Waterfront
Engineering
Consultants

Vine
ASSOCIATES, INC.

190 Old Derby Street
Suite 311
Hingham
Massachusetts
02043

tel: (781) 749-2530
fax: (781) 749-2750

June 22, 2007

Mr. Raul Silva, Deputy Chief Engineer
Department of Conservation and Recreation
251 Causeway Street Suite 700
Boston, MA 02114

Re: ***Wave & Flood Analysis***
Salisbury Beach Center Dune Project
Salisbury, Massachusetts
VAI Project No. 1183

Dear Mr. Silva:

As requested, Vine Associates, Inc. (VAI) has reviewed the pre and post construction site conditions to evaluate if the Salisbury Beach Center Dune Project has the potential to alter wave and storm conditions in the project area. Specifically, this letter addresses the concerns being raised by the owner of the 5 O'clock Club (Club) at 25 Broadway that the dune project is likely to direct storm flowage at the Club.

The analyses and opinions presented in this letter are based on observations, photographs and pre/post-construction surveys of the Salisbury Beach Center dune area performed by VAI. All elevations are referenced to the National Geodetic Vertical Datum (NGVD). VAI's review of this information indicates the following:

- The pre-construction dune crest elevations to the north and south of the Club were approximately 15 feet and 14 feet NGVD, respectively.
- The post-construction dune crest elevations to the north and south of the Club are approximately 18 feet and 17 feet NGVD, respectively.
- The FEMA 100-year flood elevation at the site is 15 feet NGVD.
- The dune nourishment was limited to the placement of sand within historic dune areas and material was not placed on the beach.
- The dune area to the north of the Club is only 70 feet long and is sheltered by the adjacent buildings and deck structures.

- The dune area to the south of the Club is approximately 485 feet long.

Storm flowage is the result of storm surge and runup of wind generated storm waves. The primary factors that govern the storm surge are the offshore winds and nearshore water depths. The Project is not capable of impacting offshore wind conditions and should have no measurable impact on nearshore water depths. Therefore, storm surge elevations in the Project area can be expected to remain unchanged.

The primary factors that control wave runup on beaches are wave height, wave period and beach slope. The wave height and period are the result of offshore wind conditions that will not be altered by the Project. The dune nourishment work has not significantly altered the beach profile since the placement of sand was limited to the dune area. Past observations of wave runup in the Salisbury area indicates that the storm waves do not tend to run up the dune but to erode the face and form a scarp. Since the project only increased the dune elevations in the vicinity of the Club by approximately three feet, there should be no changes in runup patterns. It should also be noted that the dune to the north of the Club is constricted/protected by the existing buildings and therefore, there is little chance for alteration of runup patterns.

Based on the preceding, it is my professional opinion that the Salisbury Beach Center Dune Project has not altered wave runup conditions in the Project area, and will not direct more storm flowage toward the 5 O'clock Club.

Please feel free to contact me at (781) 749-2530 x201 should you have any questions on this matter.

Sincerely,
VINE ASSOCIATES, INC.

Peter J. Williams, P.E.
Principal

Waterfront
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Vine
ASSOCIATES, INC.

372 Merrimac
Street
Newburyport
Massachusetts
01950
(978) 463-4300
FAX
(978) 463-9449

June 13, 2007

Mr. Raul Silva, Deputy Chief Engineer
Department of Conservation and Recreation
251 Causeway Street Suite 700
Boston, MA 02114

Re: ***As-Built Survey/Post Construction Volumes***
Atlantic Road Dune
Beach Center Dune
Salisbury Beach, MA

Dear Mr. Silva:

Vine Associates, Inc. (VAI) has performed as-built surveys of the constructed dunes at the above-referenced project sites. The Atlantic Road post-construction survey was performed on June 7, 2007 and the Beach Center survey was performed on June 11, 2007.

We have compared the post-construction survey to the pre-construction survey at each project site in order to determine the volume of material placed by the Contractor at each dune location. Volume calculations are shown on the attached spreadsheets. The table below presents a summary of calculated sand volumes based upon pre-construction and post-construction survey conducted by VAI and estimated sand volumes delivered to the site based upon truck delivery slips provided by the Contractor.

Site	Engineer's Pre-Construction Volume Estimate (CY)	Post – Construction Volume (CY)	Estimated Truck Volume (CY)
Atlantic Road	**14,087**	**14,926**	**18,900**
Beach Center	**2,637**	**2,775**	**3,825**
Total	**16,724**	**17,701**	**22,725**

The estimated truck volume has been determined based upon the number of trucks that delivered material to the site and assuming that each truck was full to capacity and contained 25 CY of sand. As indicated at the start of this work, the Contractor's supplier for the sand did not have a scale at the source site to weigh trucks and verify the amount of sand placed into each truck. Therefore, the actual volumes of sand

delivered to the site cannot be verified beyond the estimates made based upon truck slips and maximum truck load capacity.

It is reasonable to assume that additional amounts of sand were delivered and placed at the site verses the calculated survey volume due to compaction; however we estimate this valve would be in the range of 10 to 15 percent. Laboratory testing could be performed to more accurately assess the effects of compaction on sand volume if so desired.

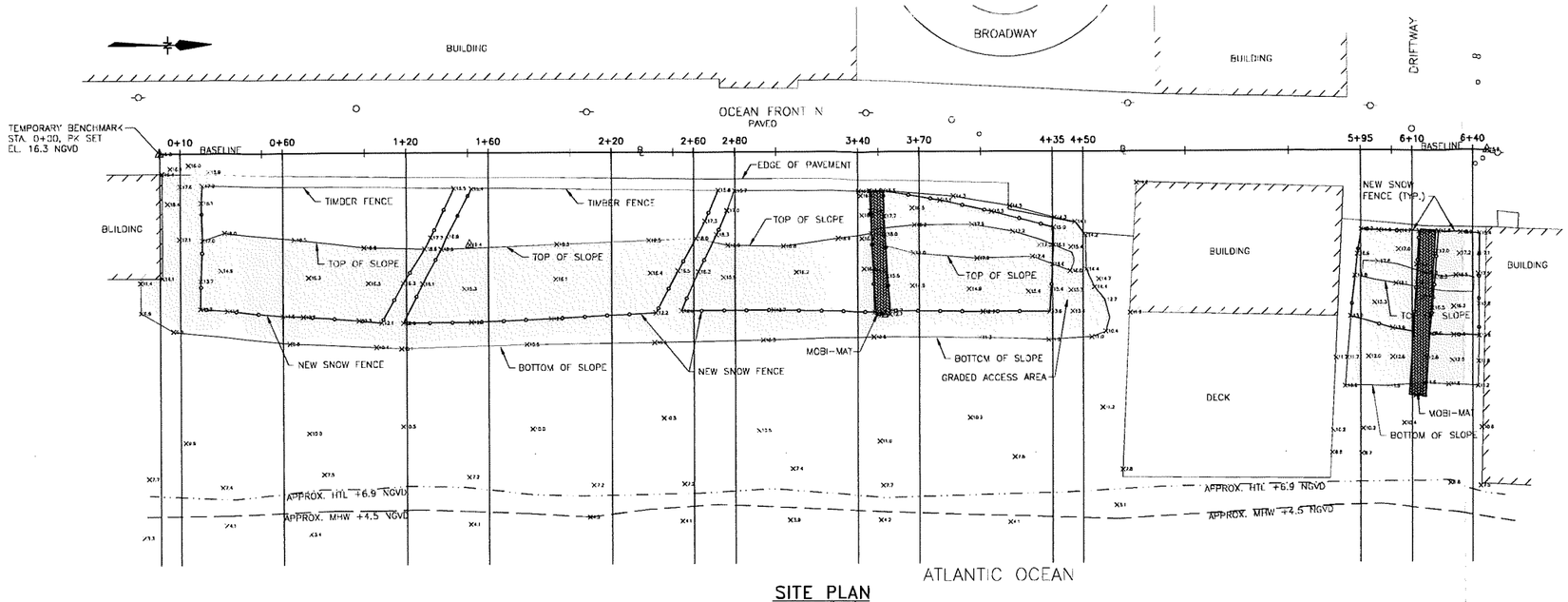
In addition to the volumes presented in the table above, VAI estimates that approximately 187 CY was placed at Access No. 10 (11 off-road trucks at 17 CY per truck) and 34 CY (2 trucks) that were incidentally dumped along the beach at random locations due to equipment problems.

VAI will be finalizing the as-built plan and sections and will submit these drawings under a separate cover. If you have any questions or require any additional information, please feel free to call me at (978) 465-1428 or Ms. Christine Player at (781) 749-2530 x202.

Very truly yours,
VINE ASSOCIATES, INC.

