# Hingham Natural Resource Evolution Summary

***These results are part of the Statewide Modeling the Effects of Sea Level Rise on Coastal Wetlands for Massachusetts Coastal Zone Management. (ENV 14 CZM 08 in publication, 2015).***

*Elevation information:*

High resolution elevation data may be the most important Sea Level Affecting Marsh Migration (SLAMM) model data requirement, since the elevation data demarcate not only where salt penetration is expected, but also the frequency of inundation for wetlands and marshes when combined with tidal range data. Input elevation data also helps define the lower elevation range for beaches, wetlands and tidal flats, which dictates when they should be converted to a different land-cover type or open water due to an increased frequency of inundation.

For this project, LiDAR was acquired from MassGIS. The majority of the state was covered with the 2011 USGS LiDAR for the Northeast project, and this covers the Hingham area. In order to reduce processing time within the SLAMM model, areas of higher elevation within each regional panel that are unlikely to be affected by coastal processes, such as sea level rise, were excluded prior to processing; all areas above an elevation of 60 feet (NAVD88) were clipped from the input files.

*Wetland Classification Information:*

The 2011 wetland layer developed by the National Wetlands Inventory (NWI) is used as the baseline source for the wetlands input file for marsh migration modeling.

Utilizing the NWI data had two key benefits over the 1990s MassDEP wetland layer. First, the NWI data not only provided a more recent dataset, but also matches that of the LiDAR datasets. Although different input years were used, most of the LiDAR data used was collected in or around 2011.

The second benefit to utilizing the NWI data is that it streamlined the conversion between source wetland categories and Sea Level Affecting Marsh Migration (SLAMM) model wetland codes. The documentation provided with the SLAMM software contains a key to convert each NWI classification to the wetland classification system used by SLAMM. A summary of this conversion key is present in Table 1.

*Sea Level Rise Projections:*

The Sea Level Rise (SLR) projections are consistent with those used in the BH-FRM modeling to produce the inundation risk maps. As such, there SLR used in the marsh migration modeling is consistent with the values used it the flood risk modeling.

*Additional data input:*

Additional model input includes, but is not limited to, Accretion rates (marsh, beach, etc.), erosion rates, tidal range and attenuation, freshwater parameters, dikes and dams, and impervious surfaces. For complete details, see the Statewide Modeling: the Effects of Sea Level Rise on Coastal Wetlands for Massachusetts Coastal Zone Management. (ENV 14 CZM 08 in publication, 2015).

