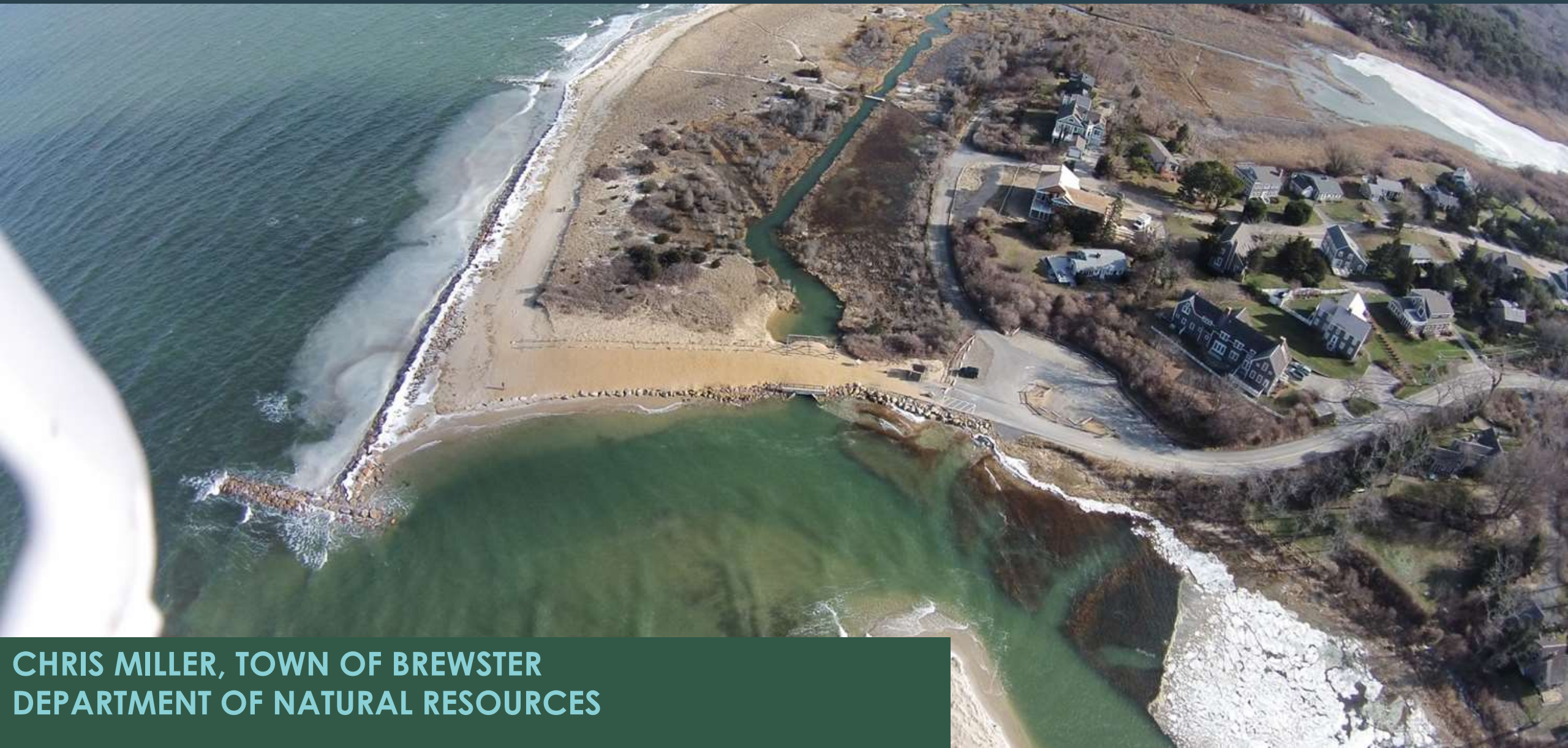
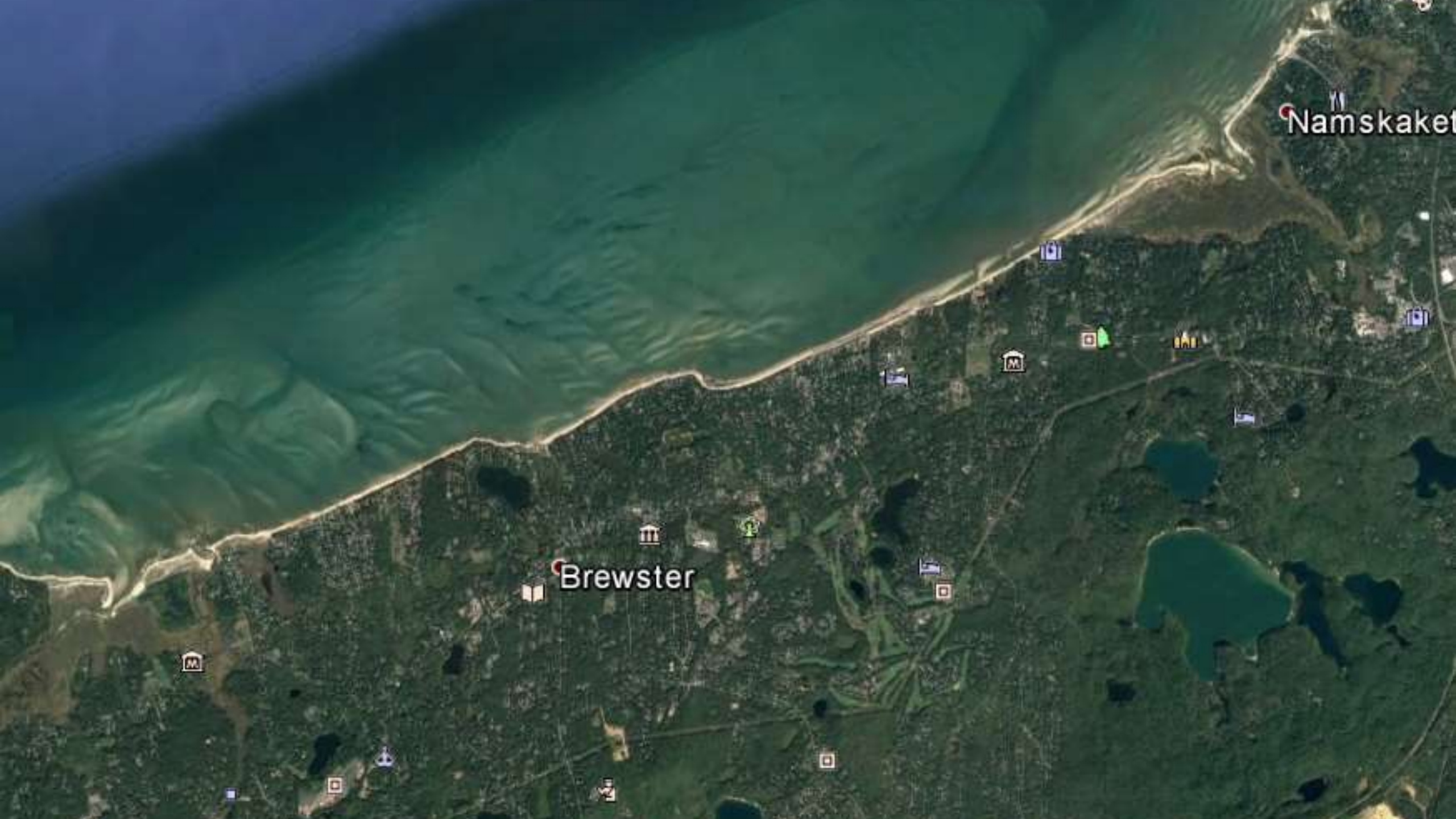
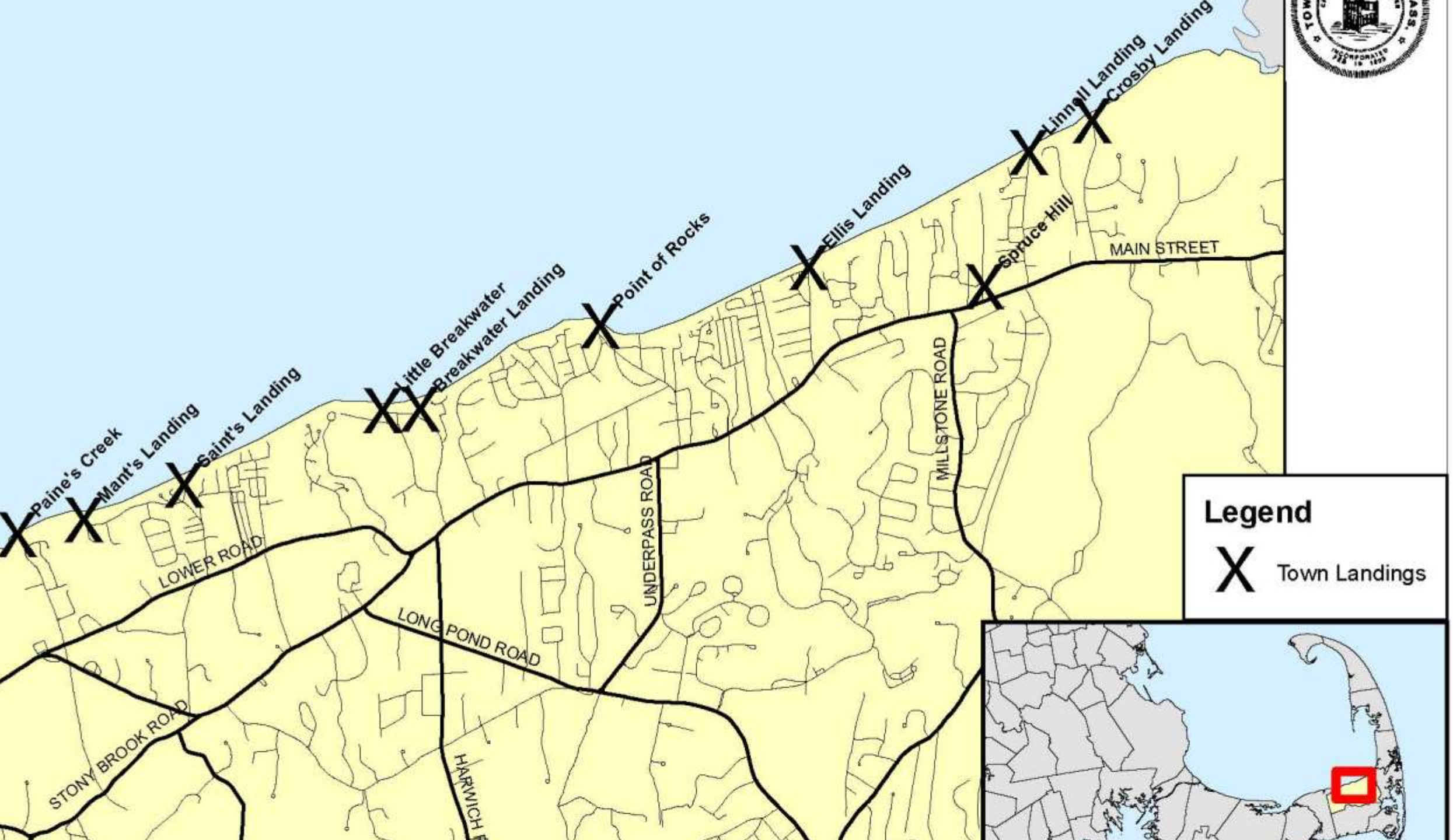
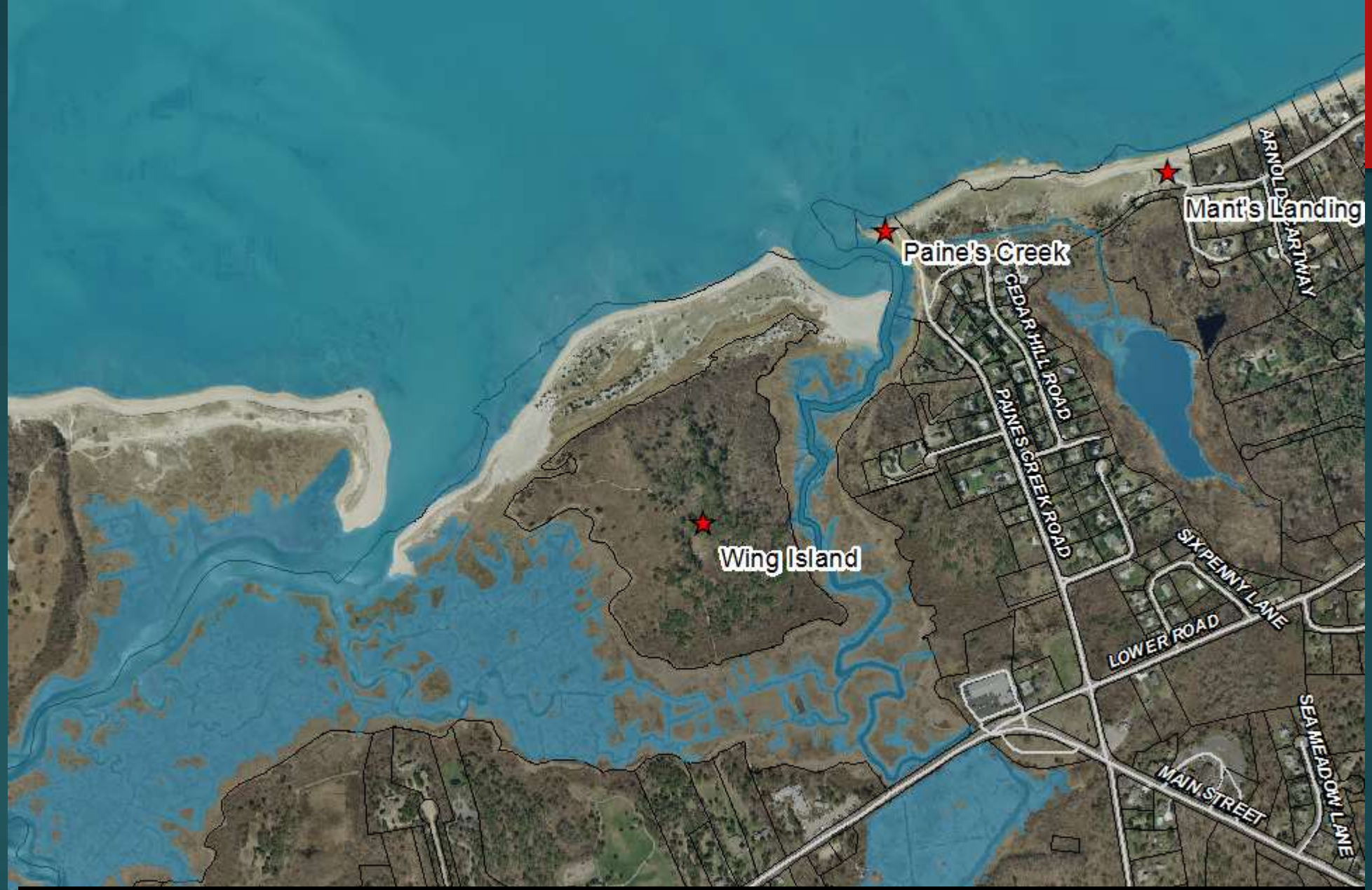
Coastal Retreat in Brewster, MA