David A. Smith
Project Manager

Attachments



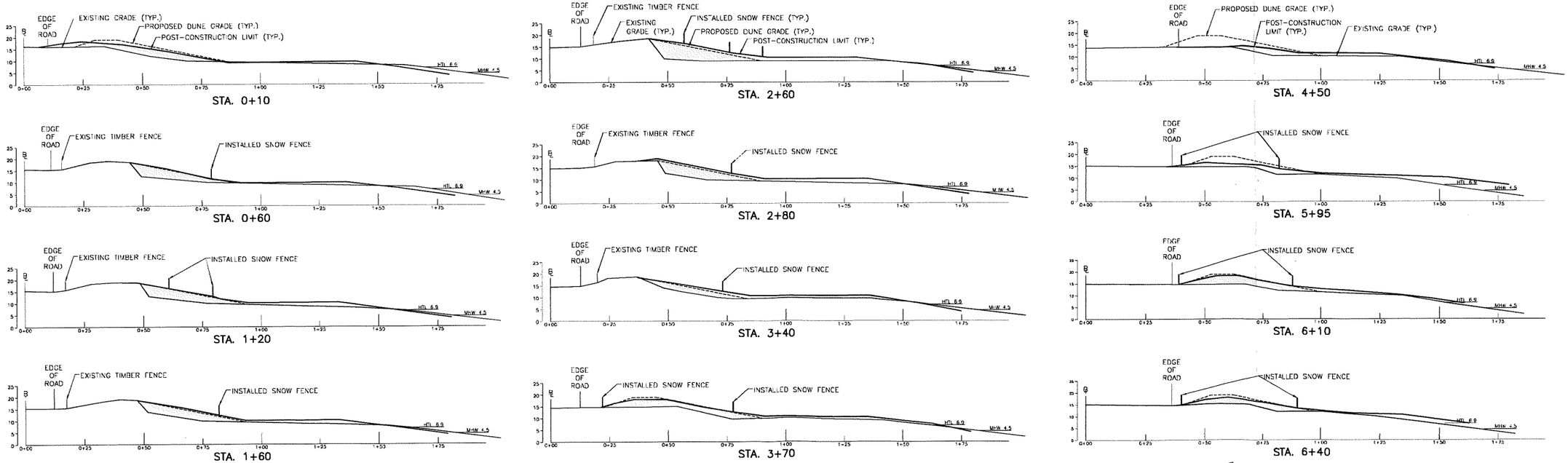
SITE PLAN
SCALE: 1"=30'

NOTES:

1. DATUM=0.0 NGVD, MLW=−3.5, MHW=+4.5, HTL=+6.9
2. AS−BUILT SURVEY PERFORMED BY VINE ASSOCIATES, INC. ON JUNE 11, 2007 AND REPRESENT CONDITIONS AT TIME OF SURVEY.
3. AS−BUILT PLAN AND SECTIONS REFERENCED TO: "EMERGENCY BEACH NOURISHMENT, SALISBURY BEACH CENTER, OCEAN FRONT" BY VINE ASSOCIATES, INC.
4. DUNE PLANTING SHOWN ON PROPOSED WORK PLAN TO OCCUR IN FALL OF 2007

LEGEND:

- LIMIT OF BEACH NOURISHMENT
- MOBI−MAT BEACH ACCESS
- X 1.1 − AS−BUILT GRADE SHOT (TYP.)



SECTIONS
SCALE: 1"=20'

AS-BUILT DRAWINGS
DATE ISSUED: 6/20/07
BY: VINE ASSOCIATES, INC.

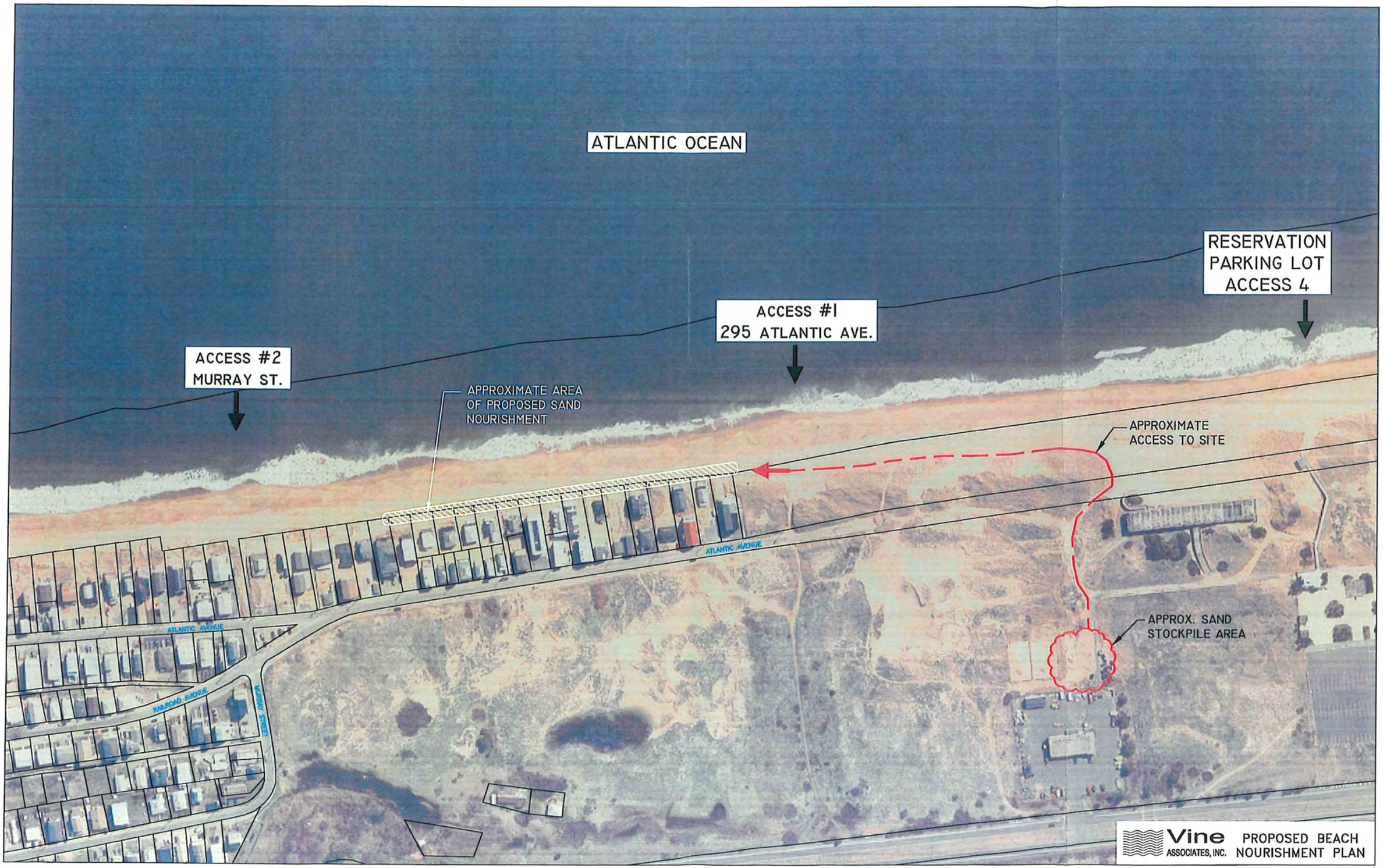
0 20 40
SCALE IN FEET

0 30 60
SCALE IN FEET

SALISBURY BEACH CENTER DUNE AS−BUILT PLANS AND SECTIONS

EMERGENCY BEACH NOURISHMENT
SALISBURY BEACH
SALISBURY, MASSACHUSETTS

Vine ASSOCIATES, INC.
372 MERRIMAC STREET, NEWBURYPORT, MA 01950, tel. (978)465−1428, fax (978)465−2640
190 OLD DERBY STREET, HINGHAM, MA 02043, tel. (781)749−2550, fax (781)749−3751
18 BEACH STREET, MONUMENT BEACH, MA. 02553, tel. (508)743−0366, fax (508)743−0391


ATLANTIC OCEAN
RESERVATION
PARKING LOT
ACCESS 4
ACCESS #1
295 ATLANTIC AVE.
ACCESS #2
MURRAY ST.
APPROXIMATE AREA
OF PROPOSED SAND
NOURISHMENT
APPROXIMATE
ACCESS TO SITE
APPROX. SAND
STOCKPILE AREA
ATLANTIC AVENUE
ATLANTIC AVENUE
RAILROAD AVENUE
MURRAY STREET
Vine
ASSOCIATES, INC.
PROPOSED BEACH
NOURISHMENT PLAN

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01950

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Fax
(978) 465-2640

May 21, 2007

Mr. Thomas Hughes, Interim Chairman
Ms. Michelle Rowden, Agent
Salisbury Conservation Commission
Town Hall
5 Beach Road
Salisbury, MA 01952

RE: Emergency Dune Stabilization and Public Access Improvements
Salisbury Beach and Salisbury Beach State Reservation
Salisbury, MA

Dear Mr. Hughes and Ms. Rowden:

On behalf of the Massachusetts Department of Conservation and Recreation (DCR), Vine Associates, Inc. (VAI) is submitting this narrative summary along with other supporting documentation to request an emergency certification for emergency dune stabilization and public access improvement work at the above-referenced location from the New Hampshire Border to the Salisbury Beach State Reservation. The severe spring nor'easter of April 15-18th eroded substantial portions of the dunes along the 3 mile length of beach. It is in the interest of DCR to perform immediate work efforts to restore sand and improve public access to the beach.

Public access has been restricted at several locations along the beach as a result of the storm. The severe erosion at access locations 8, 9 and 10 has made them unusable due to the abrupt 6 to 10 foot vertical drop in the dune. DCR is proposing to install stairs at these locations. In addition, DCR is proposing to install sand to stabilize and protect approximately 12 homes along Atlantic Avenue, install sand at select accessways to restore the grade of the paths and the dune and perform general fencing and debris cleanup work to restore the beach area.

The supporting documents attached to this summary narrative include the following;

1. WPA Emergency Certification Form.
2. Salisbury Beach Public Access Condition Assessment Report – by VAI, dated May 10, 2007.
3. Figure 1 – Aerial image site plan showing the entire Salisbury Beach site with designated public access locations shown.
4. Contract No. 1 Documentation (including description, specifications and drawings)

5. Contract No. 2 Documentation (including description, specifications and drawings)
6. Contract No. 3 Documentation (Beach Nourishment Plan)

DCR is proposing to develop three coordinated tasks under multiple contracts for the emergency repair work. The first contract will involve general debris cleanup and installation of snow fencing along the entire Reservation, where needed. Contract two will provide for a Contractor to install timber stairs at three access locations, repairs to one existing stairway, and install sand and restore dune and accessways at three locations. The third contract will involve importing and replacing sand to the dune fronting approximately twelve homes most at risk along Atlantic Avenue. The following provides a summary of the proposed emergency repair efforts to be performed;

Contract No. 1: Debris/Snow Fence

1. Contractor will mobilize equipment and materials to perform the work. Staging of equipment and materials will be at the Salisbury Beach State Reservation. Contractor access will be at the Reservation along the length of the beach by use of small dump body truck.
2. Contractor to remove general debris including old deteriorated/damaged fencing, abandoned wooden and steel fence posts and any other debris not previous removed by DCR staff.
3. Contractor to install new snow fencing in accordance with DCR's standard fencing installation procedures.

