

Mercator projection  
Geodetic Reference System 1980, North American Datum of 1983  
Longitude of central meridian 70°19' W; latitude of true scale 41°39' N  
False easting 0 m; false northing 0 m  
This map is not intended for navigational purposes

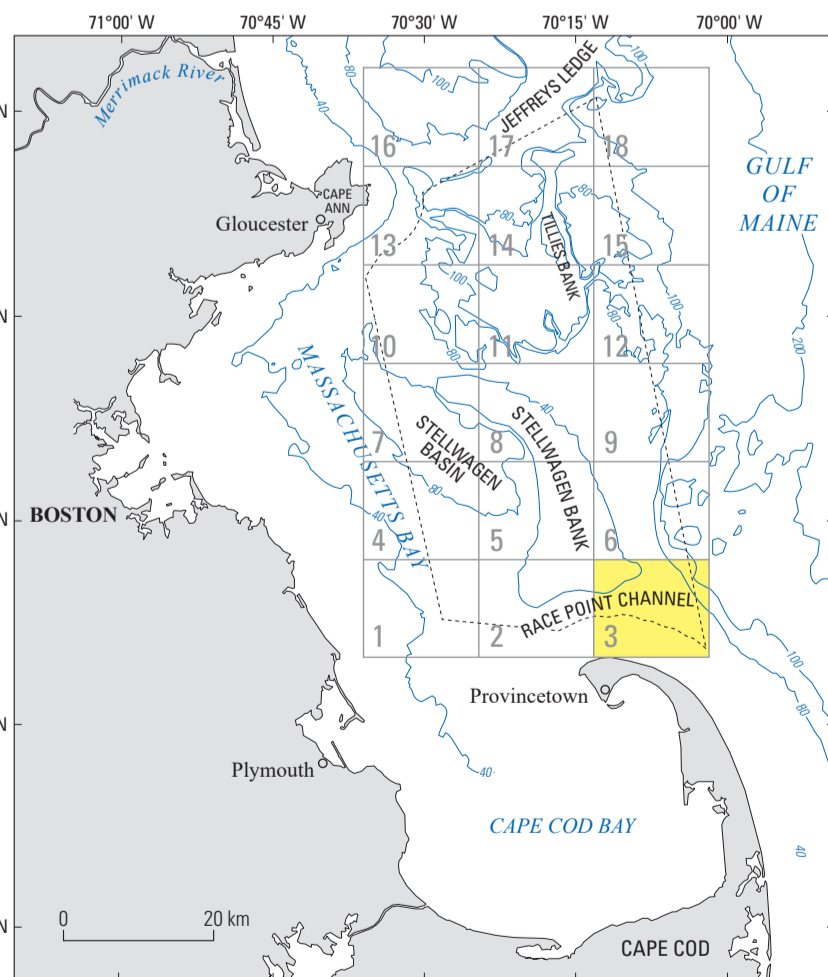
SCALE 1:25 000  
ONE CENTIMETER ON THE MAP REPRESENTS 250 METERS ON THE SEA FLOOR  
2 NAUTICAL MILES

CONTOURS SHOW SEABED DEPTH BELOW DATUM; CONTOUR INTERVALS 5 METERS  
ADDITIONAL 1-METER CONTOURS INCLUDED TO SHOW BOTTOM ROUGHNESS  
DATUM MEAN LOWER LOW WATER

