisions regarding the project under the Wetlands Protection Act are the authority of the Commission and the Massachusetts Department of Environmental Protection (MassDEP).

CZM recognizes the erosion hazard impacts and implications for both private property and public infrastructure and resources, but we also have concerns about the potential adverse impacts that could result from construction of a new revetment at this site. Provided the Commission and/or MassDEP find that the proposed revetment will prevent storm damage to buildings constructed prior 1978 and the applicant has demonstrated that no method of protecting the buildings other than the proposed revetment is feasible, CZM would recommend the evaluation of the design considerations provided below in order to minimize and mitigate the potential adverse impacts of the proposed project on the eroding coastal bank, dunes, and beach.

1) Locate the revetment as far landward as possible, overlapping onto the fronting coastal beach only to the extent necessary to achieve structural stability and the desired slope, to minimize reflection of waves onto the beach and adjacent resources and accommodate rising sea levels. Another consideration for the location of the structure is how uniform it is along the shoreline. If some sections of the structure stick out seaward of other sections (e.g., revetment section seaward of 77–

81 Baxter Road), storm waves will likely focus on the sections of the structure sticking out causing increased erosion of the beaches fronting these areas.

2) Terminate the revetment at least 15-20' from neighboring property lines to reduce end effects of the structure on adjacent unarmored properties. This buffer will focus end effects primarily on the applicant's property. On the plans dated 8/14/13, the revetment extends approximately 40' south of the property line for 63 Baxter Road and over 180' north of the property line for 115 Baxter Road. There is an existing house on the lot just south of 63 Baxter Road that could receive significant adverse effects as a result of the proposed location of the structure.

3) Taper the ends of the revetment in elevation and slope to reduce the reflection of wave energy onto adjacent properties and resource areas.

4) Since rough-faced revetments dissipate more wave energy than smooth-faced structures, avoid the use of grout or other material in between rocks of the revetment to improve wave energy dissipation and minimize the potential for reflected wave energy.

5) To mitigate for the armoring of the bank and effectively eliminating a sediment source for the beach, compatible sediment needs to be added to the beach on a regular basis to ensure that the form and volume of the beach are not reduced as a result of the project. The minimum nourishment volume required is typically based on available information regarding the erosion history at the site. To determine the appropriate volume of sediment needed for mitigation, CZM recommends using all available information about historic shoreline erosion rates, including the Massachusetts Shoreline Change Project data available on CZM's website (www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/shoreline-change), and the quarterly beach profiles conducted for the SBPF. Both the long- and short-term rates of change need to be considered in light of the current shoreline conditions, the effects of recent storms, and whether the shoreline has fluctuated between erosion and accretion. The shoreline change project webpage has more information about interpreting the shoreline change rates. Based on the information submitted by the applicant, the Massachusetts Shoreline Change Project data, and an article by Wesley Tiffney, Jr. and Clifton Andrews[1], the cycle of erosion in the project area began in the mid-1970s. Therefore, it is most appropriate to use short-term shoreline change rates, which represent the rate of change from 1978 through 2009, rather than long-term shoreline change rates, which represent the change from 1846 through 2009. The proposed mitigation volume of 9.3 cubic yards per linear foot of beach per year seems low compared to the short term shoreline change rates, which range from 6–10' per year along the project area, which is approximately equivalent to 15–26 cubic yards per linear foot of beach per year.

[1] Tiffney, W.N., Jr., and Andrews, C., 1990. Sesachacha & Sankaty: Pond opening and erosion on Nantucket's eastern shore, Historic Nantucket, V. 38, No. 1, p 4-6. Available online at www.nha.org/history/hn/HN-tiffney-sechacha.htm.

6) The volume of sediment required to mitigate for armoring the bank would be in addition to that necessary to mitigate for increased erosion of the fronting and adjacent beaches and banks. CZM recommends that the Commission consider the increased erosion of the fronting beach and adjacent banks observed with the various erosion control projects along this site to inform your decision about a minimum amount of pro-active nourishment to mitigate for these impacts. It is very likely the volume will need to be modified based on beach profile monitoring, but it is important to recognize the need for including this as part of the project.

7) Given the limited supply of on-island sediment for nourishment, the logistical complexities associated with placing sediment on the beach, and the additional complications in placing sediment on the beach as it narrows seaward of the revetment, CZM recommends that all the components of mitigation be factored into the Commission's review of the project.

8) The applicant submitted a chart summarizing grain size data for 24 sediment samples taken along eight shore-perpendicular transects within the project area. CZM recommends that the grain size data for each sediment sample be provided to the Commission to inform determination of the appropriate grain size for beach nourishment.

