

Place Vulnerability and Risk to Property: Flood Risk and Adaptive Capacity in the Salem Sound Area

By Kaiba White



Background

As climate change progresses, projected impacts in the Northeast United States include increased coastal and precipitation-based flooding. Sea-level rise has the potential not only to permanently inundate low-lying coastal areas, but also to increase the magnitude of storm surges. Precipitation-based flooding is expected due to changing precipitation patterns. Less winter snow and more winter rain will make winter flooding more common over the next century. Both coastal flooding and precipitation-based flooding can be potentially dangerous and costly to a community. The six coastal communities of Marblehead, Salem, Peabody, Danvers, Beverly and Manchester in the Salem Sound area of Massachusetts may potentially be impacted by both types of flooding.

Methodology

A place-based vulnerability assessment was conducted for the six communities in the Salem Sound area. The place-based approach combines physical vulnerability with social vulnerability to determine place vulnerability.

Social vulnerability, or limited adaptive capacity, was examined using Census data from the 2000 Census. Those with limited Mobility Capacity, or the ability to evacuate in a flooding emergency, was determined to be the elderly, infants and toddlers, the physically and mentally disabled, elderly people living alone, those living below the poverty level and those households with no vehicle. The percentages for each of those variables were summed to create Mobility Capacity (Figure 1). Those with limited Resource Capacity, or the ability to prepare for or recover from a flooding event was determined to be households with no English speaker, those with no high school diploma, single parents, the unemployed and those living below the poverty level. The percentages for each of those variables were summed to create Resource Capacity (Figure 2). Combined, Mobility Capacity and Resource Capacity form Adaptive Capacity (Figure 3).

In this study, physical vulnerability is risk of increased flooding impacts. Based on projections of sea-level rise and storm surge over the next century, coastal land was selected at 2, 3 and 4 meters elevation (Figure 4). These coastal zones may be vulnerable to permanent inundation or increased storm surge impacts. Precipitation-based flooding was examined using existing 100-year and 500-year floodplains (Figure 5). Projections indicate that 100-year floodplains may flood once every 10 years by mid-century and 500-year floodplains will become the new 100-year floodplains. Therefore, these areas will experience increased risk.

Place vulnerability was determined for coastal zones and floodplains by overlaying them with the Mobility Capacity, Resource Capacity and Adaptive Capacity data (Figures 6 and 7).

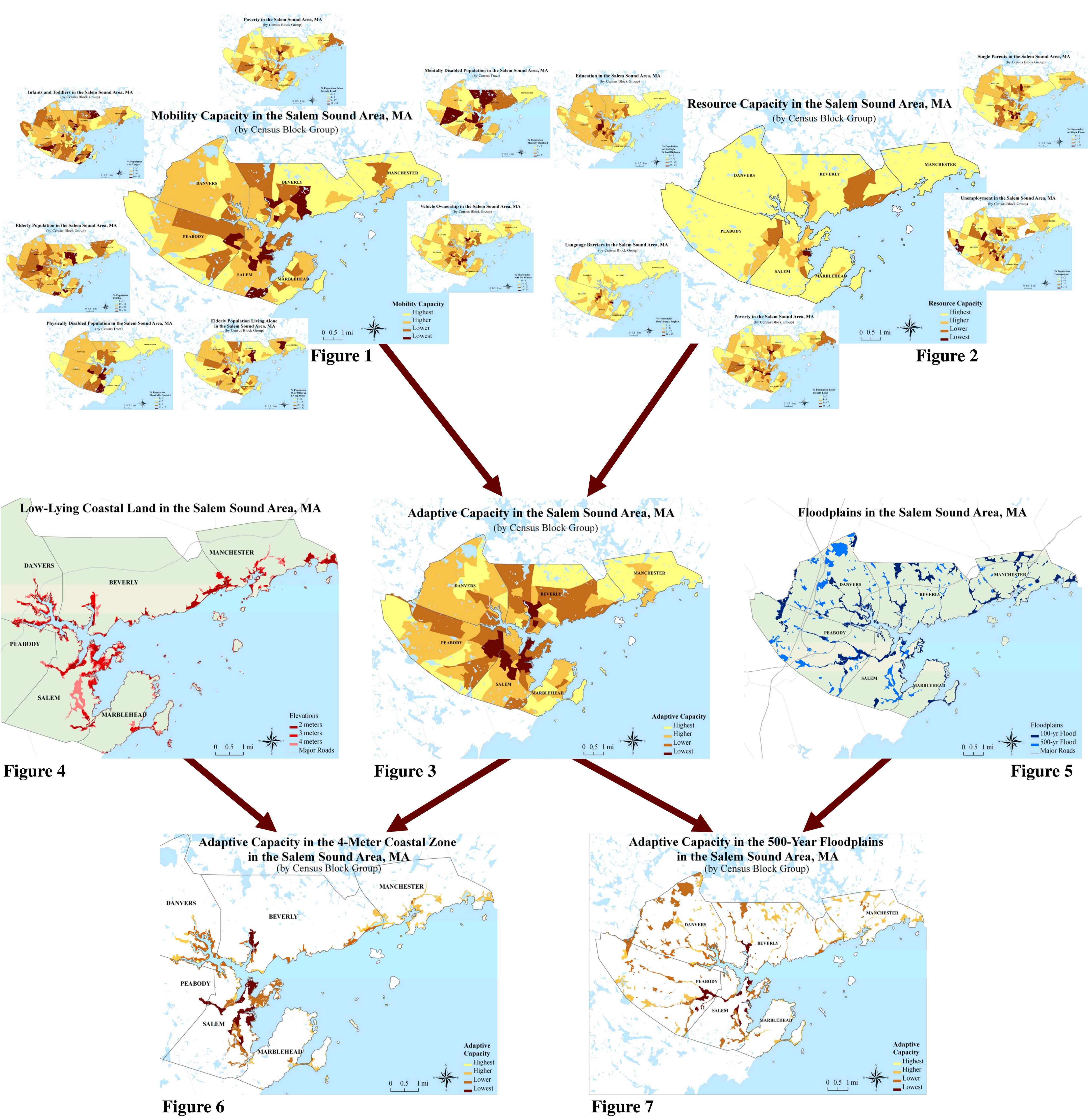
Risk of property loss or damage was determined first by calculating the acres of land by land use in each of the vulnerable zones in the Salem Sound area (Table 1). City of Beverly buildings at least partially within each of the vulnerable zones were selected and joined with building value data from the parcels layer. The values of all buildings were then summed for each zone (Table 2).