Contract No. 2: Access Ways/Boardwalks

1. Contractor will mobilize equipment and materials to perform the work. Staging of equipment and materials will be at each individual access way. Contractor access will be by use of small dump body truck and a small bobcat/backhoe.
2. Contractor to remove portions of the damaged existing timber walkways.
3. Contractor to install helical anchor foundations and construct timber access platform and stairs at three access locations (Access No's 8, 9 and 10).
4. Contractor to reconstruct the lower portion of the existing timber stairs at Reservation Parking Lot No. 2 access location.
5. Contractor to import and grade sand along the dune face and pathways at three access locations. (Access No's 2, 4 and 7). The sand to be provided will be compatible in grain size and color with existing beach sand.
6. Dune grass plantings (when seasonal conditions allow)

Contract No. 3: Dune Renourishment

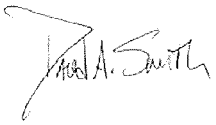
1. Contractor will mobilize equipment and materials to perform the work. Staging of equipment and materials will be as close to the impacted areas as possible. Contractor access will be at the existing access points along the length of the

beach by use of front end loaders and other heavy equipment.
2. Contractor will transport sand along the beach to the impacted area along Atlantic Avenue.
3. The sand to be provided will be compatible in grain size and color with existing beach sand.
4. Dune grass plantings (when seasonal conditions allow)

It is imperative that the above emergency dune stabilization and public access improvement work occur immediately to prevent any further damage to the homes along Atlantic Avenue, prevent further erosion of the dune, maintain public access locations to avoid non-access dune impacts and to provide fencing to aid in reestablishing the dune. It is expected that crews can begin work the week of May 21st pending local Conservation Commission and DEP approval.

Should you have any questions or comments regarding this request for Emergency Certification, or if you require any additional information or want to schedule a site visit, please contact our office at (978) 465-1428, or my cell phone at (978) 835-5532.

Sincerely,
VINE ASSOCIATES, INC.



David A. Smith
Project Manager

CC: DEP Northeast Region (1 copy)
Raul Silva/DCR
Ruth Teixeira/DCR
Joe Halloran/DCR
Mike Magnifico/DCR

Attachments

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Emergency Certification Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

A. Emergency Information

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

Issuance From: Salisbury Conservation Commission
Issuing Authority

1. Site Location: Salisbury Beach State Reservation

2 Reason for Emergency:

Public safety in and around public accessways as well as safety of infrastructure of areas in and around the shoreline.

3. Applicant to perform work: Department of Conservation and Recreation (DCR)

4. Public agency to perform work or public agency ordering the work to be performed:

DCR

5. Date of Site Visit: 5/22/2007 Start Date: 5/23/2007 End Date*: 6/24/2007

* no later than 30 days from start date or 60 days in the case of an Immediate Response Action approved by DEP to address an oil/hazardous material release.

6. Work to be allowed*:

1. Removal of debris leftover from the recent storms and installation of snow fencing along the entire reservation.

2. Installation of stairs at three public access locations, repair one existing stairway, and bring in sand to restore the dune and accessways at three locations.

3. Dune restoration in front of approximately twelve homes on the south end of Atlantic Ave.

* May not include work beyond that necessary to abate the emergency.

B. Signatures

Certified to be an Emergency by this Issuing Authority.

Signatures:

Chairman (or designee)	Date: 5/22/07

A copy of this form must be provided to the appropriate DEP Regional Office.

E. Appeals

The Department may, on its own motion or at the request of any person, review: an emergency certification issued by a conservation commission and any work permitted thereunder; a denial by a conservation commission of a request for emergency certification; or the failure by a conservation commission to act within 24 hours of a request for emergency certification. Such review shall not operate to stay the work permitted by the emergency certification unless the Department specifically so orders. The Department's review shall be conducted within seven days of: issuance by a conservation commission of the emergency certification; denial by a conservation commission of the emergency certification; or failure by a conservation commission to act within 24 hours of a request for emergency certification. If certification was improperly granted, or the work allowed thereunder is excessive or not required to protect the health and safety of citizens of the Commonwealth, the Department may revoke the emergency certification, condition the work permitted thereunder, or take such other action as it deems appropriate.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Emergency Certification Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

C. General Conditions

1. Failure to comply with all conditions stated herein, and with all related statutes and other regulatory measures, shall be deemed cause to revoke or modify this Emergency Certification or subject to enforcement action.

2. This Emergency Certification does not grant any property rights or any exclusive privileges; it does not authorize any injury to private property or invasion of property rights.

3. This Emergency Certification does not relieve the applicant or any other person of the necessity of complying with all other applicable federal, state, or local statutes, ordinances, bylaws, or regulations.

4. Any work conducted beyond that described above, and any work conducted beyond that necessary to abate the emergency, shall require the filing of a Notice of Intent.

5. The Agent or members of the Conservation Commission and the Department of Environmental Protection shall have the right to enter and inspect the area subject to this Emergency Certification at reasonable hours to evaluate compliance with this Certification, and may require the submittal of any data deemed necessary by the Conservation Commission or the Department for that evaluation.

6. This Emergency Certification shall apply to any contractor or any other person performing work authorized under this Certification.

7. No work may be authorized beyond 30 days from the date of this certification without extension by the Issuing Authority.

D. Special Conditions

1. Sand brought in shall be of comparable grain size, the source of which shall be approved by the conservation agent.
2. Removal or movement of sand from the coastal beach and/or vegetated dunes is strictly prohibited.
3. No additional work is to be performed. The extent of the work allowed under this certification is for that which is necessary to prevent imminent harm to the public.
4. All operators of heavy equipment must be made aware that no disturbance of the vegetated dunes shall occur.
5. For the entire length of the Salisbury Beach Reservation, dunes that have a greater slope than 4:1 or where the volume of sand present in the dune is less than that which would be eroded away in an ocean storm event shall be renourished in order to achieve at least a 4:1 slope or reach the volume needed to withstand an ocean storm event.
6. All areas of dune nourishment approved under this certification shall be planted with native beach vegetation at the appropriate time to ensure the survival of the plants.
7. In the area of the beach from Oceanfront South up to Drift Way, sand shall be brought in to replenish and reestablish the dunes.
8. The conservation commission reserves the right to add, delete, or to modify any and all conditions on this emergency certification until the expiration date.

9. Within six months of this certification, DCR shall submit a Notice of Intent that includes a Beach Management Plan to address short and long term protection and improvement of the barrier beach system.

Waterfront
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June 7, 2007

Mr. Raul Silva, Deputy Chief Engineer
Department of Conservation and Recreation (DCR)
251 Causeway Street Suite 700
Boston, MA 02114

RE: ***Salisbury Beach Emergency Dune Nourishment***
Salisbury Beach State Reservation
Atlantic Avenue – Access Way #1 to Access Way #2

Dear Mr. Silva:

Vine Associates, Inc. (VAI) is pleased to provide you with this letter report summarizing emergency dune nourishment efforts pertaining to the above referenced site. Enclosed please find the following documentation:

- Pre- & Post-Storm Condition Assessment (Sheets 1 through 3)
- Post-Storm Photographs (Photographs 1 through 11)
- Dune Nourishment Work Plan

The emergency dune nourishment to be implemented will provide protection to approximately 16 houses located between Access Way #1 and Access Way # 2 along Atlantic Avenue. The primary dune located in front of these homes was significantly eroded as a result of the April 15, 2007 storm event. The loss of dune can be seen when comparing the pre-storm (2005) aerial imagery as illustrated on Sheets 1 through 3 attached with the post-storm photographs that were taken on May 21, 2007 (see attached Photographs 1 through 11). Based upon approximate measurements made using the pre-storm aerial images, it is estimated that up to 45 feet of dune was lost in areas along this section of the beach.

The proposed dune nourishment plan for this location has been developed considering the average existing dune height within this area and an approximated 5-year storm event. In 2000, VAI engineered the sacrificial dune, which now exists at the Beach Center. VAI has used the 2000 Beach Center Dune Project as a basis for developing the emergency dune work plan at the Atlantic Avenue site. As part of the 2000 project, information obtained by the U.S. Army Corps of Engineers indicated that a 5-year storm event was at approximate EL. ±16.0 NGVD. The proposed geometry for nourishment at this site has been configured to allow for a dune to be constructed as close to existing homes and decks as possible, assuming that the landward slope would fill in over time by the natural migration of sand. It is anticipated that the filling in of the back slope area and underneath existing

houses and decks will occur predominantly by wind action and by sand blowing and drifting from the top of the dune. As such, VAI has recommended that the top of dune be constructed slightly higher than the 5-year storm event (El. ±19.0 NGVD) assuming that the initial height will be reduced due to material migrating along the backside of the dune. Snow fence will also be placed along both the landward and seaward slopes to further stabilize and enhance natural dune growth. Approximately 15,000 to 20,000 cubic yards of sand is anticipated for dune construction.

Construction of the dune was completed this week, and VAI is moving forward with conducting the as-built survey in order to determine final quantities for payment. VAI will forward this information to you once it is available. Should you have any questions or require any additional information, please feel free to call me at (781) 749-2530 x202 or David Smith at (978) 465-1428.

Sincerely,
VINE ASSOCIATES, INC.

Christine M. Player

Christine M. Player
Principal

Attachments (3)

Cc: FEMA (4 copies)

VAI - EVENTS TIMELINE – SALISBURY BEACH EMERGENCY WORK

APRIL 16-19TH	STORM EVENT
APRIL 30	REVISED SCOPE SENT
MAY 1	FIRST DAY - GPS SURVEY
MAY 7	DRAFT REPORT SUBMITTED
MAY 8	MEETING AT DEP
MAY 9	LAST DAY – GPS SURVEY
MAY 21	SUBMITTED EMERGENCY REQUEST
MAY 22	DCR-DEP-CONCOM MEETING
MAY 23	DUNE SURVEY – START OF SAND DELIVERIES

SALISBURY BEACH DUNE RECONSTRUCTION

PHOTOGRAPH 1: WEDNESDAY, JUNE 6,2007. SAND PILES AT THE SOUTHERN END OF THE ATLANTIC AVE. SITE.