**Table 1. NWI Category to SLAMM code conversion table.**

| | | NWI Code Characters | | | | | |
|---|---|---|---|---|---|---|---|
| **SLAMM Code** | **SLAMM Name** | **System** | **Subsystem** | **Class** | **Subclass** | **Water Regime** | **Notes** |
| 1 | Developed Dryland | U | | | | | Upland |
| 2 | Undeveloped Dryland | U | | | | | Upland |
| 3 | Nontidal Swamp | P | NA | FO, SS | 1, 3 to 7, None | A,B,C,E,F,G,H,J,K, None or U | Palustrine Forested and Scrub-Shrub |
| 4 | Cypress Swamp | P | NA | FO, SS | 2 | A,B,C,E,F,G,H,J,K, None or U | Needle-leaved Deciduous Forest and Scrub-Shrub |
| 5 | Inland Fresh Marsh | P | NA | EM, f** | All, None | A,B,C,E,F,G,H,J,K, None or U | |
| | | L | 2 | EM | 2, None | E,F,G,H,K, None or U | Palustrine Emergents; Lacustrine and Riverine |
| | | R | 2, 3 | EM | 2, None | E,F,G,H,K, None or U | Nonpersistent Emergents |
| 6 | Tidal Fresh Marsh | R | 1 | EM | 2, None | Fresh Tidal N, T | |
| | | P | NA | EM | All, None | Fresh Tidal S, R, T | Riverine and Palustrine Freshwater Tidal Emergen |
| 7 | Transitional Marsh / Scrub Shrub | E | 2 | FO, SS | 1, 2, 4 to 7, None | Tidal M, N, P, None or U | Estuarine Intertidal, Scrub-shrub and Forested (ALL except 3 subclass) |
| 8 | Regularly Flooded Marsh | E | 2 | EM | 1, None | Tidal N, None or U | Only regularly flooded tidal marsh; No intermittently flooded "P" water regime |
| 9 | Mangrove | E | 2 | FO, SS | 3 | Tidal M, N, P, None or U | Estuarine Intertidal Forested and Scrub-shrub, Broad-leaved Evergreen |
| 10 | Estuarine Beach | E | 2 | US | 1,2 | Tidal N,P | Estuarine Intertidal Unconsolidated Shores |
| | | E | 2 | US | None | Tidal N,P | Only when shores |
| 11 | Tidal Flat | E | 2 | US | 3,4, None | Tidal M, N, None or U | Estuarine Intertidal Unconsolidated Shore (mud or organic) and Aquatic Bed; Marine Intertidal Aquatic Bed |
| | | E | 2 | AB | All, Except 1 | Tidal M, N, None or U | |
| | | E | 2 | AB | 1 | P | Specifically for wind-driven tides on the south coast of TX |
| | | M | 2 | AB | 1, 3, None | Tidal M, N, None or U | |
| 12 | Ocean Beach | M | 2 | US | 1, 2 | Tidal N, P | Marine Intertidal Unconsolidated Shore, cobble-gravel, sand |
| | | M | 2 | US | None | Tidal P | |
| 13 | Ocean Flat | M | 2 | US | 3, 4, None | Tidal M, N, None or U | Marine Intertidal Unconsolidated Shore, mud or organic, (low energy coastline) |
| 14 | Rocky Intertidal | M | 2 | RS | All, None | Tidal M, N, P, None or U | |
| | | E | 2 | RS | All, None | Tidal M, N, P, None or U | |
| | | E | 2 | RF | 2, 3, None | Tidal M, N, P, None or U | Marine and Estuarine Intertidal Rocky Shore and Reef |
| | | E | 2 | AB | 1 | Tidal M, N, None or U | |
| 15 | Inland Open Water | R | 2 | UB, AB | All, None | All, None | |
| | | R | 3 | UB, AB, RB | All, None | All, None | |
| | | L | 1, 2 | UB, AB, RB | All, None | All, None | |
| | | P | NA | UB, AB, RB | All, None | All, None | Riverine, Lacustrine, and Palustrine |
| | | R | 5 | UB | All | Only U | Unconsolidated Bottom, and Aquatic Beds |
| 16 | Riverine Tidal Open Water | R | 1 | All, Except EM | All, None, Except 2 | Fresh Tidal S, R, T, V | Riverine Tidal Open Water |
| 17 | Estuarine Open Water | E | 1 | All | All, None | Tidal L, M, N, P | Estuarine subtidal |
| 18 | Tidal Creek | E | 2 | SB | All, None | Tidal M, N, P; Fresh Tidal R, S | Estuarine intertidal streambed |
| 19 | Open Ocean | M | 1 | All | All | Tidal L, M, N, P | Marine Subtidal and Marine Intertidal Aquatic |
| | | M | 2 | RF | 1, 3, None | Tidal M, N, P, None or U | Bed and Reef |
| 20 | Irregularly Flooded Marsh | E | 2 | EM | 1, 5, None | P | Irregularly Flooded Estuarine Intertidal Emergent marsh |
| | | E | 2 | US | 2, 3, 4, None | P | Only when these salt pans are associated with E2EMN or P |
| 21 | NotUsed | | | | | | |
| 22 | Inland Shore | L | 2 | US, RS | All | All Nontidal | |
| | | P | NA | US | All, None | All Nontidal, None or U | |
| | | R | 2, 3 | US, RS | All, None | All Nontidal, None or U | Shoreline not pre-processed using tidal range |
| | | R | 4 | SB | All, None | All Nontidal, None or U | elevations |
| 23 | Tidal Swamp | P | NA | FO, SS | All, None | Fresh Tidal R, S, T | Tidally influenced swamp |

Figures 1 through 3 show the wetland classification areas for 2011, 2030, and 2070 respectively. Figure 1 presents the current conditions, as defined by the NWI (with the exception of Non-tidal upland swamp). Subsequently, Figure 2 shows the change in wetland classification locations projected to 2030, impacted by SLR. Similarly, Figure 3 shows the change in wetland classification locations projected to 2070, impacted by SLR.