CHRIS MILLER, TOWN OF BREWSTER
DEPARTMENT OF NATURAL RESOURCES


Namskaket
Brewster


Paine's Creek
Mant's Landing
Saint's Landing
Little Breakwater
Breakwater Landing
Point of Rocks
Ellis Landing
Linnell Landing
Crosby Landing
Spruce Hill
MAIN STREET
MILLSTONE ROAD
UNDERPASS ROAD
LOWER ROAD
LONG POND ROAD
STONY BROOK ROAD
HARWICH
Legend
Town Landings



Paine's Creek, Mant's Landing, and Wing Island
Mean High Water

Paines Creek Landing: 2007

Paines Creek Landing: 2009

Paines: January 2, 2010

March 2010

Table 5. Alternatives analysis for shoreline protection at Paines Creek Beach

ALTERNATIVE	Overall Effectiveness	Shoreline Stabilization	Structural Lifetime *	Permitability	Permitting / Engineering Cost *	Construction Cost *	Construction Feasibility	Maintenance Requirements
1. Do Nothing	○	○	N/A	N/A	N/A	N/A	N/A	○
2. Stone Revetment	●	●	●	◎	◎	○	●	●
3. Vertical Wall/bulkhead (timber/steel/composite)	●	●	●	○	○	○	◎	●
4. Rock-filled Gabion Baskets	◎	◎	◎	○	○	○	◎	◎
5. Coir Logs	◎	◎	○	●	●	●	◎	◎
6. Cobble Berm	◎	○	○	◎	◎	◎	●	○

* = Relative to other alternatives, varies depending on alternative items and local costs

● = Good

◎ = Medium

○ = Poor

N/A = Not Applicable

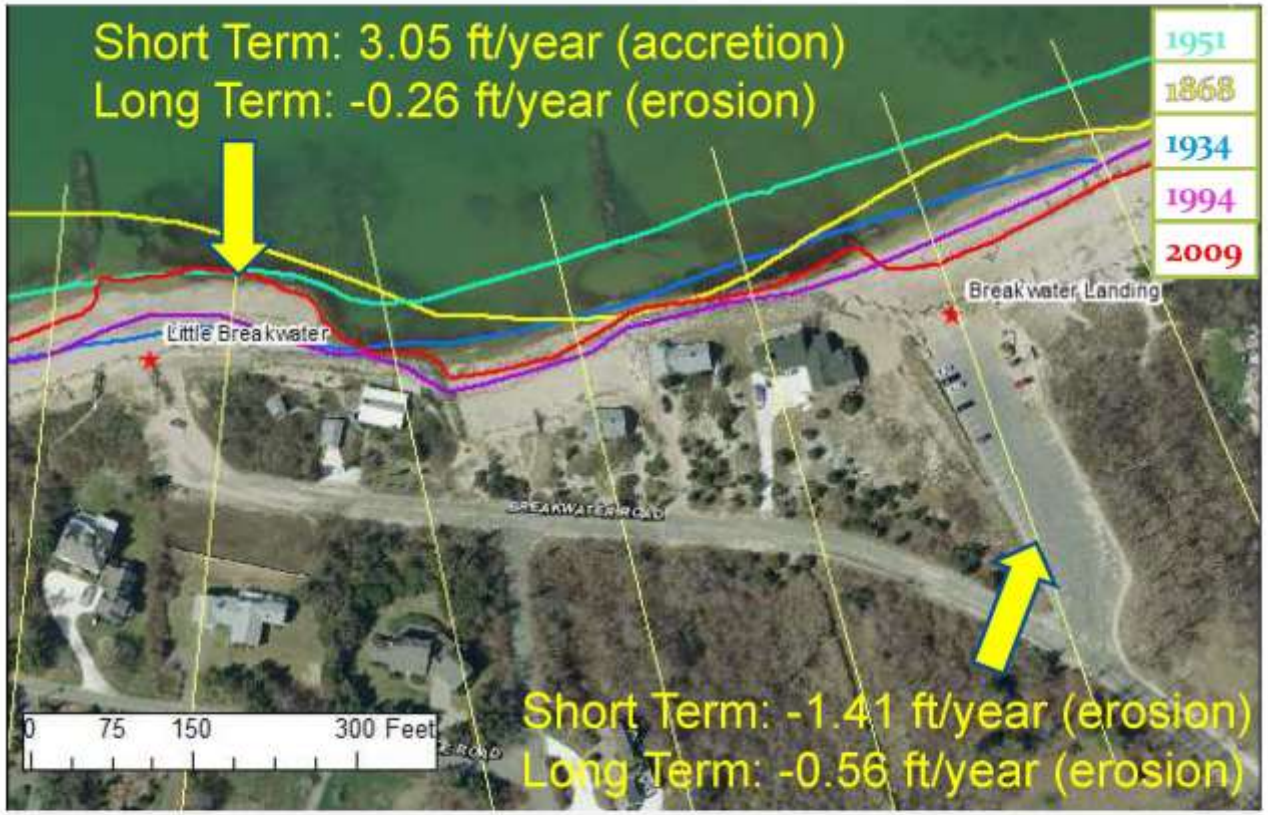
Local Planning for Retreat

- Several years of substantial investment in repairs
  - Selectmen meetings, town meeting expenditures
  - Selectmen presentation on alternatives
  - Grant opportunity NRCS Stormwater
    - Can we promise to maintain infrastructure for 75 years?
- Rethink investments, use grant, improve stormwater conditions
  - Removal of pavement = less stormwater
  - Resilient lot able to withstand inundation
  - Culvert replacement

Paine's Creek


Breakwater Beach
WATER ROAD
THE TIDES COURT
268
115
116
98
97
61
55
54
88
86
38
0