PHOTOGRAPH 2: NEW SAND ADDED TO NORTHERN END OF DUNE UP TO PUBLIC ACCESS #2.

PHOTOGRAPH 3: NEW SAND AT PUBLIC ACCESS #2.

PHOTOGRAPH 4: NEW SAND BEING DELIVERED AT PUBLIC ACCESS #4.

PHOTOGRAPH 5: STOCKPILE AND LOADING AREA AT PUBLIC ACCESS #4.

PHOTOGRAPH 6: TRANSPORTING THE NEW SAND TO THE SALISBURY BEACH CENTER DUNE.

PHOTOGRAPH 7: THURSDAY, JUNE 7, 2007. THE COMPLETED DUNE AT THE ATLANTIC AVE. SITE LOOKING NORTH.

PHOTOGRAPH 8: THE NORTHERN END OF THE COMPLETED DUNE WITH ADDED SAND UP TO PUBLIC ACCESS #2.

PHOTOGRAPH 9: THE SOUTHERN END OF THE COMPLETED DUNE AT THE ATLANTIC AVE. SITE LOOKING SOUTH.

PHOTOGRAPH 10: SOUTHERN END AND TRANSITION NEEDS TO BE FINISH GRADED.

PHOTOGRAPH 11: NEW SAND IN FRONT OF EXISTING SACRIFICIAL DUNE BEGINNING TO TAKE SHAPE.

PHOTOGRAPH 12: SAND IS FORMED INTO THE PROPOSED DUNE AT THE END OF BROADWAY ST.

PHOTOGRAPH 13: SAND BEING FORMED INTO THE PROPOSED DUNE IN BETWEEN BUILDINGS.

PHOTOGRAPH 14: PROPOSED DUNE TAKING SHAPE AT THE END OF BROADWAY ST.

PHOTOGRAPH 15: THE PROPOSED DUNE TAKING SHAPE BETWEEN THE BUILDINGS.

PHOTOGRAPH 16: THE COMPLETED DUNE AT THE END OF BROADWAY ST. WITH SNOW FENCE AND MOBI-MAT.

PHOTOGRAPH 17: THE SOUTHERN END OF THE COMPLETED DUNE OCEANSIDE OF THE EXISTING SACRAFICIAL DUNE.

PHOTOGRAPH 18: THE COMPLETED DUNE OCEANSIDE OF THE EXISTING SACRAFICIAL DUNE WITH SNOW FENCE.

PHOTOGRAPH 19: MOBI-MAT ACCESS TO BEACH ACROSS THE NEW DUNE AT THE END OF BROADWAY ST.

PHOTOGRAPH 20: THE COMPLETED DUNE AT THE END OF BROADWAY ST. WITH SNOW FENCE AND MOBI-MAT.

PHOTOGRAPH 21: THE GRADED AREA ALLOWING BEACH ACCESS THROUGH NEW DUNE AT THE END OF BROADWAY ST.

PHOTOGRAPH 22: THE COMPLETED DUNE BETWEEN BUILDINGS WITH ACCESS TO THE BUILDING.

PHOTOGRAPH 23: THE COMPLETED DUNE BETWEEN THE BUILDINGS WITH SNOW FENCE AND MOBI-MAT.

PHOTOGRAPH 24: THE COMPLETED DUNE BETWEEN THE BUILDINGS WITH SNOW FENCE AND MOBI-MAT.

SALISBURY BEACH DUNE RECONSTRUCTION

PHOTOGRAPH 1: DAY 4, STOCKPILING OF NEW SAND BEHIND DCR BUILDING.

PHOTOGRAPH 2: NORTHERN END OF THE ATLANTIC AVE. SITE..

PHOTOGRAPH 3: BEGINNING TO FORM THE PROPOSED DUNE.

PHOTOGRAPH 4: SHAPING OF PROPOSED DUNE.

PHOTOGRAPH 5: PROPOSED DUNE BEGINNING TO TAKE SHAPE AT THE BEGINNING OF DAY 5.

PHOTOGRAPH 6: SHAPING THE TRANSITION INTO THE EXISTING DUNE.

PHOTOGRAPH 7: THE ATLANTIC AVE. SITE LOOKING NORTH.

PHOTOGRAPH 8: BULLDOZER SHAPING THE NEW DUNE AT THE ATLANTIC AVE. SITE LOOKING SOUTH.

PHOTOGRAPH 9: THE PROPOSED DUNE WITH THE TOP PLATFORM AT APPROXIMATELY ELEVATION +19.

PHOTOGRAPH 10: SAND CONTINUES TO MOVED TO THE SOUTHERN END OF THE ATLANTIC AVE. SITE..

PHOTOGRAPH 11: NEW SAND HAS BEEN GRADED TO MAKE ROOM FOR MORE.

PHOTOGRAPH 12: THE NORTHERN END OF THE PROPOSED DUNE IS COMPLETED AS OF JUNE 5, 2007, DAY 8.

PHOTOGRAPH 13: A VIEW OF THE COMPLETED HALF OF THE PROPOSED DUNE LOOKING SOUTH.

PHOTOGRAPH 14: A VIEW FROM ATOP THE COMPLETED HALF OF THE PROPOSED DUNE LOOKING SOUTH.

PHOTOGRAPH 15: A VIEW OF THE NORTHERN END. THE COMPLETED TRANSITION WITH THE EXISINTG DUNE.

PHOTOGRAPH 16: LOOKING SOUTH AT THE PILES TO BE FORMED INTO THE PROPOSED DUNE.

APRIL 2007 POST-STORM PHOTOGRAPHS
ATLANTIC AVENUE – ACCESS WAY #1 TO ACCESS WAY #2

PHOTOGRAPH 1 (5/21/07)

PHOTOGRAPH 2 (5/21/07)

PHOTOGRAPH 3 (5/21/07)

PHOTOGRAPH 4 (5/21/07)

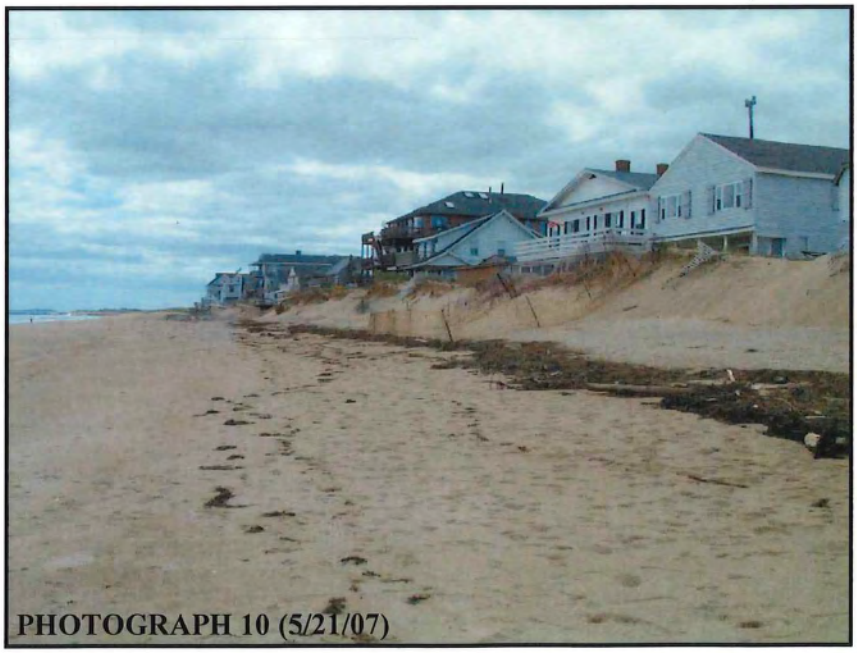
PHOTOGRAPH 5 (5/21/07)

PHOTOGRAPH 6 (5/21/07)

PHOTOGRAPH 7 (5/21/07)

PHOTOGRAPH 8 (5/21/07)

PHOTOGRAPH 9 (5/21/07)



PHOTOGRAPH 10 (5/21/07)

PHOTOGRAPH 11 (5/21/07)

Attachment A - Mitigating Measures
Dunes Restoration

The purpose of the project is to allow the Town of Salisbury to restore the dune along Salisbury Beach from Ocean Street to approximately 250 feet south of Fowler Street. (approximately 1000 feet). This is required due to severe storms which occurred along the coast during December 10-11, 1992 and resulted in the loss of significant amounts of the back shore dune along Salisbury Beach. (Refer to attached correspondence form Army Corp. of Engineers)

The dune will be constructed to elevation 16 NGVD at the top crest, the calculated elevation of waves for a "five year storm". The top width of the dune will be a minimum of 10 feet wide, with a wider top width toward the southerly end of the dune. The ocean side of the dune will be graded at a slope of 5 to 1 to match into the existing grade. The estimated amount of fill for this project will be approximately 10,000 C.Y. of sand and will take approximately 4 weeks to complete.

Soil samples of the existing beach sand have been analyzed in order to provide a basis for providing sand with a similar grain size from off-site sources. The off-site source of sand will also be tested prior to construction to confirm the suitability of the sand material to conform to the proposed specifications.

As shown on the site plans, sand that is delivered to the site will be stockpiled and distributed from an area adjacent to the beach across from the eastern end of Vermont Street. From this point the sand will be distributed across the proposed dune location with a front end loader and medium size bulldozer to form the required slopes and elevations.