*Primary Areas where natural resources are evolving in response to SLR:*

- Broad Cove
    - By 2030, Broad Cove shows a reduction in transitional marsh, which has been converted to a mix of low and high marsh. Fringing high marsh begins to transition to low marsh and the estuarine open water (subtidal portions of the Cove) has expanded. There is also a relatively significant loss of upland area in the region.
    - By 2070, there is a major loss of upland area, all existing high marsh has essentially disappeared and has transitioned to low marsh and/or unvegetated tidal flats. While there is some room for marsh migration, Broad Cove has become a degraded system by 2070.

- Home Meadow - The Home Meadow system shows growth of the Tidal Creeks/ Estuarine Open Waters resources in 2030, and continued expansion by 2070. Due to the restricted tidal signal in this region, the existing marsh regions (including low, high, and transitional areas all remain relatively constant through time.

- Hingham Harbor Shoreline – The shoreline shows retreat through 2030, with conversion of beach and upland to open water areas. By 2070, there is a significant loss of shoreline area transitioning to open water resources. There is also the start of some transitional marsh resources in areas that were previously upland.

- World's End – The World's End area, which currently consists of estuarine open water with fringing transitional marsh area, converts to all open water by 2030, and then expands into upland areas and forms unvegetated tidal flats and some fringing marsh area.

- Foundry Pond and Lyford Lyking Area – These areas, in the northeast corner of Hingham show minor changes by 2030 with slight loss of upland and marsh expansion. By 2070; however, there is a significant transition of high marsh to low marsh, loss of major uplnd areas, and connection of various marsh regions along the river. Tidal creeks have also expanded and created a system that is transitioning to open water from marsh.

- Back River and Beal Cove – The areas along the Back River show minimal changes between 2011 and 2030, with the exception of minor shoreline retreat. By 2070, the tidal creeks have expanded and there is loss of upland area and estuarine beach. All high marsh has either transitioned to open water or low marsh in this area.

*Major changes from 2011 to 2030:*

Town-wide there is a significant loss of area identified in three major classifications:

- Loss of approximately 13 acres of irregularly flooded marsh (high marsh). This is loss of high marsh that is transitioning to low marsh, which is not necessarily a problem, at least initially.
- Loss of approximately 10-30 acres of upland area. As expected, this loss occurs along the edges of water bodies (in the areas discussed above).
- Loss of 28 acres of transitional marsh, where marsh is converted to high marsh.

Town-wide there is a significant gain of area identified in two major classifications:

- Gain of approximately 28 acres of regularly flooded marsh (low marsh).
- Gain of approximately 25 acres of tidal flats.

*Major changes from 2030 to 2070:*

Town-wide there is a significant loss of area identified in three major classifications:

- Loss of approximately 92 additional acres of irregularly flooded marsh (high marsh). This is loss of high marsh that is transitioning to low marsh, which is not necessarily a problem, at least initially.
- Loss of approximately 70 to 100 additional acres of upland area. As expected, this loss occurs along the edges of water bodies (in the areas discussed above).
- Loss of 26 acres of estuarine beach. This occurs along the edge of estuaries and results in the expansion of Tidal Creeks.

Town-wide there is a significant gain of area identified in three major classifications:

- Gain of approximately 100 additional acres of regularly flooded marsh (low marsh), a lot of area that was formerly upland has transitioned all the way to low marsh, especially in the Broad Cove region.
- Gain of approximately 32 additional acres of tidal flats, most occurring in the Broad Cove region.