9) Additional beach profiles may be needed at the ends of the proposed structures to fully assess the impacts associated with the Phase one revetments as well as the longer Phase two project. Because of the complex sediment transport patterns in this area, it has been difficult to differentiate the impacts of various shore protection projects along the Sconset shoreline from the natural changes in the system based on beach profiling conducted for the SBPF. CZM recommends that the Town and the applicant consider using an independent third party to conduct the monitoring, analyze the data, and provide recommendations for mitigation volumes based on that analysis. CZM also recommends that clear thresholds be established to determine when additional mitigation will be needed.

10) Due to the exposed nature of the project site and relatively narrow dry beach, there have been significant logistical challenges with the installation and maintenance of various shore protection projects along the project area in the past. These challenging conditions have resulted in unanticipated impacts during construction. For example, when components of the beach dewatering system were being installed in 1994, large sand-filled tubes were needed to provide a buffer from daily tides and waves so the beach dewatering system could be installed. In 2005, when the beach had narrowed even further, steel sheathing was needed to establish dry workspace for installation of the upgraded beach dewatering system. The interaction of the waves with the steel sheathing eroded the beach in front of the sheathing and there was additional erosion of the beach created by runoff from dewatering the work space (photographs available). Although the information submitted by the applicant to date contains some information on the construction methodology, CZM recommends that additional detail be provided to facilitate the Commission's review of the potential adverse impacts that may occur during construction and any mitigation that might be necessary for the short-term impacts.

In summary, CZM recommends that the above design considerations be carefully evaluated and additional information be provided to facilitate the Commission's review of the potential impacts associated with the proposed project. If you have any follow up questions regarding coastal processes, please contact me at (617) 626-1228.

Sincerely,

Rebecca Haney
Coastal Geologist

Cc: Stephen McKenna, CZM Cape Cod and Islands Regional Coordinator
Elizabeth Kouloheras and Jim Mahala, DEP Southeast Regional Office
Lealdon Langley, DEP Boston Office

8.0 LITTORAL BUDGET

Waves and currents are the forces that transport beach sediment along the coastline, and are the forces of beach erosion in some instances. A "littoral budget" is an assessment of the magnitude and direction of sediment transport in the project area. The Sconset Beach littoral budget is based on annual cumulative sand volume change rates at each profile line. The littoral budget was developed for the time period of December 1995 through December 2005, which also coincides with the period of highest shoreline recession rates.

The average shoreline recession rate was multiplied by the active profile height and effective distance between profiles to develop a volume change rate at each profile line (Table 10). (It would have been preferable to use the measured volumetric change but the lack of profile closure necessitated using shoreline changes). The top of the active profile height varies along the project length, peaking at a height of 110 feet at profile 92.5. (The active profile height (APH) is the distance from the top of the active profile to the depth of closure). Light Detection and Ranging (LIDAR) topographic mapping data was used to determine the top of the active profile height in the highly eroding bluff area (profile 90.6 to 95). The bluff elevation was later confirmed when the August 2006 survey data became available. In the areas where there is a highly vegetated dune landward of the beach, the top of the active profile height was taken at the base of the vegetation. A vegetated dune indicates that it has been stable long enough to vegetate and is therefore not considered part of the 'active' profile height. The depth of closure (Section 5.7) was assumed to be -26 ft MLW along the entire project length.

Once the volume change was established, the percentage of silt at each profile line was removed from the total volume change, in order to account exclusively for the longshore movement of coarse grained material (sand and gravel). It was assumed that the silts were put into suspension by wave activity and swept out of the project area. The percentage of silt was determined by an elevation weighted average of the silt content from 298 cross-shore samples. The cumulative sand volume changes represent the littoral transport rates, as summarized in Table 10.

The total longshore transport could then be estimated by summing the volumetric changes at each line using the sand conservation equation. A starting point for this summation had to be assumed. A typical method of determining this starting point is to identify the point where there is no net sediment transport, which is termed the nodal point. The nodal point is typically located at the location experiencing the highest shoreline recession rates, as there is no sediment being supplied from an updrift source. The largest shoreline recession rate occurs at profile 88.6, which suggests that this is the location of the nodal point. Once the nodal point is located the volumes are then summed going away from this point to provide the littoral transport rate. The sign indicates the direction of transport so positive transport is to the south and west while negative transport is to the north.