The site plans, as presented, indicate pedestrian access ways to protect the dune from deterioration by pedestrian foot traffic. These wooden walkways are proposed for temporary use during seasonal use of the beach and will be stored during the winter months when foot traffic is minimal along the beach. Snow fencing is also proposed along the dune and access walks in order to limit pedestrian access and provide dune stabilization. The fencing would consist of a double row of fence 10 feet apart with a perpendicular section installed every 100 feet between the two rows. The final phase of dune stabilization would involve the plantings of dune grass. This scheme would require plantings every eighteen inches in staggered rows eighteen inches apart. Refer to the accompanying Schedule of Planting and Fertilizing.

It should be noted that the funding for this project from the Federal and State agencies does not include monies for the walkways, fencing or planting. These items are included in the Notice of Intent application in order for contractors to bid these items as alternatives. If the bids received are able to include these items within the available budget then some or all of the alternative items would be constructed.

CENED-ED-DE

5 May 1993
Meader/jdd/7228

MEMORANDUM FOR Director of Operations, ATTN: Mr. Steve Andon

SUBJECT: Emergency Remedial Action Subsequent to the Storm of 10-11 Dec 92 for the Town of Salisbury

1. Purpose: This report is being prepared for the Federal Emergency Management Agency's (FEMA) local disaster field office for negotiations with the town of Salisbury.

2. Background: The severe weather along the Massachusetts coast during the Nor'easter of 10-11 December 1992 resulted in loss of much of the backshore dune along the shoreline of Salisbury Beach. A team of coastal engineers from the New England Division (NED) and the Coastal Engineering Research Center (CERC) was requested, by FEMA, to evaluate the vulnerability of the community to additional damages from coastal storms. The report by this team confirmed potential vulnerability of shore front structures to damages associated with a five year coastal flood event. Since the backshore dune offered protection from wave induced damages to residential properties, FEMA has indicated an interest in a reconnaissance level report to assist with the decision concerning dune replacement actions.

3. Assumptions: Assumptions made for this report are as follows:

a. Dune crest elevation will be 16.0 feet NGVD.

b. Dune crest width will be 10 feet.

c. Dune seaward slope will be 1 vertical to 5 horizontal.

d. Dune is continuous along entire ±1,100 feet of beach.

e. Material is available for delivery to the beach.

f. Constructibility is not a problem using a dozer, loader and two laborers.

4. Cost Estimate: In order to estimate the cost of constructing a "sacrificial dune," site surveys were made and dune/beach cross-sections drawn. The proposed dune was drawn on these sections and volumes calculated from this information. Commercial suppliers of materials were contacted for availability and pricing, and the quoted prices have been relied upon for the following estimate.

CENED-ED-DE 5 May 1993
SUBJECT: Emergency Remedial Action Subsequent to the Storm of 10-11 Dec 92 for the Town of Salisbury

Table 1

Sacrificial Dune Construction Cost

	Quantity (CY)	Unit Cost	Total
Delivered Sand	7,000	$7.50	$ 52,500
Shaping	7,000	2.00	14,000
Construction Management			10,500
	Estimated Total *		$ 77,000

* Engineering and Design costs are not included in estimated total (see para. 5).

5. Engineering and Design Process: If it is determined to proceed with construction, detailed design will be required based on additional surveys and established controls. Office calculations with the survey information to refine volumes and possibly dune width, crest elevation and beach slope will be necessary. Grain size testing of existing dune and proposed beach material should be performed to ensure proper gradation. Environmental and legal concerns must be addressed (i.e. permits, construction access, etc.).

6. Reference Materials: A base map with the locations of the surveyed cross-sections, seven cross-sections and quantity calculations are attached.

atch

RICHARD D. REARDON
Director of Engineering

CF (w/o atch):
Mr. Meader, 112N
Engr Dir Files, 112S

Memorandum

To: Ken Pinkham, PO, FEMA
Dick Henderson, PO, FEMA

CC: Michael Cullivan, PO, FEMA

From: Caroline Hoffman, TAC, FEMA

Date: August 8, 2007

Re: 1701 MA, Salisbury, MA, 5-year Storm Emergency Dune Design

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1.0 Introduction

An emergency dune nourishment project has taken place for a portion of Salisbury beach to protect approximately 16 homes located between Access Way #1 and Access Way # 2 along Atlantic Avenue.

According to the Stafford Act emergency work is limited to the essential measures required to protect against a similar event expected to occur not less frequently than every five years, or to restore the protection that existed immediately prior to the event, whichever is lesser. The 5-year storm design of an emergency berm that FEMA has utilized for over 20 years is six cubic yards per linear foot above 5-year storm stillwater elevation. This approximation is based on an empirical formula based on pre- and post-storm beach profiles developed by Hallermeir and Rhodes (1988) that estimates the mean erosion of a dune over a five year period.

There is concern that the emergency dune was designed and built for an event greater than the 5-year storm. This report provides information on the 5-year storm design and previous emergency dune designs for the Salisbury beach.

2.0 Salisbury Emergency Dune Design

2.1 USACE 1993 Design

The dunes along Salisbury Beach from Ocean Street to approximately 250 feet south of Fowler Street were significantly damaged due to the December 1992 storm. The U.S. Army Corps of Engineers (USACE) calculated the five year storm elevation to be 16 feet NGVD which included wave run-up. In May 1993, the dunes were reconstructed to elevation 16 feet NGVD, top width of 10 feet, and slope of 5 to 1 on the ocean side. (Ref. 8)

2.2 Vine Associates 2000 Design

In 2000, Vine Associates, Inc. (VAI) engineered the sacrificial dune, which now exists at the Beach Center. VAI has used the 2000 Beach Center Dune Project as a basis for developing the emergency dune work plan at the Atlantic Avenue site. As part of the 2000, project, information obtained by the USACE indicated that the 5-year storm elevation including wave run-up is 16 feet NGVD. VAI recommended that the top of the dune be constructed slightly higher than the 5-year storm at 19 feet NGVD assuming that the initial height will be reduced due to material migrating along the backside of the dune. (Ref. 7)

3.0 5-Year Storm Stillwater Elevation

3.1 FEMA Flood Insurance Study

In 1984, FEMA developed a Flood Insurance Study (FIS) for the town of Salisbury to investigate the existence and severity of flood hazards. Analyses of Atlantic Ocean flood levels were coordinated with the U.S. Army Corps of Engineers (USACE) and the National Oceanic and Atmospheric Administration (NOAA). The Massachusetts Department of Public Works (DPW) provided information on historic flooding and high-water marks. Vertical control data used to establish the network of elevation reference marks were provided by the Massachusetts DPW, U.S. Geological Survey (USGS), NOAA, and the U.S. Coast & Geodetic Survey (USCGS). On November 19, 1984 the results of the FIS were reviewed at a final meeting attended by representatives of FEMA, the town. and study coordinator. (Ref. 3)

In the study, tidal flood including wave action from the Atlantic Ocean was studied in detail methods. A total of 165 storms from 1942 to 1978 were considered in the analysis of flood levels. Table 3-1 below shows the storm tide elevation along the Salisbury Atlantic Ocean shoreline for various return periods that was provided in the FIS. The storm tide elevation includes the tidal and wind set-up effects. The Gumbel distribution method was used to extrapolate the elevations to a 5-year storm event. Figure 3-1 below shows the distribution curve where the 5-year storm tidal elevation is 8.0 feet National Geodetic Vertical Datum of 1929 NGVD.

Table 3-1: FEMA FIS Storm Water Elevations

Elevation (ft, NGVD 29)			
10-Year	50-Year	100-Year	500-Year
8.2	8.9	9.1	9.8

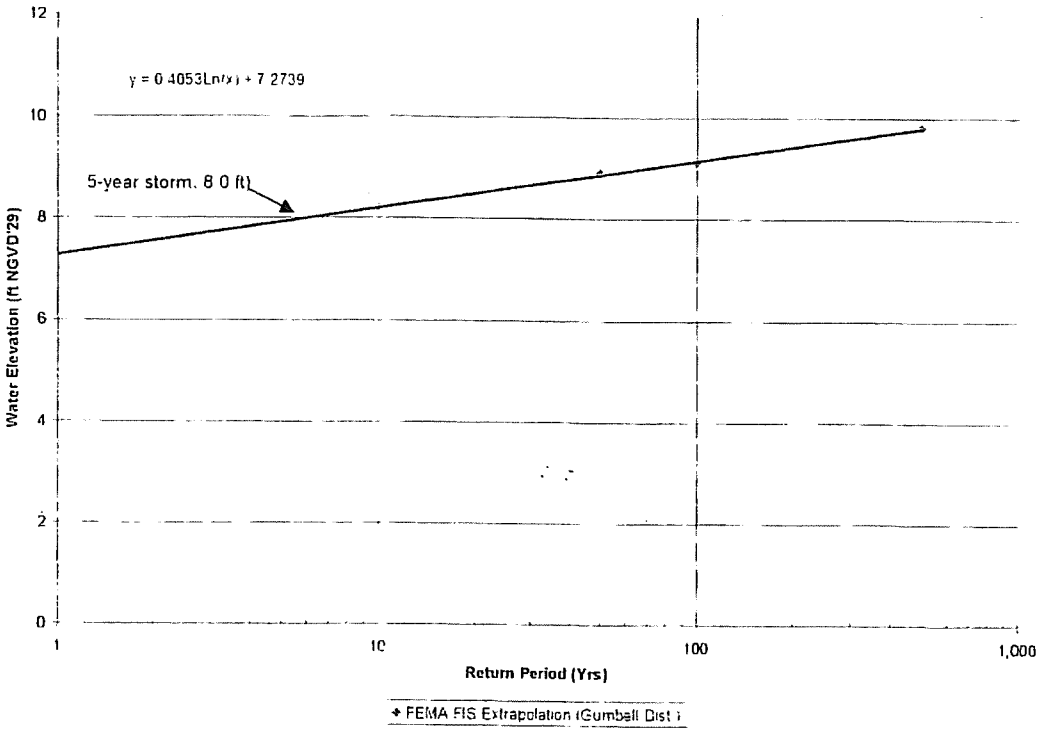


Figure 3-1: FEMA FIS Storm Elevation Extrapolation Curve

3.2 *USACE New England Flood Profiles*

The Hydraulics and Water Quality Section for the New England Division of the USACE developed tidal flood profiles of the New England coastline in September 1988. Table 3-2 below shows the associated storm elevations.