- Gain of approximately 38 acres of Tidal Creeks, likely expansion of existing creeks and formation of new creeks.

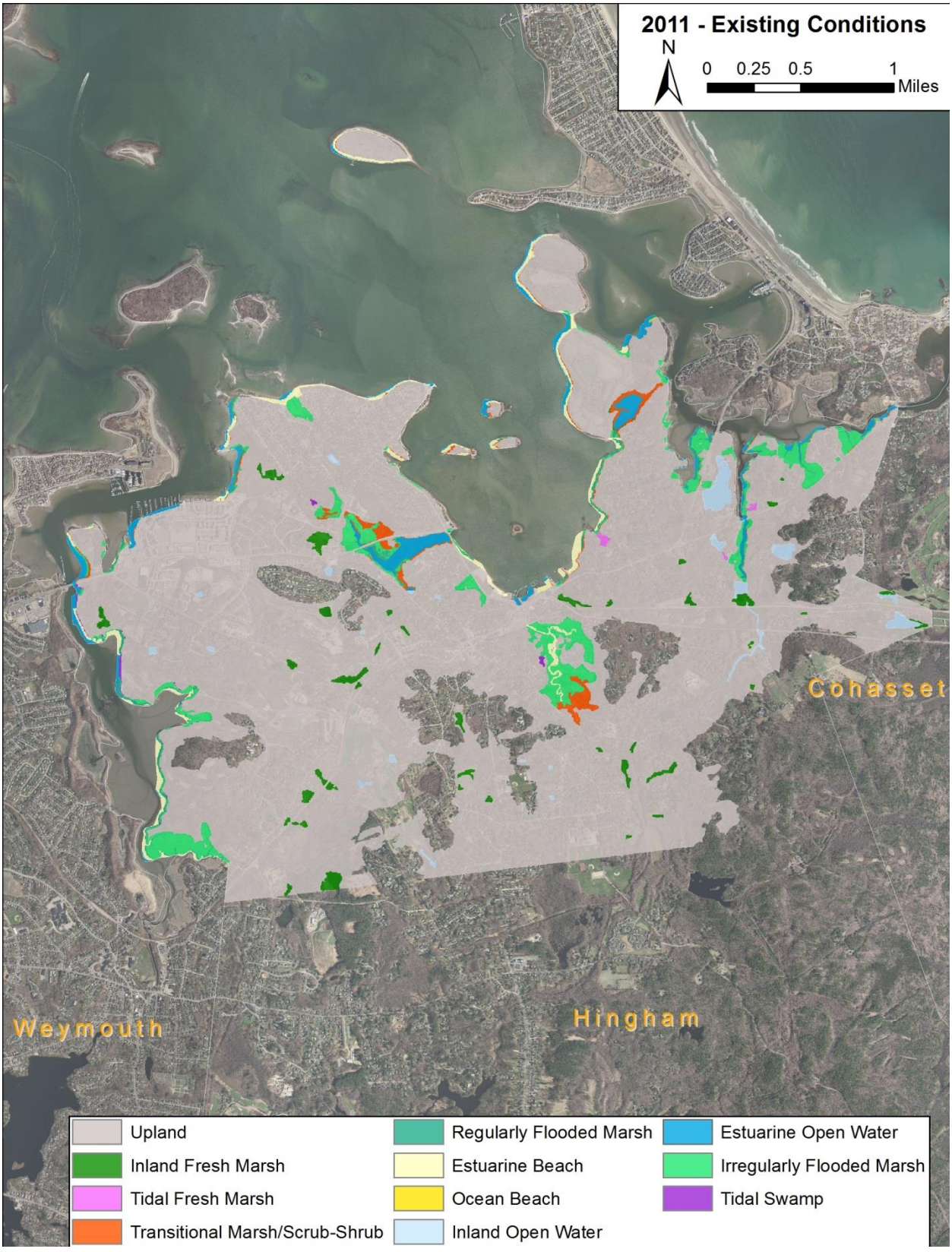