Long term erosion trends



Breakwater and Little Breakwater Landings
Historic Shorelines, Erosion Rates and Variability

Recurring storm damage

Planting beach grass

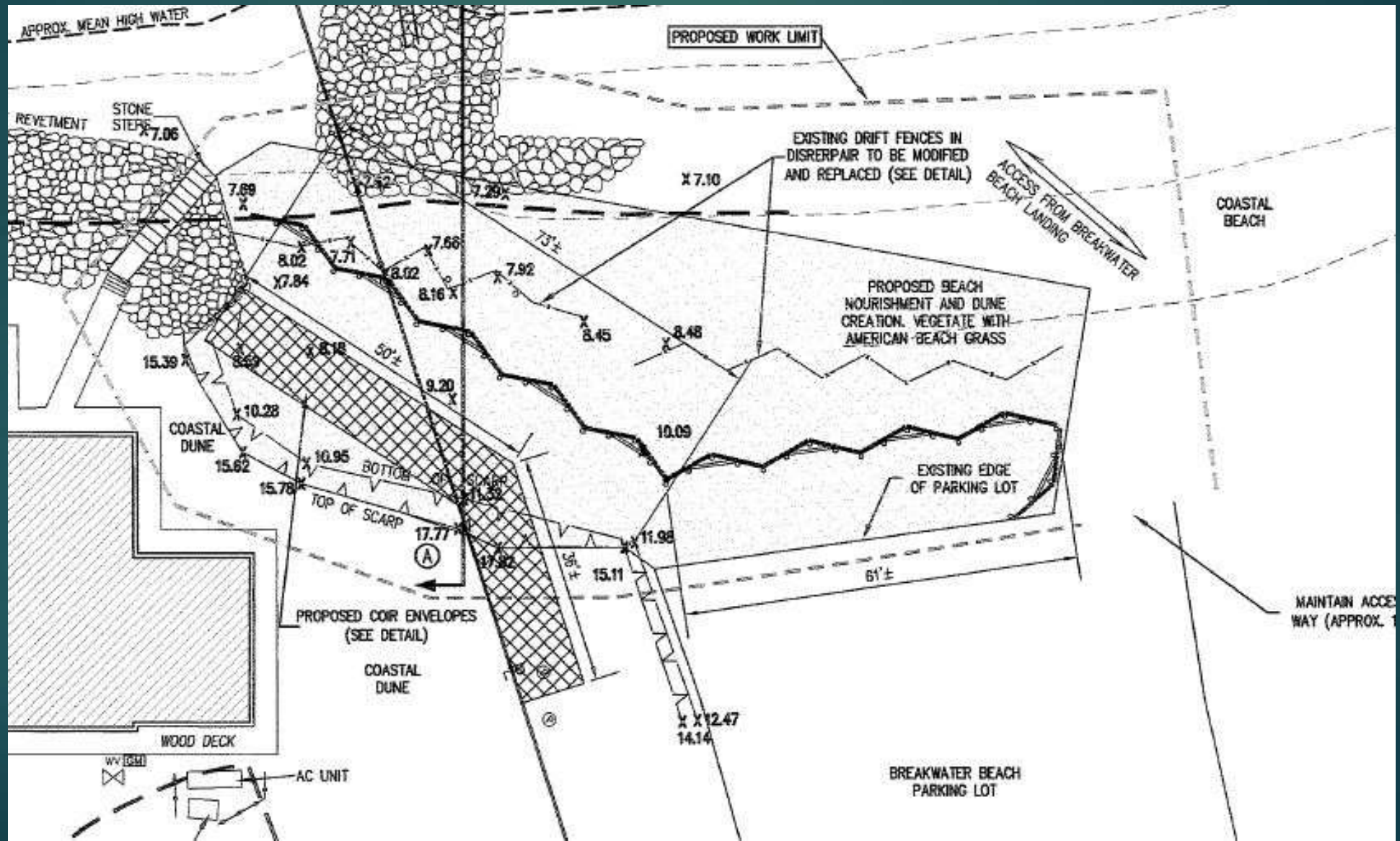
- Alternative spring break, Brandeis University

Breakwater spring 2012

Breakwater February 2013

Breakwater February 2013

End scour from revetment to west

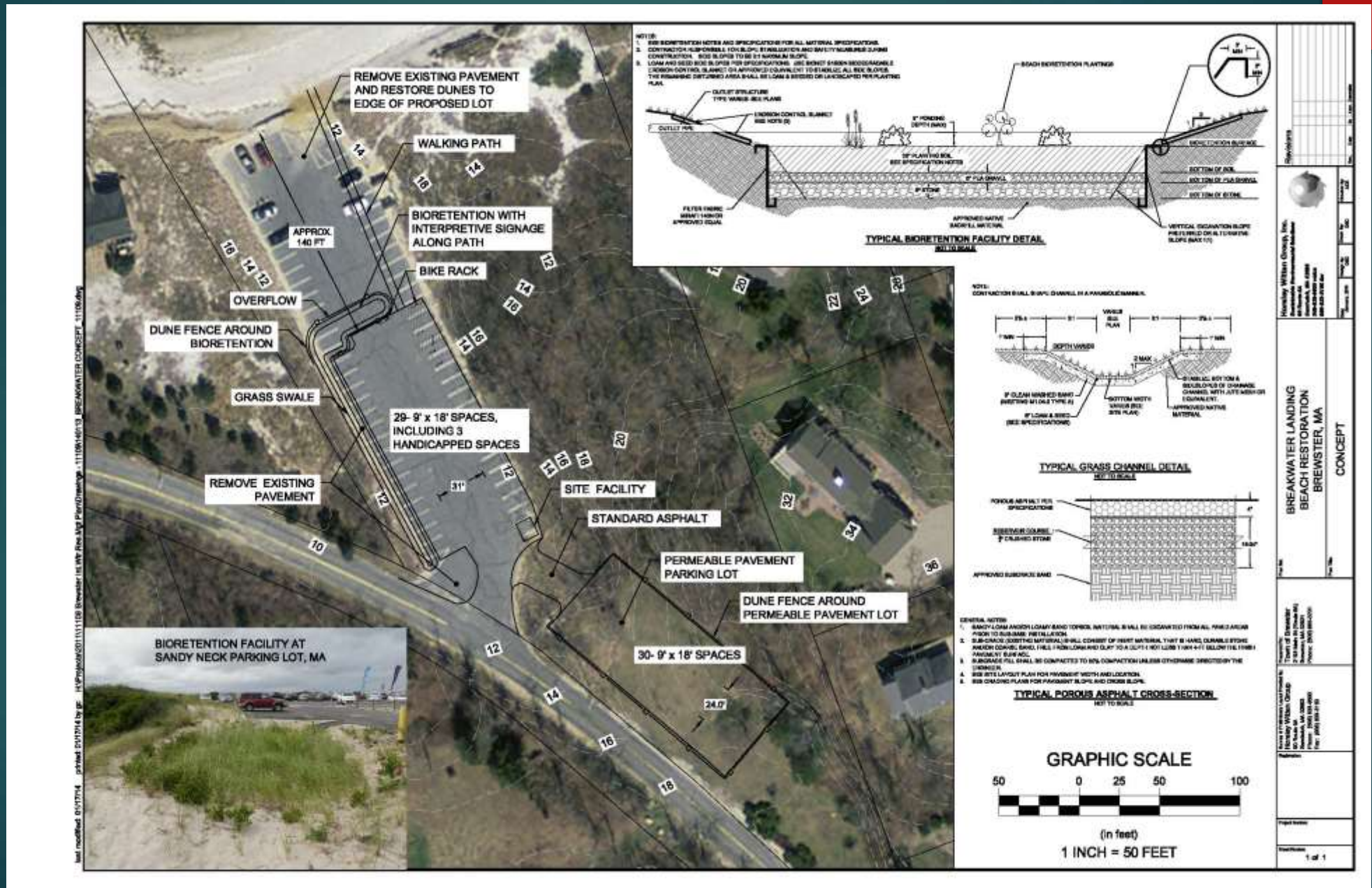


Sturdy sand fence in sacrificial dune at Breakwater

Sturdy fence buried under new dune located slightly further from active beach.