The Gumbel distribution method was used to extrapolate the elevations to a 5-year storm event. Figure 3-2 below shows the distribution curve where the 5-year storm tidal elevation is 8.2 feet NGVD.

Table 3-2: USACE Storm Elevations

Elevation (ft, NGVD 29)		
10-Year	50-Year	100-Year
8.5	9.25	9.5

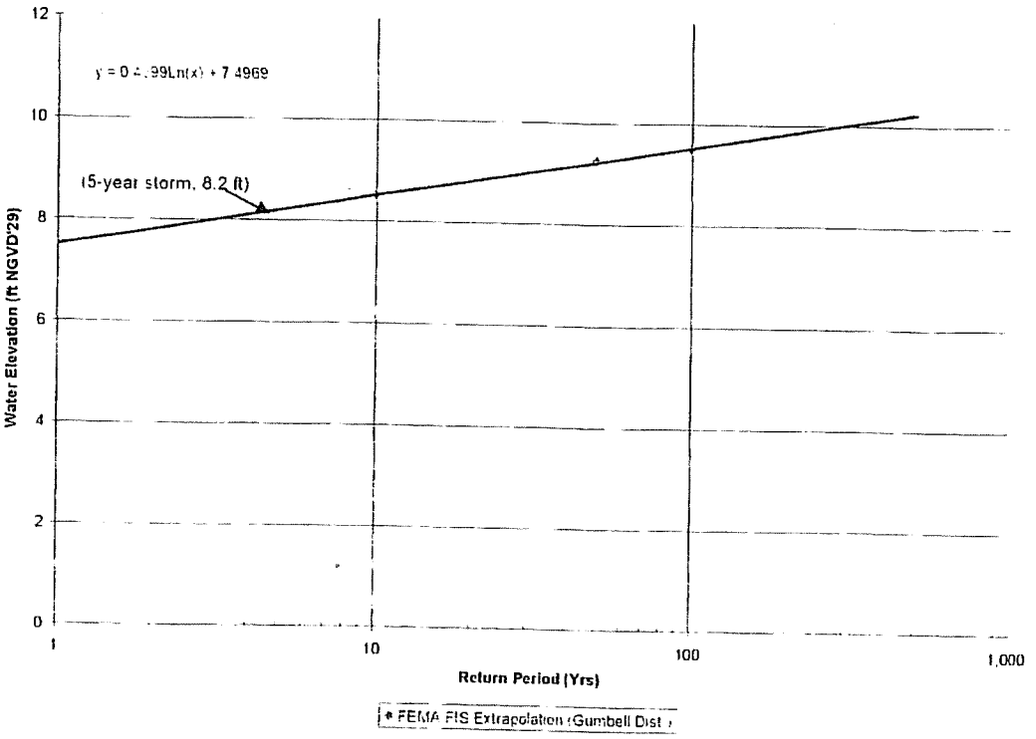


Figure 3-2: USACE Storm Elevation Extrapolation Curve

4.0 Wave Run-up Elevation

Wave run-up is the maximum elevation of wave uprush above the stillwater level. The wave uprush consists of two components super elevation of the mean water level due to wave action and fluctuations about that mean. Figure 4-1 below provides an illustration of a typical wave run-up.

The emergency dune design elevation developed by VAI includes the wave run-up during a 5-year storm event. According to the USACE the 5-year storm stillwater elevation is 8.2 feet and the 5-year storm design elevation is 16 feet. The difference of 7.8 feet is considered to be wave run-up. According to VAI the USACE used the Automated Coastal Engineering System (ACES) model to estimate the wave run-up. The ACES model uses the Ahrens and Titus equation to calculate run-up on a smooth slope. The USACE ACES input is not available therefore wave height data and slope information was obtained to ensure a wave run-up of 7.8 feet is appropriate for the Salisbury beach.

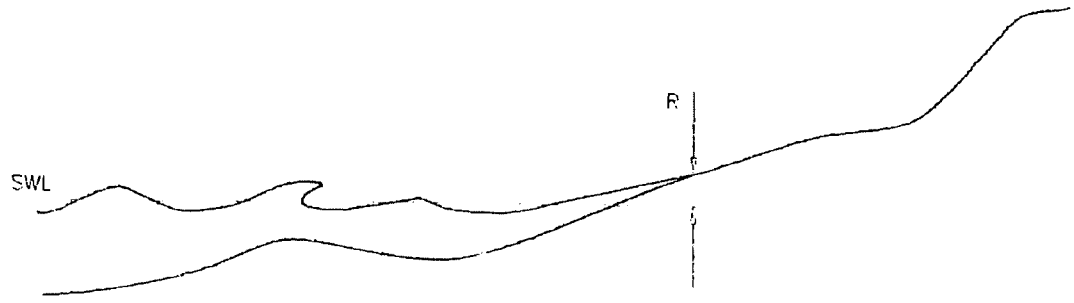


Figure 4-1: Definition Sketch for Wave Runup

The Coastal and Hydraulics Lab Wave Information Studies (WIS) have stations along the U.S. coastlines that contain hourly wave height data. The station closest to Salisbury, MA is Station 45 located at 42.83 N and -70.58W shown below on Figure 4-2 and 4-3. The offshore 5-year storm significant wave height of 16.4 feet was based on 20 years of hourly data. (Ref. 10)

According to Goda (2000) the associated wave period was approximated as 4.5 times the square root of the significant wave height, 10 seconds. (Ref. 4)

Based on documents provided by VAI the approximate beach slope is 5 degrees.

Using ACES the average wave run-up is 8.5 feet for an offshore significant wave height of 5 meters, 10 seconds period, and 5 degree beach slope. This wave run-up is similar to the 7.8 feet assumed by the USACE. It should be noted that the beach slope was

approximated and the wave run-up elevation is sensitive to the beach slope where the wave run-up elevation will decrease as the slope decreases.