Table 10. Littoral Budget between 1995 and 2005

Profile	Effective Distance (ft)	Top of APH (ft)	DOC (ft)	APH (ft)	Shoreline Change (ft/yr)	Volume Change (cy/yr)	Percent Silt (%)	Sand Vol Change (cy/yr)	Littoral Transport (cy/yr)
81	536	11	-26	37	-4.5	-3,300	0.3	-3,300	-20,500
82	865	15	-26	41	7.9	10,300	0.3	10,300	-23,800
82.6*	546	13	-26	39	13.2	10,400	0.2	10,400	-13,500
83	522	15	-26	41	18.6	14,700	0.3	14,700	-3,100
83.5	529	15	-26	41	22.4	18,000	0.3	17,900	11,600
84	444	15	-26	41	18.4	12,400	0.3	12,400	29,500
84.3	396	15	-26	41	12.3	7,400	0.2	7,400	41,900
84.6	351	13	-26	39	8.0	4,000	0.2	4,000	49,300
85	398	13	-26	39	3.9	2,200	0.2	2,200	53,300
86	441	13	-26	39	-0.7	-500	0.2	-500	55,500
86.5	435	14	-26	40	-6.5	-4,200	0.2	-4,200	55,000
87	436	14	-26	40	-13.0	-8,400	0.3	-8,400	50,800
87.4*	351	15	-26	41	-12.0	-6,400	0.2	-6,400	42,400
87.5	533	16	-26	42	-11.0	-9,200	0.2	-9,200	36,000
88	514	18	-26	44	-18.2	-15,200	0.1	-15,200	26,800
88.3	223	18	-26	44	-20.6	-7,500	0.2	-7,500	11,600
88.6	223	18	-26	44	-22.6	-8,200	0.2	-8,200	0
89	248	15	-26	41	-20.7	-7,800	0.2	-7,800	-11,900
89.2	273	15	-26	41	-15.4	-6,400	0.2	-6,400	-18,300
89.5	273	15	-26	41	-16.4	-6,800	0.2	-6,800	-25,100
89.8	276	15	-26	41	-14.3	-6,000	0.6	-6,000	-31,100
90	425	14	-26	40	-12.6	-7,900	0.6	-7,900	-39,000
90.6	639	85	-26	111	-8.0	-21,100	7.6	-19,500	-58,500
91	622	82	-26	108	-7.2	-17,900	15.1	-15,200	-73,700
91.5	431	90	-26	116	-3.8	-7,000	1.7	-6,900	-80,600
92	404	102	-26	128	-4.3	-8,200	1.7	-8,100	-88,700
92.5	483	110	-26	136	-2.0	-4,800	6.2	-4,500	-93,200
93	393	108	-26	134	-8.0	-15,600	3.6	-15,000	-108,200
93.5	500	96	-26	122	-6.1	-13,700	4.6	-13,100	-121,300
94	740	72	-26	98	-6.0	-16,200	3.1	-15,700	-137,000
95	802	57	-26	83	-4.9	-12,200	9.4	-11,100	-148,100
95.5	888	42	-26	68	-4.2	-9,500	4.2	-9,100	-157,200
96	979	26	-26	52	0.9	1,700	1.7	1,700	-155,500
96.5	606	26	-26	52	-1.0	-1,200	1.3	-1,200	-156,700
96.7	208	28	-26	54	0.9	400	0.6	400	-156,300
96.9	210	24	-26	50	1.2	500	0.6	500	-155,800
97	272	25	-26	51	1.0	500	0.6	500	-155,300
97.3	350	24	-26	50	0.3	200	0.4	200	-155,100
97.6	408	24	-26	50	0.1	100	0.4	100	-155,000
98	722	20	-26	46	-0.5	-600	0.4	-600	-155,600
99	1,225	21	-26	47	-0.4	-800	0.4	-800	-156,400
Q	2,985	23	-26	49	-0.3	-1,800	0.4	-1,800	-158,200
S	5,159	18	-26	44	2.5	20,700	0.4	20,600	-137,600
W	2,900	21	-26	47	1.7	8,300	0.4	8,300	-129,300

A plot of the littoral transport curve is shown in Figure 8. This figure shows that from profile 86 through to profile 95.5 that the littoral transport rate is increasing, which is indicative of an erosional area. The graph also shows that north of profile 95.5, the littoral transport rate curve is relatively flat so the volume of material entering the section is similar to the volume leaving this section and the beach is stable. North of profile Q, the sediment transport rate is decreasing, which is indicative of an accretional area.