**Figure 1. 2011 Wetland classification areas in Hingham.**

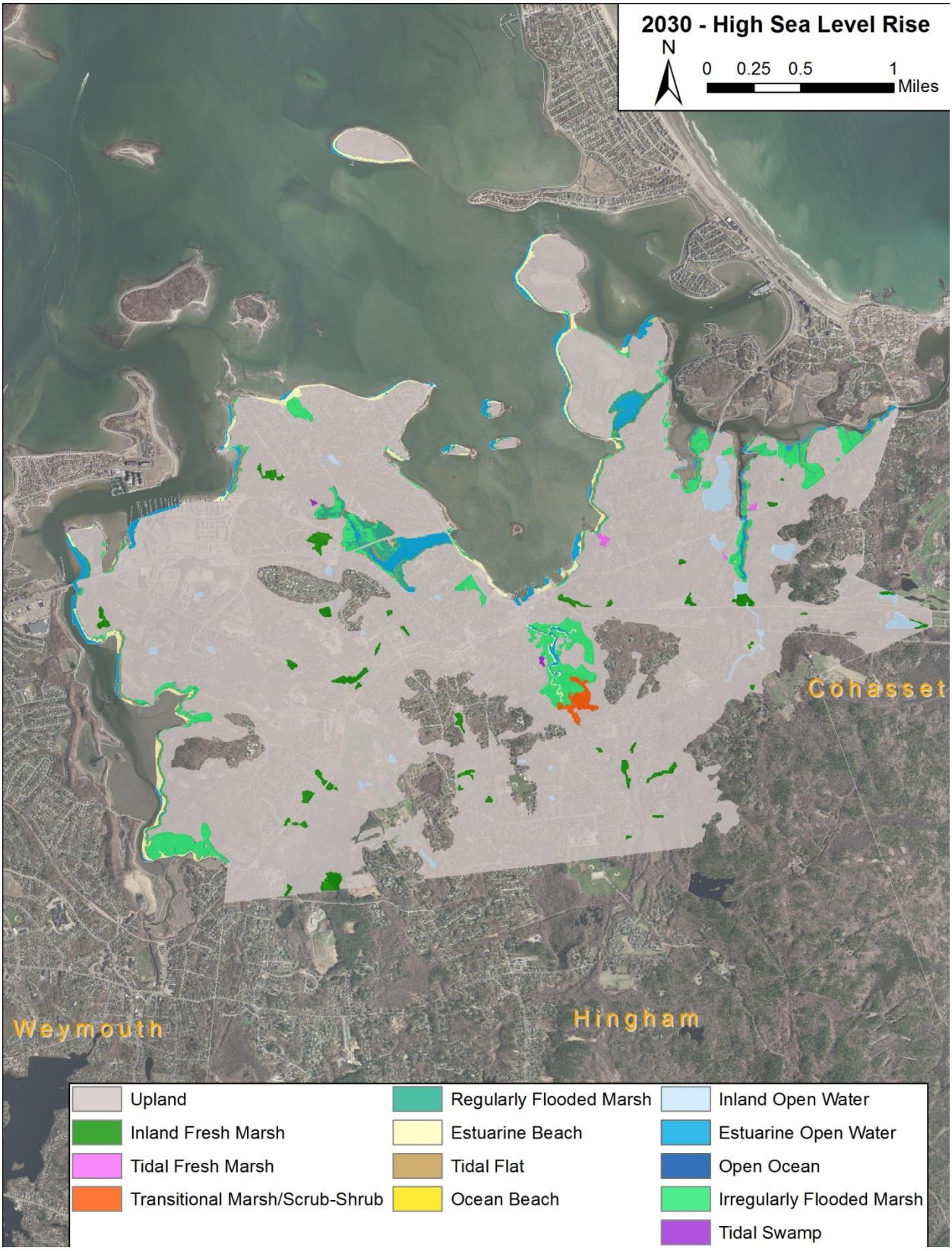