**DESCRIPTION OF MAP UNITS**

- A1\_r\_cgS** Rippled, coarse-grained sand—Water depth range of the mapped substrate: 30 to 60 m. Grain-size categories: mud, <1; sand, 94 (fgS, 2; cgS, 92); gravel, 6 (G<sub>1</sub>, 6; G<sub>2</sub>, <1)
- A2\_i\_cgS** Immobile, coarse-grained sand—Water depth range of the mapped substrate: ~55 to 80 m. Grain-size categories: mud, 1; sand, 98 (fgS, 10; cgS, 88); gravel, 2 (G<sub>1</sub>, 2; G<sub>2</sub>, 0)
- C\_i\_cbG** Immobile, cobble, boulder gravel—Water depth range of the mapped substrate: >25 to 87 m
- E\_l\_cgS** Immobile, coarse-grained sand—Water depth range of the mapped substrate: 75 to 80 m. Substrate E is not represented by any samples in quadrangle 3, and it is interpreted to be a short extension (1.5 km) of substrate E from the adjoining quadrangle 6 to the north (Valentine and Gallea, 2015)
- FL\_cgS/pcbG** Immobile, coarse-grained sand; partial veneer on pebble, cobble, boulder gravel—Water depth range of the mapped substrate: 85 to 115 m. Upper layer grain-size categories: mud, 5; sand, 56 (fgS, 40; cgS, 16); gravel, 39 (G<sub>1</sub>, 15; G<sub>2</sub>, 24)
- G1\_i\_mfgS** Immobile, muddy, fine-grained sand—Water depth range of the mapped substrate: 70 to 135 m. Grain-size categories: mud, 6; sand, 88 (fgS, 69; cgS, 20); gravel, 6 (G<sub>1</sub>, 3; G<sub>2</sub>, 3)
- Y\_r\_cgS** Rippled, coarse-grained sand—Water depth range of the mapped substrate: 60 to 63 m. Grain-size categories: mud, 3; sand, 96 (fgS, 36; cgS, 60); gravel, 1 (G<sub>1</sub>, 1; G<sub>2</sub>, 0)
- Z\_r\_cgS** Rippled, coarse-grained sand—Water depth range of the mapped substrate: 43 to 62 m. Grain-size categories: mud, 1; sand, 97 (fgS, 5; cgS, 91); gravel, 3 (G<sub>1</sub>, 2; G<sub>2</sub>, 1)
- AB\_r\_fgS** Rippled, fine-grained sand—Water depth range of the mapped substrate: ~49 to 55 m. Substrate AB is not represented by any samples in quadrangle 3, and it is interpreted to be a short extension of substrate AB from the adjoining quadrangle 2 to the west (Valentine and Cross, 2024c)
- AC\_r\_cgS** Rippled, coarse-grained sand—Water depth range of the mapped substrate: 59 to 60 m. Grain-size categories: mud, 2; sand, 98 (fgS, 12; cgS, 86); gravel, <1 (G<sub>1</sub>, <1; G<sub>2</sub>, 0)
- AG\_r\_cgS** Rippled, coarse-grained sand—Water depth range of the mapped substrate: ~50 to ~60 m. Substrate AG is not represented by any samples in quadrangle 3, and it is interpreted to be a short extension of substrate AG from the adjoining quadrangle 2 to the west (Valentine and Cross, 2024c)
- AI\_r\_cgS** Rippled, coarse-grained sand—Water depth range of the mapped substrate: 43 to 55 m. Grain-size categories: mud, <1; sand, 90 (fgS, 4; cgS, 85); gravel, 10 (G<sub>1</sub>, 6; G<sub>2</sub>, 5)
- AJ\_i\_cgS** Immobile, coarse-grained sand—Water depth range of the mapped substrate: 110 to 111 m. Grain-size categories: mud, 9; sand, 88 (fgS, 29; cgS, 59); gravel, 3 (G<sub>1</sub>, 3; G<sub>2</sub>, 0)
- AK\_i\_cgS/pcbG** Immobile, coarse-grained sand; partial veneer on pebble, cobble, boulder gravel—Water depth range of the mapped substrate: 55 to 61 m. Upper layer grain-size categories: mud, 2; sand, 84 (fgS, 12; cgS, 72); gravel, 13 (G<sub>1</sub>, 5; G<sub>2</sub>, 9)
- AL\_r\_gcgS/i\_pcG** Rippled, gravely, coarse-grained sand; partial veneer on immobile, pebble, cobble gravel—Water depth range of the mapped substrate: 45 to 53 m. Upper layer grain-size categories: mud, <1; sand, 56 (fgS, 17; cgS, 39); gravel, 44 (G<sub>1</sub>, 5; G<sub>2</sub>, 39)
- AM\_r\_cgS** Rippled, coarse-grained sand—Water depth range of the mapped substrate: 40 to 64 m. Grain-size categories: mud, 1; sand, 98 (fgS, 4; cgS, 94); gravel, 1 (G<sub>1</sub>, 1; G<sub>2</sub>, <1)
- AN\_r\_cgS** Rippled, coarse-grained sand—Water depth range of the mapped substrate: 45 to 50 m. Grain-size categories: mud, <1; sand, 99 (fgS, 32; cgS, 67); gravel, 1 (G<sub>1</sub>, 1; G<sub>2</sub>, 0)
- AO\_r\_cgS** Rippled, coarse-grained sand—Water depth range of the mapped substrate: 28 to 55 m. Grain-size categories: mud, 1; sand, 97 (fgS, 3; cgS, 94); gravel, 2 (G<sub>1</sub>, 2; G<sub>2</sub>, 1)
- AP\_r\_cgS/i\_pcbG** Rippled, coarse-grained sand; partial veneer on immobile, pebble, cobble, boulder gravel—Water depth range of the mapped substrate: 30 to 51 m. Upper layer grain-size categories: mud, <1; sand, 92 (fgS, 3; cgS, 89); gravel, 8 (G<sub>1</sub>, 5; G<sub>2</sub>, 3)
- AQ\_r\_fgS** Rippled, fine-grained sand—Water depth range of the mapped substrate: 50 to 61 m. Grain-size categories: mud, 3; sand, 96 (fgS, 62; cgS, 34); gravel, 1 (G<sub>1</sub>, <1; G<sub>2</sub>, <1)