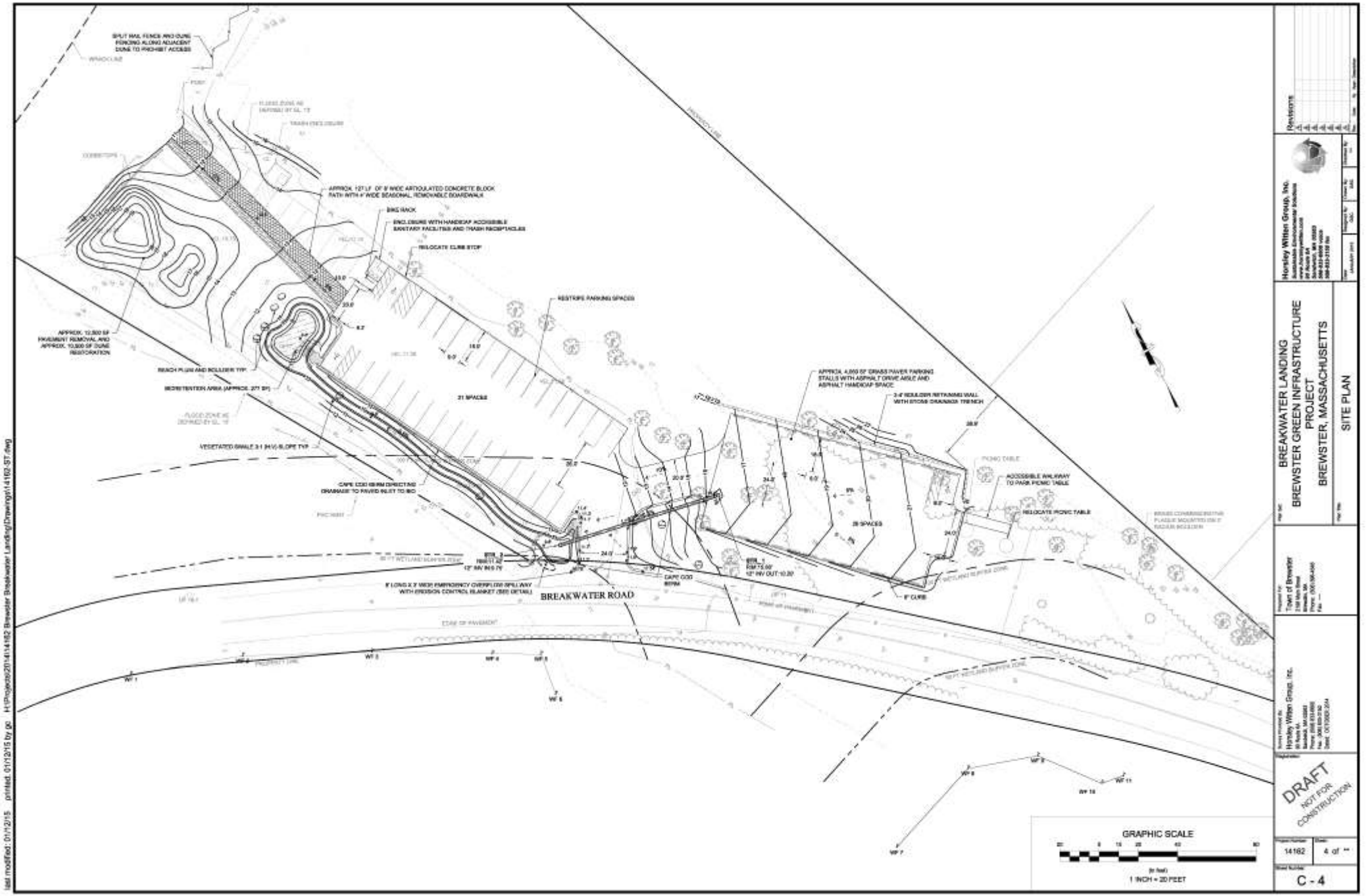

RESERVED
PARKING

Breakwater Beach Conceptual Plan



Concept: Retreat and rebuild

New replacement lot


SPLIT RAIL FENCE AND DUNE FENCING ALONG ADJACENT DUNE TO PROHIBIT ACCESS
APPROX. 127 LF OF 8' WIDE ARTICULATED CONCRETE BLOCK PATH WITH 4' WIDE SEASONAL, REMOVABLE BOARDWALK
BIKE RACK
ENCLOSURE WITH HANDICAP ACCESSIBLE SANITARY FACILITIES AND TRASH RECEPTACLES
RELOCATE CURB STOP
RESTRIPE PARKING SPACES
APPROX. 12,500 SF PAVEMENT REMOVAL AND APPROX. 10,500 SF DUNE RESTORATION
BEACH PLUM AND BOLLDER TYP.
BIORETENTION AREA (APPROX. 271 SF)
21 SPACES
VEGETATED SWALE 3:1 (H:V) SLOPE TYP.
CAPE COD BERM DIRECTING DRAINAGE TO PAVED INLET TO BIO
APPROX. 4,650 SF GRASS PAVER PARKING STALLS WITH ASPHALT DRIVE AISLE AND ASPHALT HANDICAP SPACE
3-4' BOULDER RETAINING WALL WITH STONE DRAINAGE TRENCH
PICNIC TABLE
ACCESSIBLE WALKWAY TO PARK PICNIC TABLE
RELOCATE PICNIC TABLE
28 SPACES
8" CURB
CAPE COD BERM
8' LONG X 3' WIDE EMERGENCY OVERFLOW SPILL WAY WITH EROSION CONTROL BLANKET (SEE DETAIL)
BREAKWATER ROAD
EDGE OF PAVEMENT
PROPERTY LINE
100 FT WETLAND BUFFER ZONE
GRAPHIC SCALE
1 INCH = 20 FEET
Revisions
Horsley Witten Group, Inc.
BREAKWATER LANDING
BREWSTER GREEN INFRASTRUCTURE PROJECT
BREWSTER, MASSACHUSETTS
SITE PLAN
Prepared For:
Town of Brewster
DRAFT
NOT FOR CONSTRUCTION
14162
4 of **
C - 4
last modified: 01/12/15 printed: 01/12/15 by: gc H:\Projects\2014\14162 Brewster Breakwater Landing\Drawings\14162-ST.dwg

Public Outreach

- Televised beach tours and discussions of alternatives
- Town meeting articles for funding (twice)
- Two state CZM grants (design and for construction)
- Postcards to neighborhood
- Multiple televised selectmen meetings
- Articles in newspaper
- Multiple Brewster Coastal Committee meetings
- MEPA site visit
- Historic, Conservation, Planning Board meetings (multiple)

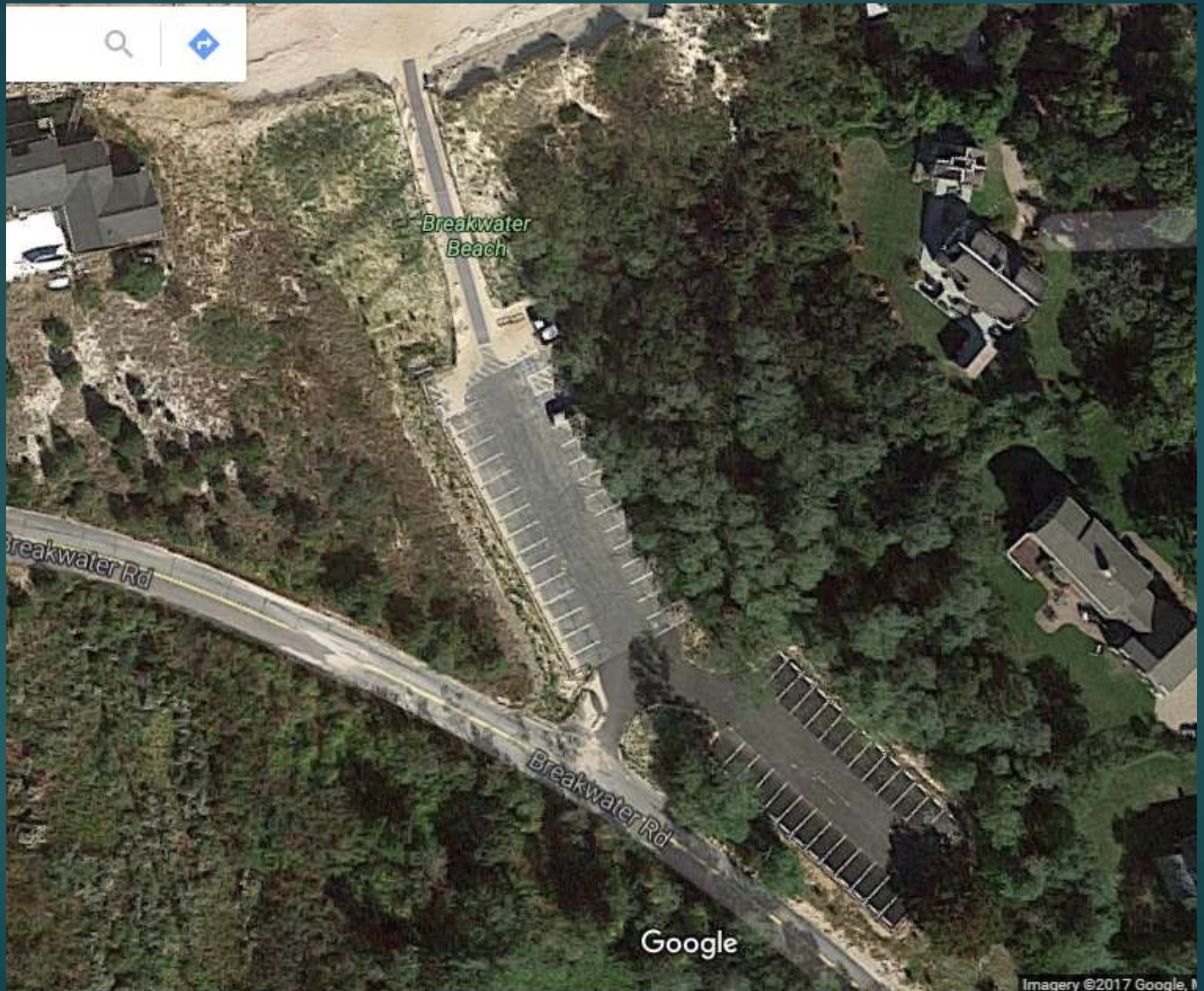
Results?

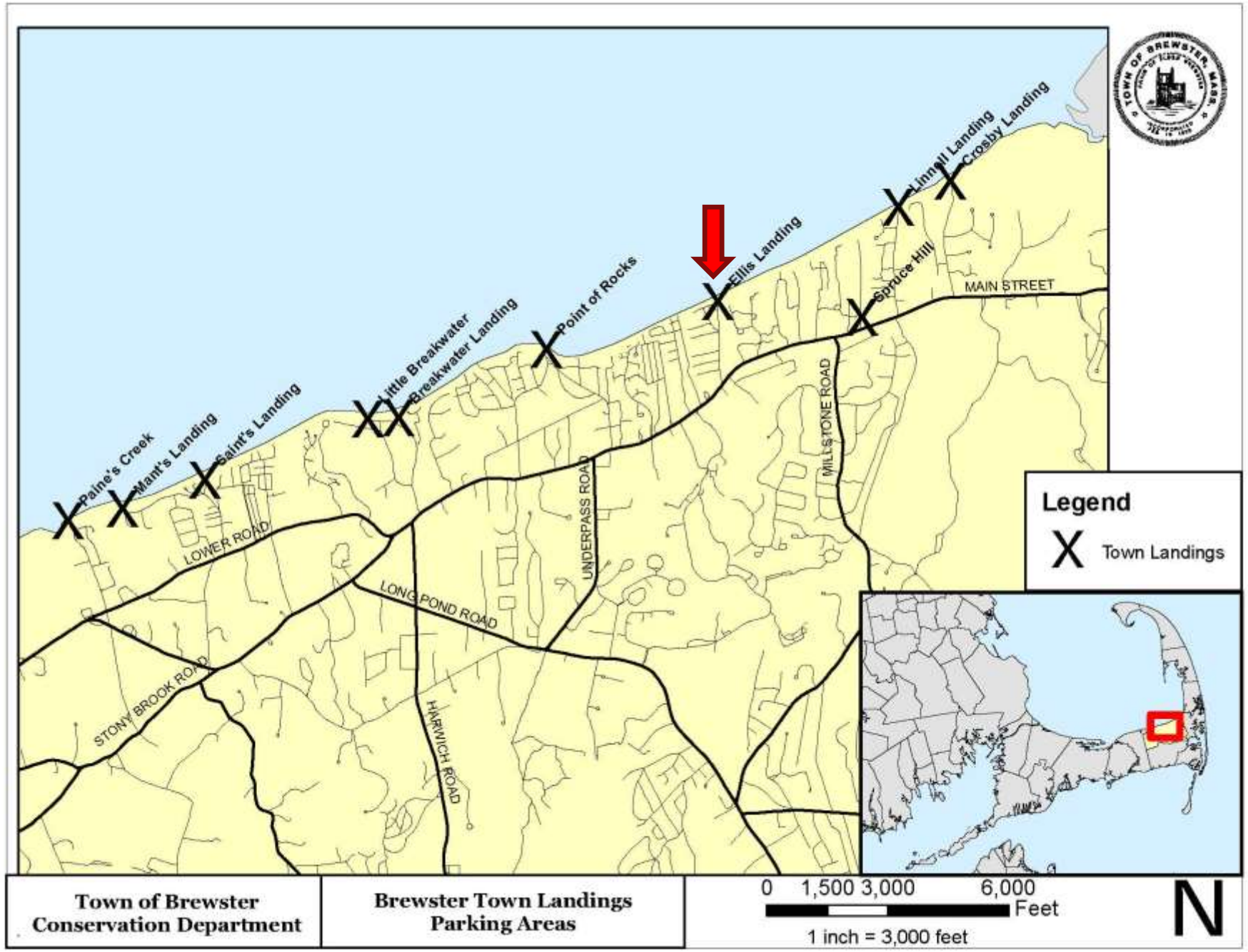
- Strong support from Selectmen and boards
- Many neighbors liked the retreat, if we didn't replace the parking that was lost
- Some neighbors supporting, but a group formed to oppose the project (and others)
- Lawsuit, petitions, different designs, confused boards
- Lots more press and editorials
- town meeting articles to oppose this and other projects
- Concurrently, town applied for a CZM Coastal Resiliency Grant to develop community support and understanding of coastal issues.
- Outcome: Selectment sponsored specific yes/no votes at town meeting; and the project was approved and constructed.