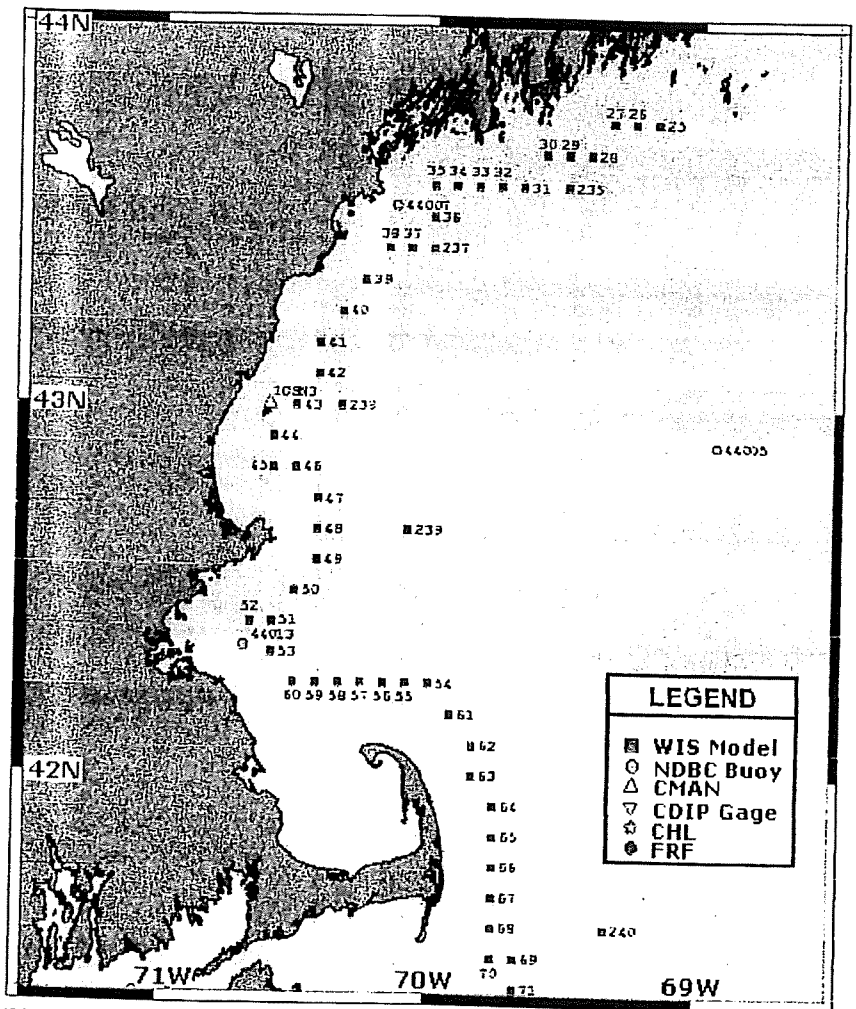


Figure 4-2: Coastal and Hydraulics Lab Wave Stations

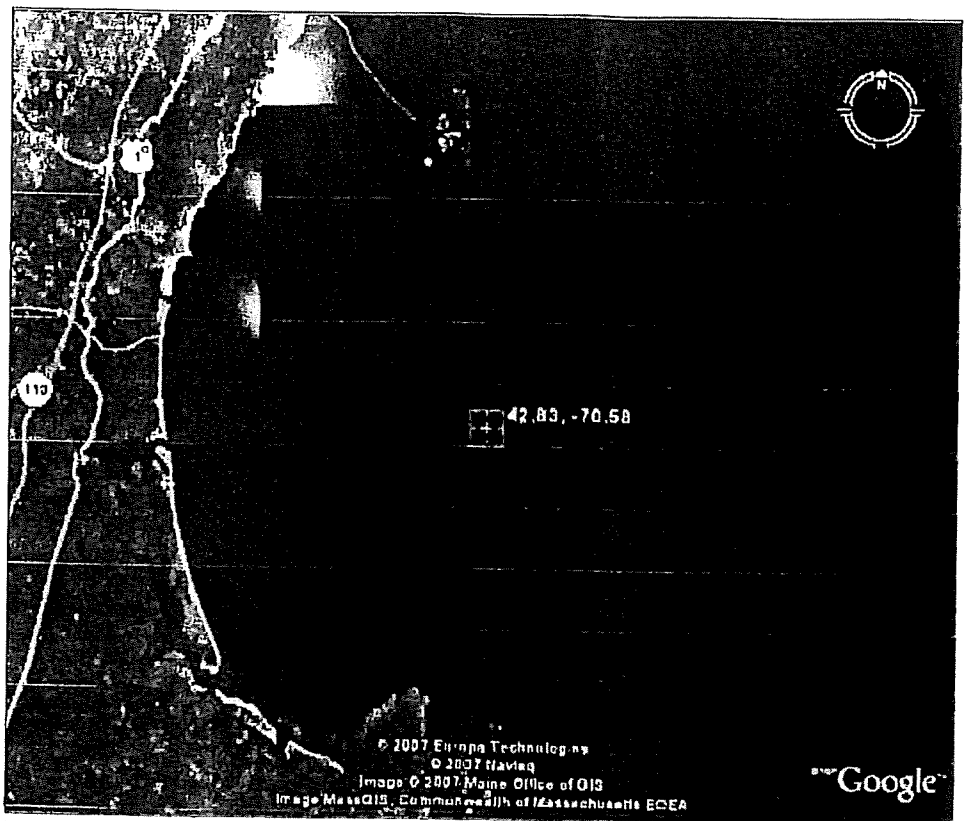


Figure 4-3: Atlantic WIS Station 45 Location

5.0 FEMA 5-year Storm Dune Design

For beaches. emergency work is typically the construction of a sand dune to protect against additional infrastructure damage from a five-year storm. The sand dune is not intended to be permanent. Instead, the purpose of the emergency dune is to only provide protection from immediate threats and to allow for the repair, reinforcement, and/or relocation of improved property.

According to Perry Rhodes, the 5-year storm design of an emergency dune that FEMA has utilized for over 20 years is six cubic yards per linear foot above the 5-year storm stillwater elevation. (Ref. 9) This approximation is based on an empirical formula based on pre- and post-storm beach profiles developed by Hallermeir and Rhodes (1988) that estimates the mean erosion of a dune over a five year period.

The maximum area for the emergency berm should have a unit volume of six cubic yards per linear foot above the five-year storm stillwater elevation. However if there is existing sand above the 5-year storm stillwater elevation then only additional sand should be placed such that there is a maximum of six cubic yards per linear foot above the 5-year storm elevation between the stillwater intercept and the protected property.

Table 5-1 below provides the volume of existing sand above the approximate 5-year storm stillwater elevation of 8 feet between the stillwater intercept and the landward toe of the dune based on the as-built drawings provided by VAI. (Ref. 1) Table 5-2 below provides the volume of sand eligible for FEMA reimbursement based on the above criteria. The total volume of sand eligible for FEMA reimbursement based on the FEMA emergency dune design is 4,791 cubic yards.

Table 5-1: Existing Sand Above 5-year Storm Stillwater Elevation

Station	Height of Existing Grade above 5-year storm Elevation[1]	Width of Existing Grade above 5-year storm Elevation[2]	Area of Existing Sand Above 5-year Storm Elevation[3]	Existing Sand Above 5-year Storm Stillwater Elevation[4]
	ft	ft	ft²	yd³/ft
0+00	2.0	50	100	3.70
0+80	0.0	-	0	0.00
1+40	2.0	50	100	3.70
2+00	0.0	-	0	0.00
3+00	0.0	-	0	0.00
4+00	0.0	-	0	0.00
5+20	0.0	-	0	0.00
6+30	0.5	100	50	1.85
7+40	1.0	100	100	3.70
8+40	0.0	-	0	0.00
9+40	1.0	50	50	1.85
9+90	4.0	50	200	7.41
10+35	5.0	50	250	9.26
11+70	6.0	50	300	11.11
12+30	6.0	50	300	11.11

[1] Height of post-storm grade elevation above the 5-year storm stillwater elevation of 8.0 feet based on figures provided by Vine Associates.

[2] Width of post-storm grade elevation that is above the 5-year storm stillwater elevation of 8.0 feet based on figures provided by Vine Associates.

[3] Area of sand above the 5-year storm stillwater elevation of 8.0 feet based on station cross-section figures provided by Vine Associates.

[4] Cubic yards per linear feet above the 5-year storm stillwater elevation of 8.0 feet based on station cross-section figures provided by Vine Associates.

Table 5-2: Sand Eligible for FEMA Reimbursement

	Average Existing Sand Above 5-year Storm Elevation[1]	Eligible Sand Based on FEMA Emergency Dune Design[2]	Volume of Sand Eligible Based on FEMA Emergency Dune Design[3]
	yd^3/ft	yd^3/ft	yd^3
0+00 to 0+80	1.85	4.15	332
0+80 to 1+40	1.85	4.15	249
1+40 to 2+00	1.85	4.15	249
2+00 to 3+00	0.00	6.00	600
3+00 to 4+00	0.00	6.00	600
4+00 to 5+20	0.00	6.00	720
5+20 to 6+30	0.93	5.08	558
6+30 to 7+40	2.78	3.23	355
7+40 to 8+40	1.85	4.15	415
8+40 t 9+40	0.93	5.08	508
9+40 to 9+90	4.63	1.37	206
9+90 to 10+35	8.34	0.00	0
10+35 to 11+70	10.19	0.00	0
11+70 to 12+30	11.11	0.00	0
		Total	**4,791**

[1] The average cubic yards per linear feet above the 5-year storm stillwater elevation of 8.0 feet.

[2] Cubic yards per linear feet of sand eligible for FEMA reimbursement equivalent to 6 yd^3/ft minus the existing sand above the 5-year storm stillwater elevation.

[3] Volume of sand eligible for FEMA reimbursement based on the FEMA emergency dune design.

7.0 References

1. "Atlantic Avenue Dune As-Built Plan and Sections." Vine Associates. 20 June 2007

2. Connolly, John. "Emergency Berm Assessment" FEMA, May 3, 2004.

3. FEMA. "Flood Insurance Study for Town of Salisbury." 4 September 1986

4. Goda, Y. (2000), Random Seas and Design of Maritime Structures, in Advanced Series on Ocean Engineering, vol. 15, World Scientific Publishing.

5. Hallermeier, R. J., and Rhodes, P. E., 1988 "Generic treatment of dune erosion for 100-year event." ASCE Coastal Engineering Conference.

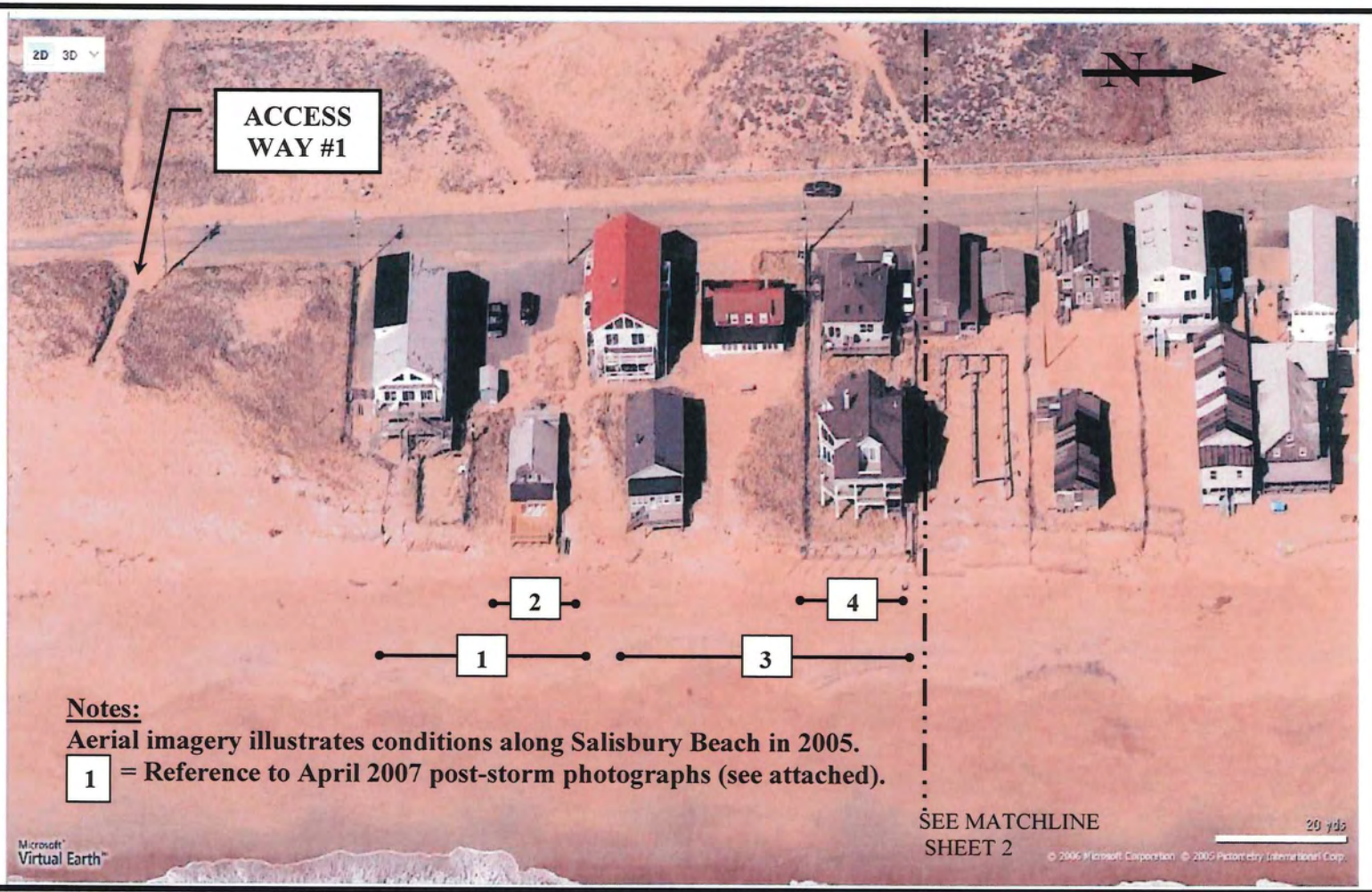
6. National Data Buoy Center, Wave data [WWW], retrieved from http://www.ndbc.noaa.gov/, November, 2005.