- AX\_l\_cgS/pcbG** Immobile, coarse-grained sand; partial veneer on pebble, cobble, boulder gravel—Water depth range of the mapped substrate: 55 to 61 m. Upper layer grain-size categories: mud, 2; sand, 84 (fgS, 12; cgS, 72); gravel, 13 (G<sub>1</sub>, 5; G<sub>2</sub>, 9)
- AL\_r\_gcgS/i\_pcG** Rippled, gravely, coarse-grained sand; partial veneer on immobile, pebble, cobble gravel—Water depth range of the mapped substrate: 45 to 53 m. Upper layer grain-size categories: mud, <1; sand, 56 (fgS, 17; cgS, 39); gravel, 44 (G<sub>1</sub>, 5; G<sub>2</sub>, 39)
- AM\_r\_cgS** Rippled, coarse-grained sand—Water depth range of the mapped substrate: 40 to 64 m. Grain-size categories: mud, 1; sand, 98 (fgS, 4; cgS, 94); gravel, 1 (G<sub>1</sub>, 1; G<sub>2</sub>, <1)
- AN\_r\_cgS** Rippled, coarse-grained sand—Water depth range of the mapped substrate: 45 to 50 m. Grain-size categories: mud, <1; sand, 99 (fgS, 32; cgS, 67); gravel, 1 (G<sub>1</sub>, 1; G<sub>2</sub>, 0)
- AO\_r\_cgS** Rippled, coarse-grained sand—Water depth range of the mapped substrate: 28 to 55 m. Grain-size categories: mud, 1; sand, 97 (fgS, 3; cgS, 94); gravel, 2 (G<sub>1</sub>, 2; G<sub>2</sub>, 1)
- AP\_r\_cgS/i\_pcbG** Rippled, coarse-grained sand; partial veneer on immobile, pebble, cobble, boulder gravel—Water depth range of the mapped substrate: 30 to 51 m. Upper layer grain-size categories: mud, <1; sand, 92 (fgS, 3; cgS, 89); gravel, 8 (G<sub>1</sub>, 5; G<sub>2</sub>, 3)
- AQ\_r\_fgS** Rippled, fine-grained sand—Water depth range of the mapped substrate: 50 to 61 m. Grain-size categories: mud, 3; sand, 96 (fgS, 62; cgS, 34); gravel, 1 (G<sub>1</sub>, <1; G<sub>2</sub>, <1)



Location Map. Map showing the location of quadrangle 3 (highlighted in yellow) of the Stellwagen Bank National Marine Sanctuary region offshore of Boston, Massachusetts. The numbered grid indicates the quadrangles of the U.S. Geological Survey multibeam sonar substrate-mapping project. The dashed line represents the Stellwagen Bank National Marine Sanctuary boundary. Bathymetric contours are labeled in meters and the contour interval is variable. Figure modified from Valentine and Cross (2024d).

**Sheet 2.—Seabed geology and sun-illuminated topography**  
**Map D.—Distribution of Geologic Substrates**

Seabed Maps Showing Topography, Ruggedness, Backscatter Intensity, Sediment Mobility, and the Distribution of Geologic Substrates in Quadrangle 3 of the Stellwagen Bank National Marine Sanctuary Region Offshore of Boston, Massachusetts

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2026

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.  
For sale by U.S. Geological Survey, Box 25086, Denver Federal Center, Denver, CO 80225.  
https://www.usgs.gov/1-888-AS4-USGS (1-888-275-8747)  
Suggested citation: Valentine, P.C., and Cross, V.A., 2026, Seabed geology and sun-illuminated topography, sheet 2 of Distribution of geologic substrates, map D of seabed maps showing topography, ruggedness, backscatter intensity, sediment mobility, and the distribution of geologic substrates in quadrangle 3 of the Stellwagen Bank National Marine Sanctuary region offshore of Boston, Massachusetts: U.S. Geological Survey Scientific Investigations Map 3544, 8 sheets, scale 1:25,000, 30-p pamphlet, https://doi.org/10.3122/sim3544.  
Associated data for this publication: Valentine, P.C., and Cross, V.A., 2026, Geospatial datasets of seabed topography, sediment mobility, and the distribution of geologic substrates in quadrangle 3 of the Stellwagen Bank National Marine Sanctuary region offshore of Boston, Massachusetts: U.S. Geological Survey data release, https://doi.org/10.3122/dri3544.