Sept. 2015

Jan. 2016

Breakwater Rd
The Channel Way
The Tides Ct


Breakwater
Beach
reakwater Rd
Breakwater Rd
Google
Imagery ©2017 Google,


Paine's Creek
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LONG POND ROAD
STONY BROOK ROAD
HARWICH ROAD
Legend
Town Landings
Town of Brewster
Conservation Department
Brewster Town Landings
Parking Areas
0 1,500 3,000 6,000
Feet
1 inch = 3,000 feet
N

Town of Brewster
Department of Natural Resources

Ellis Landing Parking Area

0 25 50 100 150 200 Feet
1 inch = 100 feet

NORTH

Ellis Landing March 2010

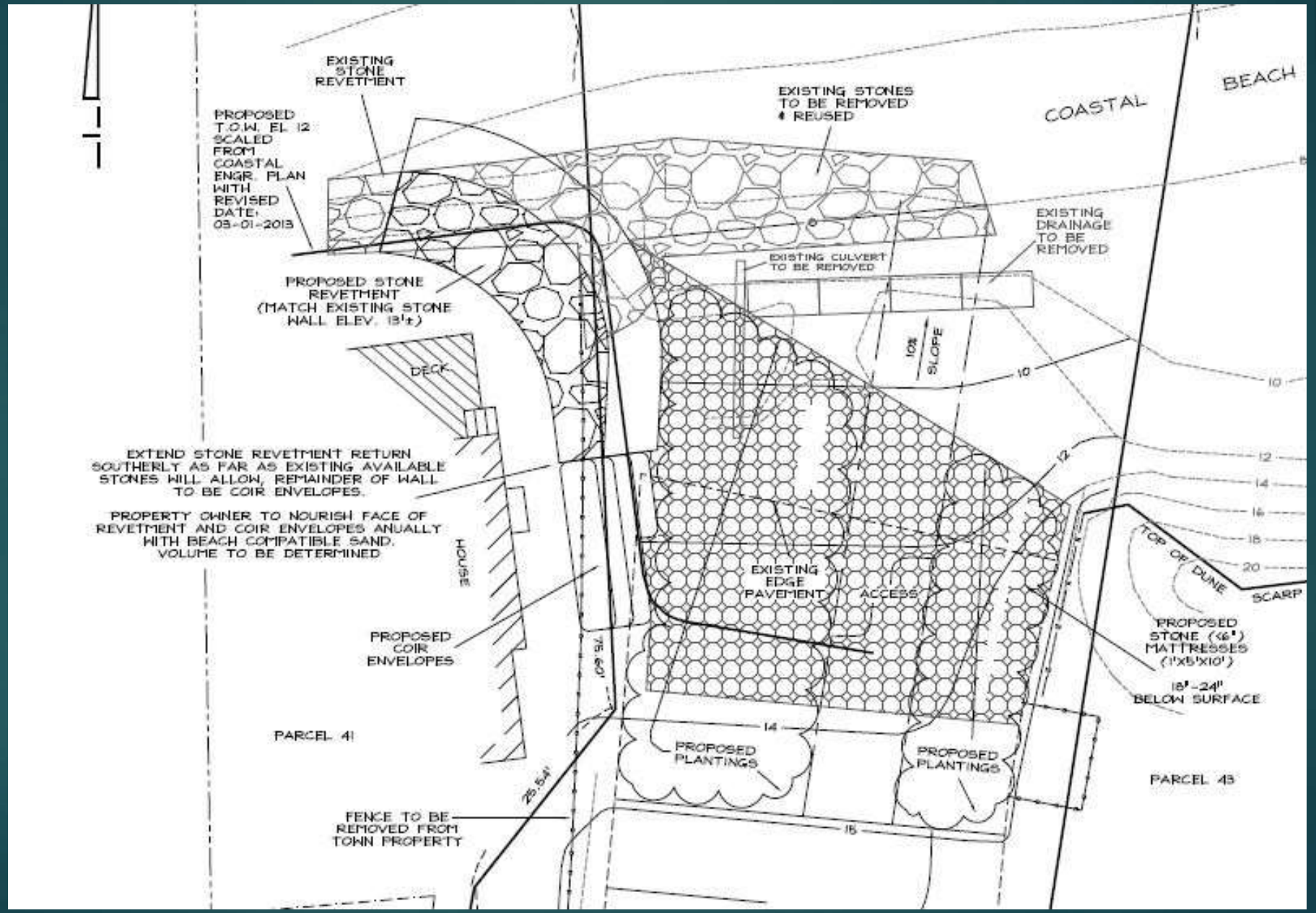
Ellis February 2011

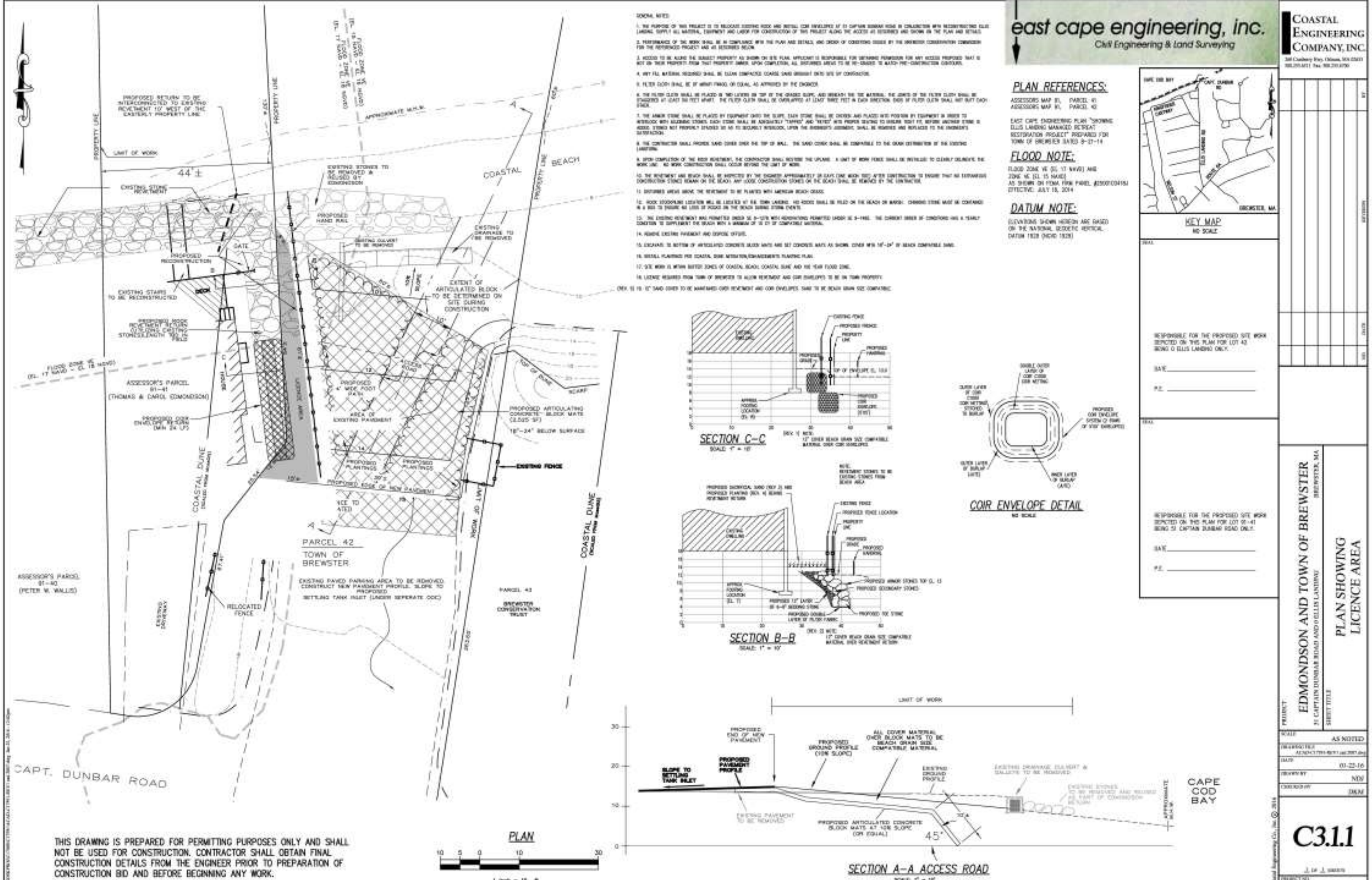
Ellis May 2012 stormwater

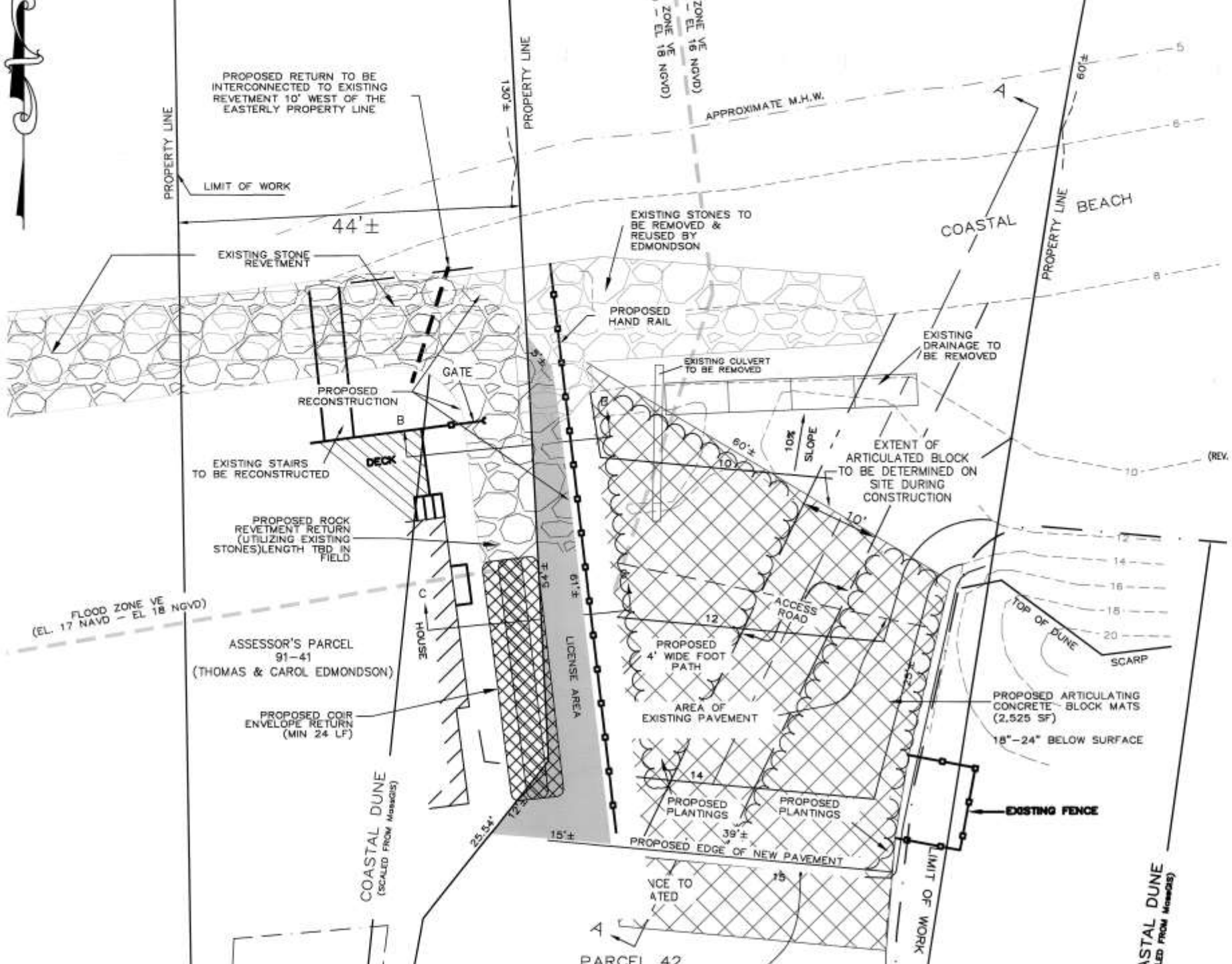
February 2013

Ellis March 2014

Ellis concept




east cape engineering, inc.
Civil Engineering & Land Surveying
COASTAL ENGINEERING COMPANY, INC.
GENERAL NOTES
PLAN REFERENCES:
ASSESSORS MAP 81, PARCEL 41
ASSESSORS MAP 81, PARCEL 42
FLOOD NOTE:
DATUM NOTE:
KEY MAP
NO SCALE
BREWSTER, MA
COASTAL BEACH
COASTAL DUNE
PARCEL 42
TOWN OF BREWSTER
ASSESSOR'S PARCEL 81-41 (THOMAS & CAROL EDMONDSON)
ASSESSOR'S PARCEL 81-40 (PETER W. WALLIS)
CAPT. DUNBAR ROAD
LIMIT OF WORK
PROPOSED ARTICULATING CONCRETE BLOCK MATS
EXISTING FENCE
PLAN
SECTION C-C
SECTION B-B
COIR ENVELOPE DETAIL
NO SCALE
SECTION A-A ACCESS ROAD
CAPE COD BAY
45°
THIS DRAWING IS PREPARED FOR PERMITTING PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION. CONTRACTOR SHALL OBTAIN FINAL CONSTRUCTION DETAILS FROM THE ENGINEER PRIOR TO PREPARATION OF CONSTRUCTION BID AND BEFORE BEGINNING ANY WORK.
EDMONDSON AND TOWN OF BREWSTER
PLAN SHOWING LICENCE AREA
AS NOTED
03-22-16
C3.1.1