7. Player, Christine. "Salisbury Beach Emergency Dune Nourishment." Vine Associates. 7 June 2007.

8. Reardon, Richard. "Emergency Remedial Action Subsequent to the storm of 10 – 11 December 1992 for the Town of Salisbury," 5 May 1993.

9. Rhoads, Perry, Emergency Response Program Management Consultants (ERPMC). Email. 2 August 2007

10. USACE, Wave Information Studies (WIS), Hindcast Wave Data for US Coasts [WWW]. Coastal & Hydraulics Laboratory, retrieved from http://frf.usace.army.mil/cgi-bin/wis/atl/atl_main.html.

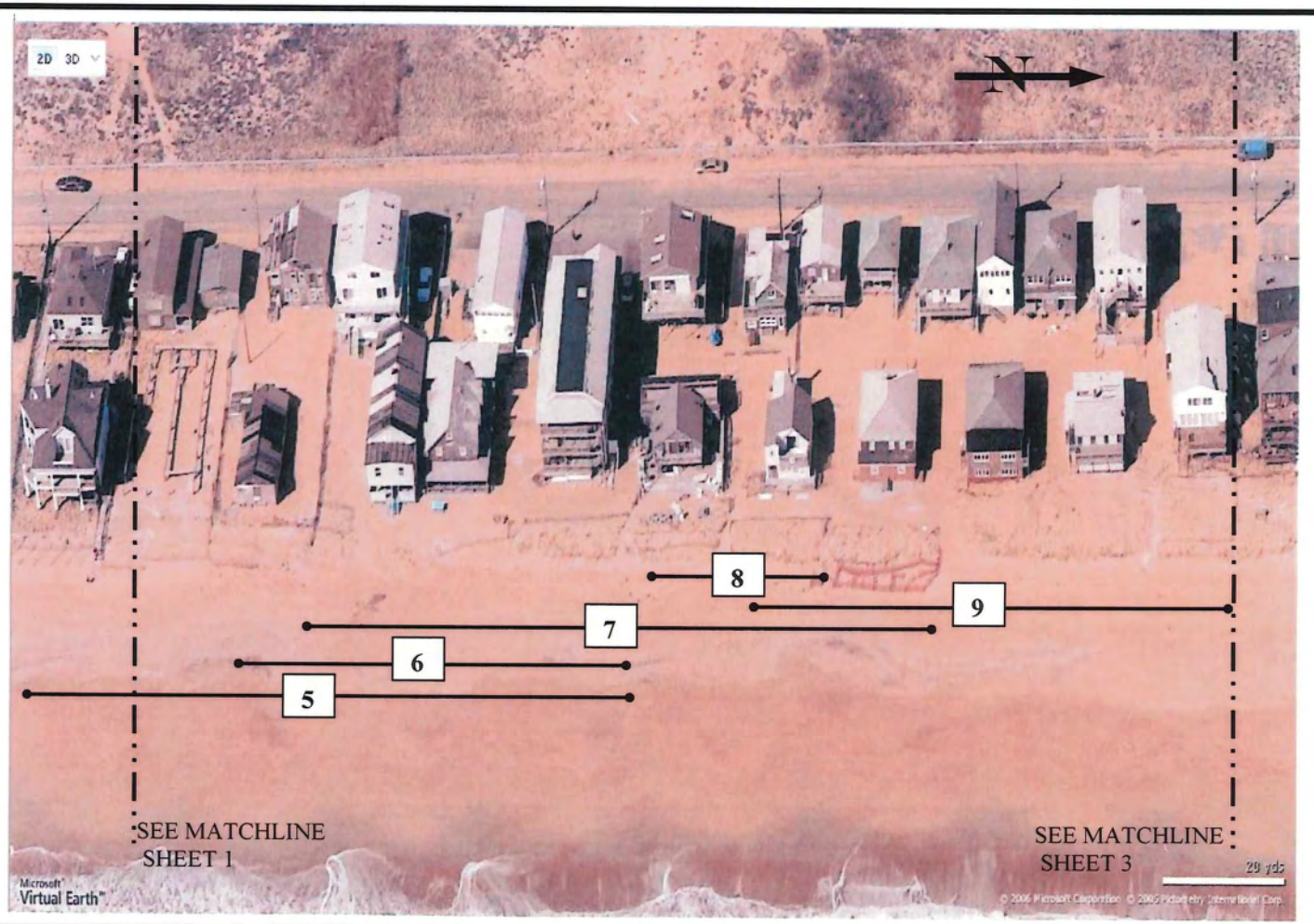


Vine ASSOCIATES, INC.

SALISBURY BEACH EMERGENCY DUNE RESTORATION PROJECT
ATLANTIC AVENUE - ACCESS WAY #1 TO ACCES WAY #2
PRE- & POST-STORM CONDITION ASSESSMENT

SHEET 1 OF 3

MAY 2007

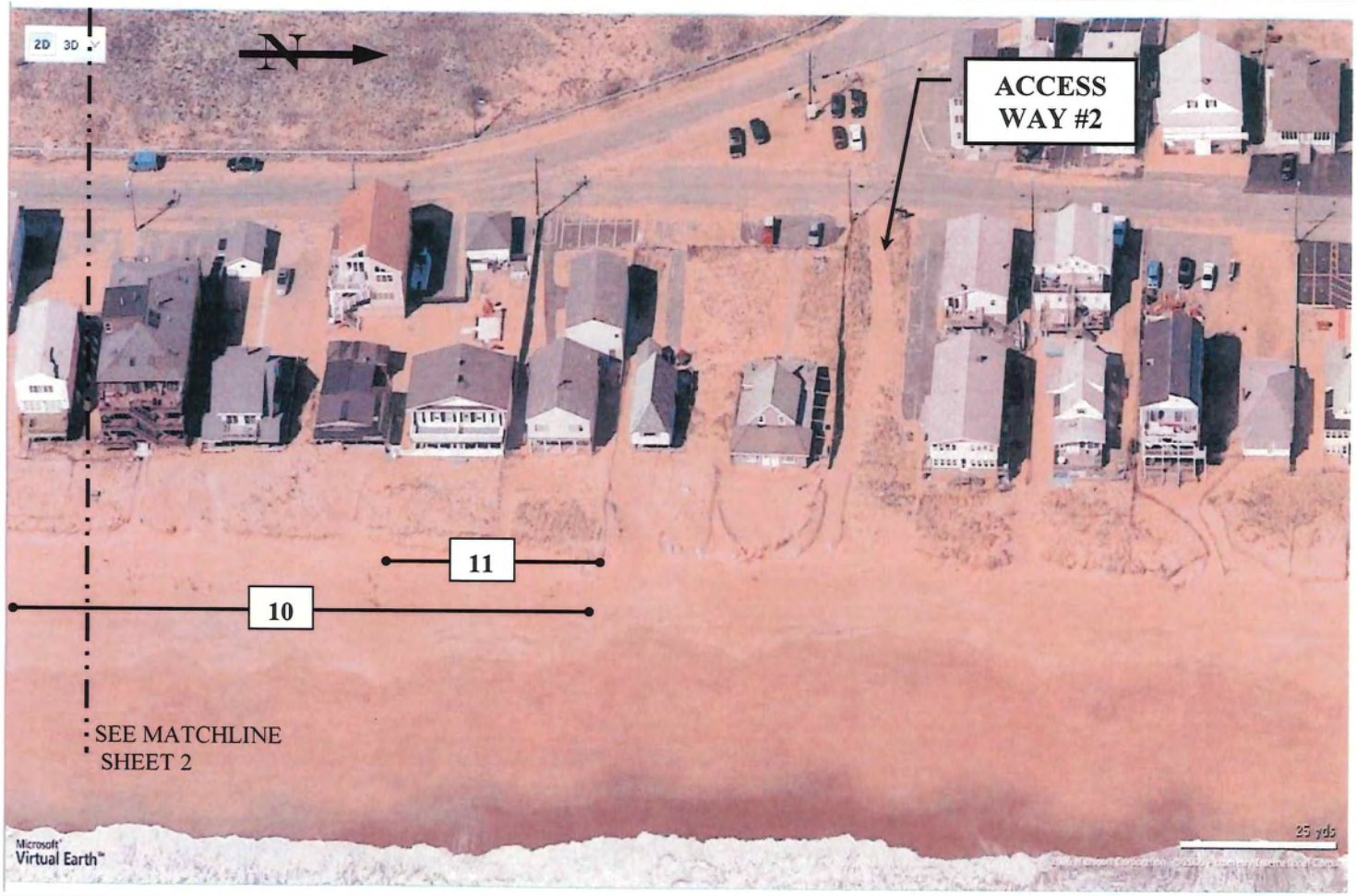


Vine ASSOCIATES, INC.

SALISBURY BEACH EMERGENCY DUNE RESTORATION PROJECT
ATLANTIC AVENUE - ACCESS WAY #1 TO ACCES WAY #2
PRE- & POST-STORM CONDITION ASSESSMENT

SHEET 2 OF 3

MAY 2007



Vine ASSOCIATES, INC.

SALISBURY BEACH EMERGENCY DUNE RESTORATION PROJECT
ATLANTIC AVENUE - ACCESS WAY #1 TO ACCES WAY #2
PRE- & POST-STORM CONDITION ASSESSMENT

SHEET 3 OF 3

MAY 2007