**Figure 2. 2030 Wetland classification areas in Hingham.**

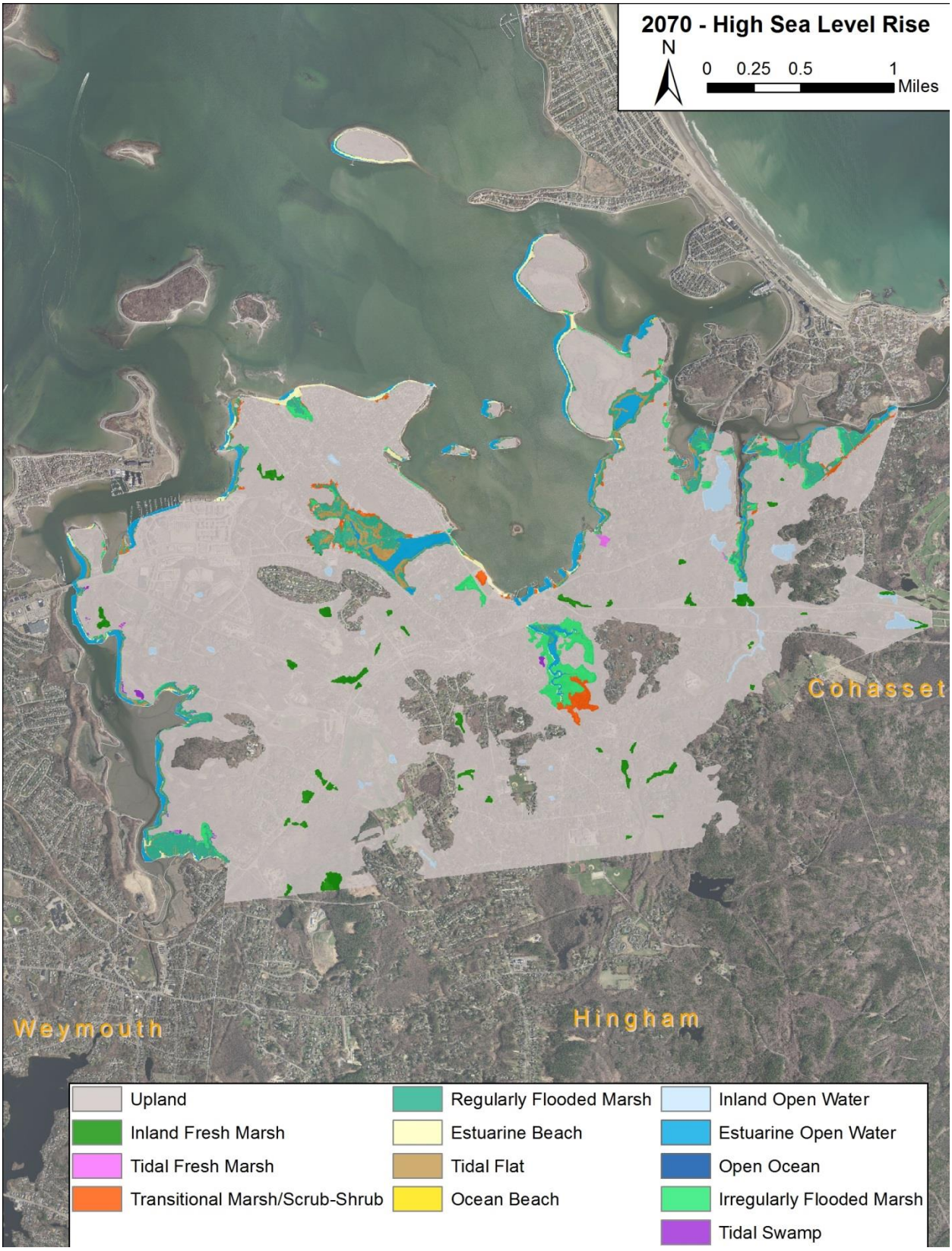


**Figure 3. 2070 Wetland classification areas in Hingham.**