4. ANY FILL MATERIAL REQUIRED SHALL BE CLEAN COMPACTED COARSE SAND BROUGHT ONTO SITE BY C

5. FILTER CLOTH SHALL BE OF MIRAFI FW400, OR EQUAL, AS APPROVED BY THE ENGINEER.

6. THE FILTER CLOTH SHALL BE PLACED IN TWO LAYERS ON TOP OF THE GRADED SLOPE, AND BENEATH STAGGERED AT LEAST SIX FEET APART. THE FILTER CLOTH SHALL BE OVERLAPPED AT LEAST THREE FEE OTHER.

7. THE ARMOR STONE SHALL BE PLACED BY EQUIPMENT ONTO THE SLOPE. EACH STONE SHALL BE CHOS INTERLOCK WITH ADJOINING STONES. EACH STONE SHALL BE ADEQUATELY "TAPPED" AND "KEYED" INTO P ADDED. STONES NOT PROPERLY STACKED SO AS TO SECURELY INTERLOCK, UPON THE ENGINEER'S JUDGM SATISFACTION.

8. THE CONTRACTOR SHALL PROVIDE SAND COVER OVER THE TOP OF WALL. THE SAND COVER SHALL BE LANDFORM.

9. UPON COMPLETION OF THE ROCK REVETMENT, THE CONTRACTOR SHALL RESTORE THE UPLAND. A LIM WORK LINE. NO WORK CONSTRUCTION SHALL OCCUR BEYOND THE LIMIT OF WORK.

10. THE REVETMENT AND BEACH SHALL BE INSPECTED BY THE ENGINEER APPROXIMATELY 28 DAYS (ONE CONSTRUCTION STONES REMAIN ON THE BEACH. ANY LOOSE CONSTRUCTION STONES ON THE BEACH SHAL

11. DISTURBED AREAS ABOVE THE REVETMENT TO BE PLANTED WITH AMERICAN BEACH GRASS.

12. ROCK STOCKPILING LOCATION WILL BE LOCATED AT THE TOWN LANDING. NO ROCKS SHALL BE PILED IN A BOX TO ENSURE NO LOSS OF ROCKS ON THE BEACH DURING STORM EVENTS.

13. THE EXISTING REVETMENT WAS PERMITTED UNDER SE 9-1278 WITH RENOVATIONS PERMITTED UNDER CONDITION TO SUPPLEMENT THE BEACH WITH A MINIMUM OF 10 CY OF COMPATIBLE MATERIAL.

14. REMOVE EXISTING PAVEMENT AND DISPOSE OFFSITE.

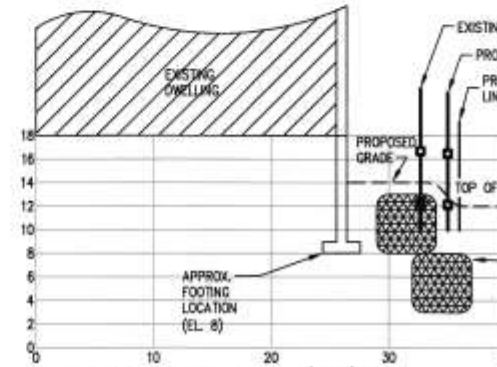
15. EXCAVATE TO BOTTOM OF ARTICULATED CONCRETE BLOCK MATS AND SET CONCRETE MATS AS SHOWN