Findings

Areas with lower Mobility and Resource Capacities can be identified in the Salem Sound area. Those areas, shown in darker shades on Figures 1, 2, 3, 6 and 7, should be priority planning areas for municipal and state planning officials. Tables 1 and 2 can also be used to determine priority planning areas by identifying types and values of vulnerable land.

Vulnerable Zone	Land Use	Beverly (Acres)	Salem Sound (Acres)
2-Meter Coastal Zone	Residential	73	197
	Commercial	1	12
	Waste Disposal /Industrial	13	24
	Transportation	0	31
	Open Space	30	163
	Salt-Water Wetland	29	115
	Fresh-Water Wetland	11	202
	Agricultural	4	5
	Forest	11	39
	Total	172	788
3-Meter Coastal Zone	Residential	118	478
	Commercial	3	75
	Waste Disposal /Industrial	53	133
	Transportation	2	103
	Open Space	58	333
	Salt-Water Wetland	32	146
	Fresh-Water Wetland	11	229
	Agricultural	4	10
	Forest	40	108
	Total	321	1,615
4-Meter Coastal Zone	Residential	159	859
	Commercial	21	191
	Waste Disposal /Industrial	68	206
	Transportation	6	191
	Open Space	74	502
	Salt-Water Wetland	32	152
	Fresh-Water Wetland	12	276
	Agricultural	4	15
	Forest	48	177
	Total	424	2,569
100-yr Floodplain	Residential	153	580
	Commercial	4	103
	Waste Disposal /Industrial	45	165
	Transportation	0	86
	Open Space	66	406
	Salt-Water Wetland	33	147
	Fresh-Water Wetland	67	377
	Agricultural	13	30
	Forest	138	679
	Total	519	2,573
500-yr Floodplains	Residential	232	892
	Commercial	14	191
	Waste Disposal /Industrial	49	246
	Transportation	2	174
	Open Space	80	608
	Salt-Water Wetland	31	156
	Fresh-Water Wetland	92	815
	Agricultural	14	49
	Forest	281	1,313
	Total	795	4,444

Table 1



Vulnerable Zone	Beverly Buildings Value (in dollars)
2-Meter Coastal Zone	101,532,600
3-Meter Coastal Zone	1,033,923,600
4-Meter Coastal Zone	1,222,234,200
100-yr Floodplains	1,104,974,730
500-yr Floodplains	1,356,781,420

Table 2

Data Sources:

- Census 2000 data and Floodplain layer and Digital Elevation Model from Mass GIS.
- Parcels and Building layers and data from the City of Beverly (2007).

Projection:
Lambert_Conformal_Conic
NAD_1983_StatePlane_Massachusetts_Mainland_FIPS_2001, meters