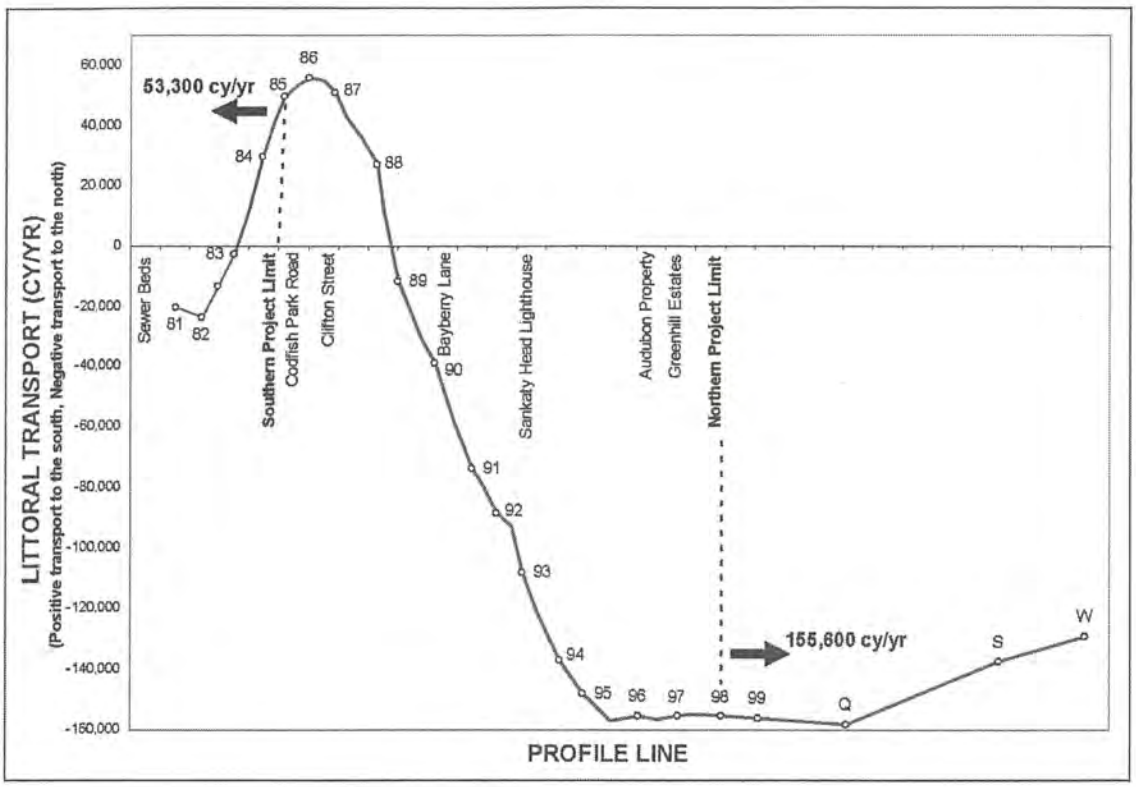

Figure 8. Annual Littoral Transport (Dec 1995 to June 2005)

The southern end of the project is located at profile 85. At this location the sediment transport rate is approximately 53,300 cy/yr being transported to the southwest. The northern end of the project has a sediment transport rate of 155,600 cy/yr being transported to the north. Therefore, the total net loss due to longshore transport is approximately 208,900 cy/yr.

Table 10 Sediment Template Volume

BANK CONTRIBUTION			
	Reis	Holdgate	
Bank Material (cy/lf/yr) (Includes 13% Fines)	13.3	13.3	
Overfill Factor R_A (Pit to Bank)	<1	<1	
Bank Material * Overfill Factor (cy/lf/yr)	13.3	13.3	
Minus 13% Fines	1.7	1.7	
Pit Contribution Volume (cy/lf/yr)	11.6	11.6	
BEACH CONTRIBUTION			
	Reis	Holdgate	Composite (50%Holdgate 50% Reis)
Beach Material (cy/lf/yr)	6.8	6.8	6.8
Overfill Factor R_A (Pit to Beach)	1.1	1.32	1.17
Pit Contribution Volume (Beach Material * Overfill Factor) (cy/lf/yr)	7.5	9.0	8.0
TOTAL ADJUSTED TEMPLATE VOLUME			
Pit Contribution Volume (Bank) + Pit Contribution Volume (Beach) (cy/lf/yr)	**19.1**	**20.5**	**19.5**
Proposed Template Volume (cy/lf/yr)	**20**	n/a	**20**

3.2.6.2 Replenishment Protocol

The sediment template will be restored to its full volume annually each spring, prior to Memorial Day. Additionally, SBPF will replenish the template volume whenever more than 75% of the volume has been removed by erosion, even if this occurs more than once in a winter.

3.2.6.3 Timeframe for Replenishment

Sediment is provided to the template from the top of the coastal bank; therefore, the ability to supply additional sediment is not precluded by beach conditions during storms. As described in Section 3.3 below, sediment will be delivered to the lower bank via a temporary chute from the top of the bank, and will be delivered to the chute via mobile conveyor belts.