16. INSTALL PLANTINGS PER COASTAL DUNE MITIGATION/ENHANCEMENTS PLANTING PLAN.

17. SITE WORK IS WITHIN BUFFER ZONES OF COASTAL BEACH, COASTAL DUNE AND 100 YEAR FLOOD ZON

18. LICENSE REQUIRED FROM TOWN OF BREWSTER TO ALLOW REVETMENT AND COIR ENVELOPES TO BE ON

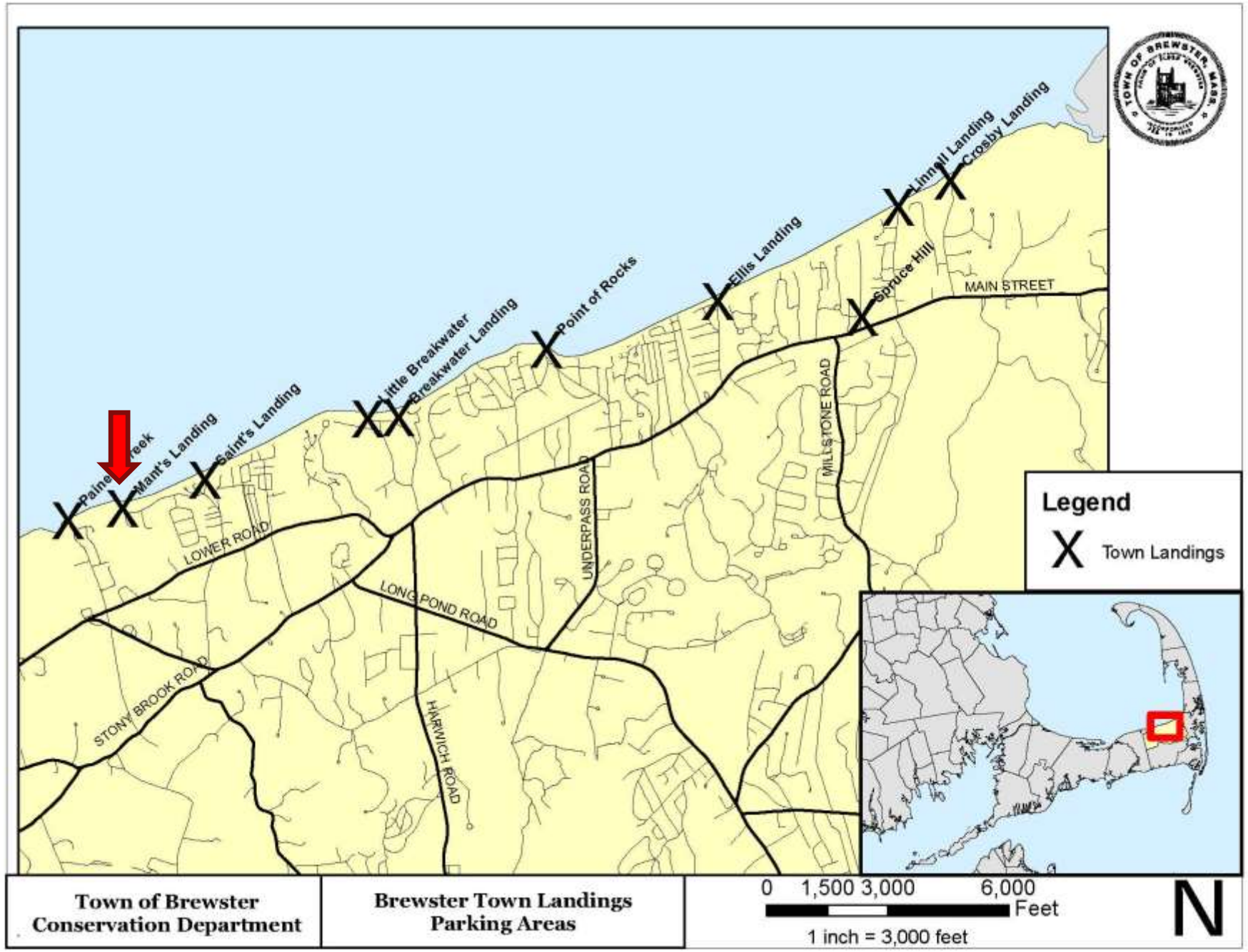
(REV. 5) 19. 12" SAND COVER TO BE MAINTAINED OVER REVETMENT AND COIR ENVELOPES. SAND TO BE BEACH GR



SECTION C–C

SCALE: 1" = 10'

(REV. 1) NOTE: 12" COVER BEACH GR MATERIAL OVER COIR


Paine Creek
Mant's Landing
Saint's Landing
Little Breakwater
Breakwater Landing
Point of Rocks
Ellis Landing
Spruce Hill
Linnell Landing
Crosby Landing
MAIN STREET
MILLSTONE ROAD
UNDERPASS ROAD
LOWER ROAD
LONG POND ROAD
STONY BROOK ROAD
HARWICH ROAD
Legend
X Town Landings
Town of Brewster
Conservation Department
Brewster Town Landings
Parking Areas
0 1,500 3,000 6,000
Feet
1 inch = 3,000 feet
N

Mants May 2010

Mants March 2010

January 2013 Mants

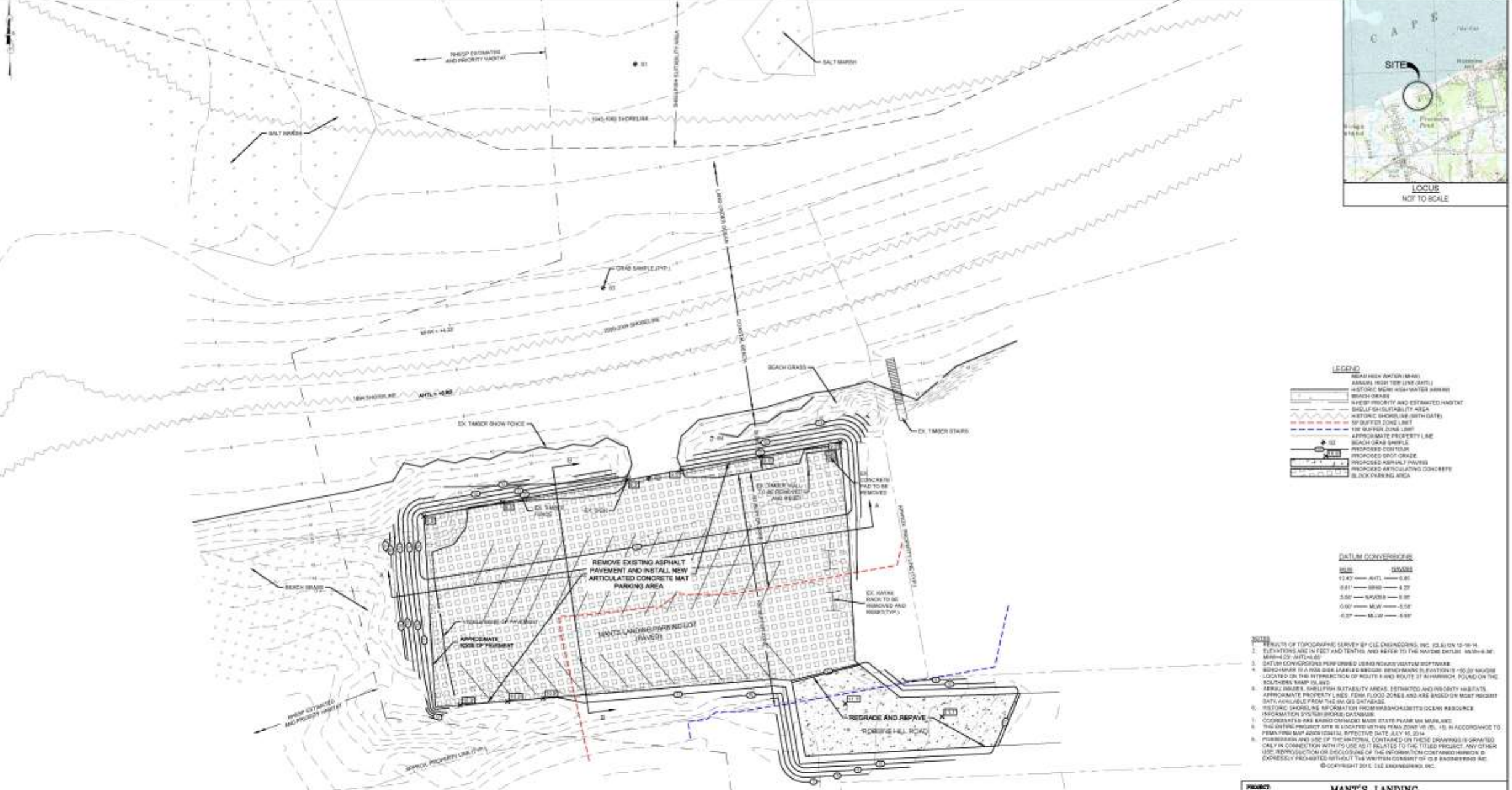
Winter storm removed sacrificial dunes. Rebuilt in early February 2013.

Mants February 2013

Nor'easter Nemo. Dunes destroyed, parking lot asphalt lifted and damaged.


JCB


MHW
MHW +2′ SLR
MHW +4′ SLR
MHW +2′ SLR +6′ SS
MHW +4′ SLR +6′ SS
LEGEND
Mean High Water (MHW)
MHW + 2′ Sea Level Rise
MHW + 4′ Sea Level Rise
MHW + 2′ SLR + 6′ Storm Surge
MHW + 4′ SLR + 6′ Storm Surge
N
Mant's Landing

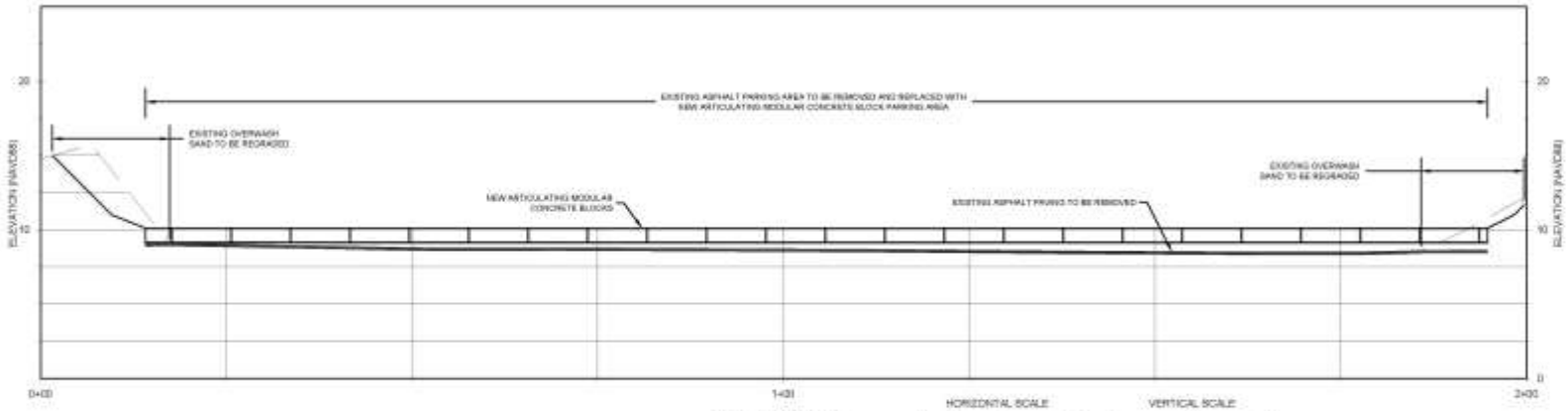


NOTES:
1. RESULTS OF TOPOGRAPHIC SURVEY BY CLE ENGINEERING, INC. (C.L.S.) ON 12-19-14.
2. ELEVATIONS ARE IN FEET AND TENTHS, AND REFER TO THE NAVD88 DATUM. MLW=-5.58', MHW=4.33', AHTL=6.85'.
3. DATUM CONVERSIONS PERFORMED USING NOAA'S VDATUM SOFTWARE.
4. BENCHMARK 10 IS A RISK DISK LABELED BBC2008. BENCHMARK ELEVATION IS +50.20' NAVD88 LOCATED ON THE INTERSECTION OF ROUTE 6 AND ROUTE 37 IN HARWICH, FOUND ON THE SOUTHERN RAMP (SLAND).
5. ABRAU BARRIER, SHELLFISH SUITABILITY AREAS, ESTIMATED AND PRIORITY HABITATS, APPROXIMATE PROPERTY LINES, FEMA FLOOD ZONES AND ARE BASED ON MOST RECENT DATA AVAILABLE FROM THE MA GIS DATABASES.
6. HISTORIC SHORELINE INFORMATION FROM MASSACHUSETTS OCEAN RESOURCE INFORMATION SYSTEM (MORIS) DATABASE.
7. COORDINATES ARE BASED ON NAD83 MAINE STATE PLANE MA MAINLAND.
8. THE ENTIRE PROJECT SITE IS LOCATED WITHIN FEMA ZONE VE (EL. 15) IN ACCORDANCE TO FEMA FIRM MAP #25001C0417J, EFFECTIVE DATE JULY 16, 2014.
9. PERMISSION AND USE OF THE MATERIAL CONTAINED ON THESE DRAWINGS IS GRANTED ONLY IN CONNECTION WITH ITS USE AS IT RELATES TO THE TITLED PROJECT. ANY OTHER USE, REPRODUCTION OR DISCLOSURE OF THE INFORMATION CONTAINED HEREON IS EXPRESSLY PROHIBITED WITHOUT THE WRITTEN CONSENT OF C.L.E. ENGINEERING INC.

PROJECT: MANT'S LANDING
BREWSTER, MASSACHUSETTS

CLIENT: TOWN OF BREWSTER
2198 MAIN STREET, BREWSTER MA 02631

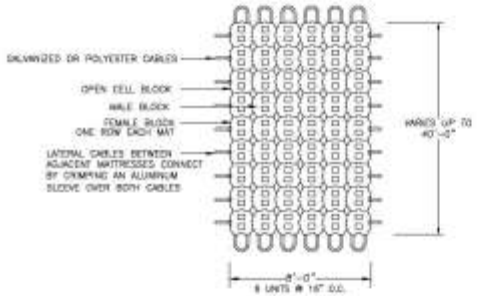
cleengineering



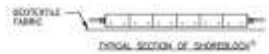
TYPICAL SECTION A-A
HORIZONTAL SCALE: 1"=10'
VERTICAL SCALE: 1"=5'

HORIZONTAL SCALE
0 5 10 20
(IN FEET)
1 INCH = 10 FEET

VERTICAL SCALE
0 2 5 10
(IN FEET)
1 INCH = 5 FEET



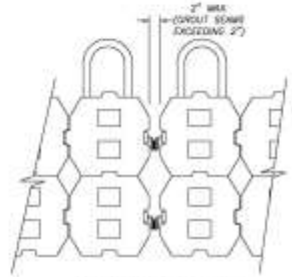
SHOREBLOCK® MAT ASSEMBLY DETAIL
N.T.S.



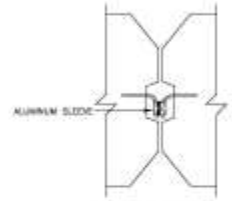
TYPICAL SECTION OF SHOREBLOCK®

TYPICAL SECTION B

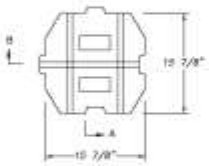
TYPICAL SECTION A



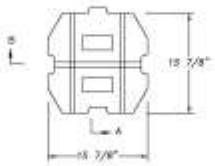
TYPICAL CONNECTION OF TWO MATS



TYPICAL SECTION OF CONNECTION
N.T.S.



80-500 DC UNIT (MALE)



80-500 DC UNIT (FEMALE)

TECHNICAL SPECIFICATIONS

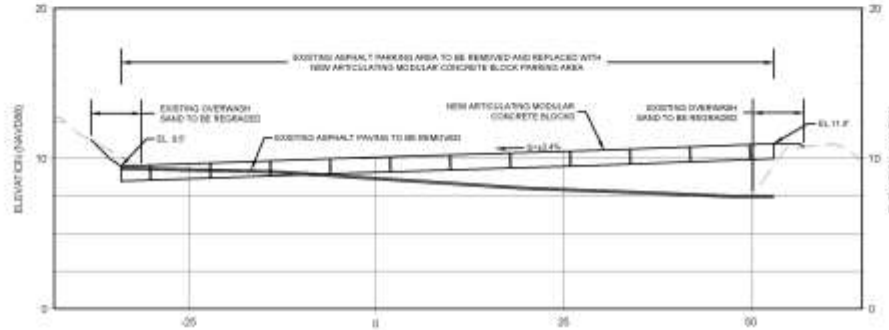
1) SHOREBLOCK® UNITS ARE MANUFACTURED IN ACCORDANCE WITH ASTM C90 AND C140 AND THE FOLLOWING CRITERIA:
   A) CONCRETE UNIT WEIGHT - 130 - 150 LBS/CF
   B) MINIMUM COMPRESSIVE STRENGTH - 4,000 PSI
   C) MAXIMUM ABSORPTION - 5 %
   D) DIMENSIONAL TOLERANCE ± 1/8"
2) GALVANIZED OR POLYESTER CABLING

NOTE:

UNIT	WEIGHT LBS.	COVERAGE (lbs/sq.ft)	OPEN AREA
80-500 DC	71 - 78	42 - 44	20%

ASSEMBLY SPECIFICATIONS

1) SHOREBLOCK® UNITS ARE SHOP ASSEMBLED IN A CABLED MATTRESS AS SHOWN ABOVE.
2) SHOREBLOCK® MATS ARE PLACED BY THE CONTRACTOR IN THE FIELD



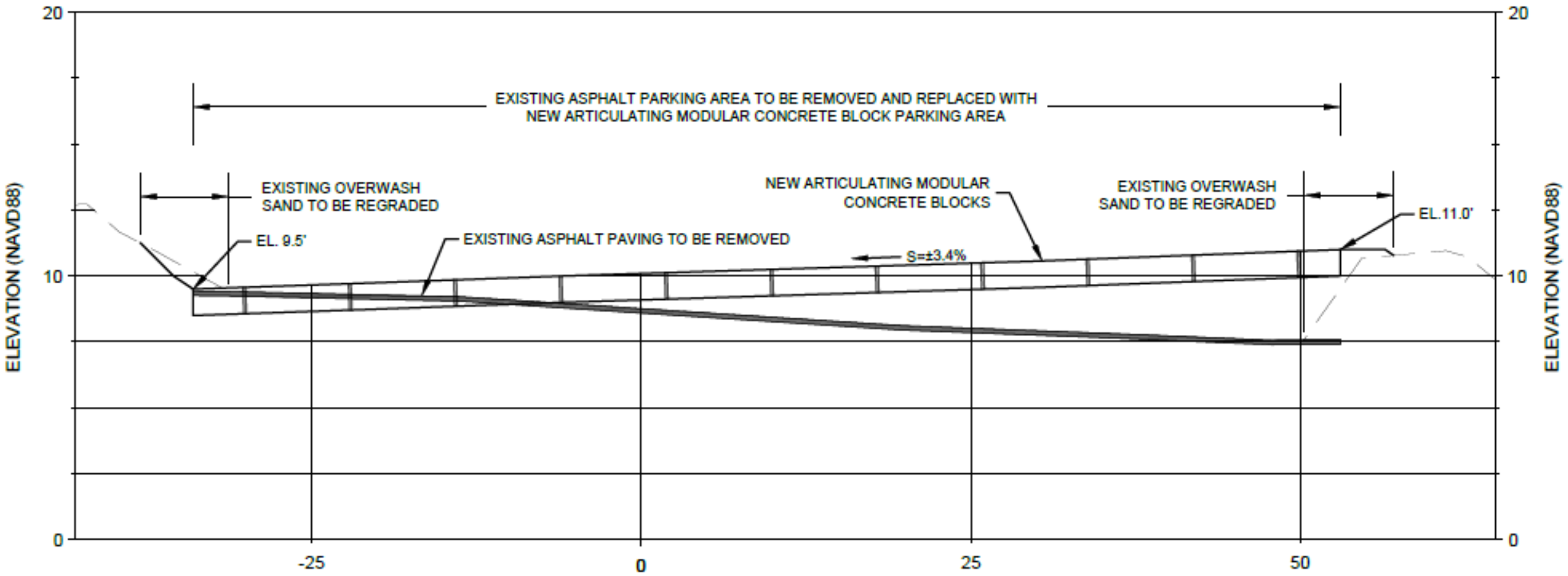
TYPICAL SECTION B-B
HORIZONTAL SCALE: 1"=10'
VERTICAL SCALE: 1"=5'

NOTES:
SEE SHEET 1 FOR NOTES

PROJECT: MANT'S LANDING
BREWSTER, MASSACHUSETTS

CLIENT: TOWN OF BREWSTER
2198 MAIN STREET, BREWSTER MA 02631

cleengineering



TYPICAL SECTION B-B

HORIZONTAL SCALE: 1"=10'

VERTICAL SCALE: 1"=5'

Articulating concrete mat

Blocks connected with flexible cable

Developing a Coastal Adaptation Strategy for Brewster

- CZM Coastal Community Resiliency Grant 2016
  - $222,000 ($160,000 grant, $62,000 local match)
- Develop a consensus-based Coastal Adaptation Strategy.
  - A measured and detailed public engagement process is the next step in adapting to Brewster's future coastal change and erosion issues.

Climate Adaptation

- Brewster's entire coast is currently in the FEMA VE flood zone and most or all of its tidal marsh and creek system are mapped as AE.
- There are 1,138 land parcels within these zones.
- In the past five years, extensive parts of coastal Brewster have been exposed to storm surge impacts, including dune washover, flooding and significant erosion. In some areas, up to 20 feet of dune/coastal bank have been lost in a single storm event.

Public Beach Access Issues

2014:

- 6,411 resident beach stickers
- 4,355 seasonal and visitor stickers

- Approximately 300 total spaces
- Stickers required 9am to 3pm daily June 15 through labor day.

20, 40 and 60 Years

- Brewster BCAG chose the following timeframes and future scenarios for the mapping and analyses of sea level rise and storm surge impacts on Brewster's coast:
  - Time horizons of 20 years and a one foot rise in sea level, 40 years (~ two feet), and 60 years (~ four ft) to provide for both short- and long- term impacts, and
  - Storm surge levels of two, four, and eight feet.

Final Report: Coastal Adaptation Strategy