Status and Trends of Coastal Hazard Exposure and Mitigation Policies for the Texas Coast: The Mitigation Policy Mosaic of Coastal Texas

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List of Acronyms

CMP – (Texas) Coastal Management Program

FEMA – Federal Emergency Management Agency

FIRM – Flood Insurance Rate Map

GIS – Geographic Information Systems

ICC – International Code Council

IBC – International Building Codes

IRC – International Residential Codes

NFIP – National Flood Insurance Program

TDI – Texas Department of Insurance

TGLO – Texas General Land Office

TMP – Texas Hazard Mitigation Plan

TWIA – Texas Wind Insurance Agency

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1. Introduction

Effective hazard mitigation is predicated upon the implementation of mitigation policies that are consistent with the hazard and risk exposure of a particular geographical area. More specifically, hazard mitigation policies such as building codes, floodplain management, flood insurance, and land use policies should reflect an area's exposure and risk to particular hazards. Hence, the expectation would be that the nature, quality, and strength of building codes should, for example, reflect the wind and flooding risk that structures are likely to face in particular areas. A community that has greater exposure and risk to hurricane winds should have building codes that are appropriate for this exposure and risk levels. Similarly, areas subject to flooding would be expected to undertake land-use planning and zoning policies and ordinances to help ensure that development is not taking place in areas subject to flooding. This type of mitigation planning may be part of a comprehensive plan or as part of an independent hazard mitigation plan.

In some states, local areas such as municipalities and counties are subject to statewide mandates for the development of comprehensive plans that include hazard assessments and land-use planning in response to these assessments that appropriately address hazard exposure and risk to lessen potential impacts. Similarly, some states have adopted a statewide building code that specifically identifies high hazard areas and adjust the nature of building codes in these areas to address the higher levels of potential hazard risk. Texas does not have statewide mandates for hazard mitigation planning or comprehensive planning. In Texas, most planning activities, such as building codes and land-use planning must be addressed at the local level by municipalities that have "home rule"[1] capabilities. To the extent that mitigation planning takes place, it has often been in response to the Federal Emergency Management Agency's (FEMA) requirements that have promoted these activities (Peacock et. al 2009). The Texas Department of Insurance (TDI) does develop a statewide building code based on the International Residential and Building Codes (IRB/IBC) with Texas revisions and promotes the adoption of the code. However there are limited mechanisms to insure that the code is adopted by local municipalities. Essentially hazard mitigation policies such as a mitigation plan or even the adoption of policies and ordinances that lend themselves to mitigation must be undertaken at the municipality level.

Since counties have not been granted home rule in Texas, they generally are very limited in their ability to engage in mitigation planning activities such as adopting and enforcing building standards and codes or developing comprehensive plans. Nevertheless counties do play roles in mitigation activities particularly with respect to floodplain management and general involvement

[1] Home rule refers to the ability of constituent governmental entities of a central government, such as a state government, to be given greater self-governmental powers within the administrative purview of the central governing. So for example a municipality with home rule may have the ability to zone land use etc.

in broad based mitigation planning through the development of county or regional mitigation plans that meet basic FEMA requirements.

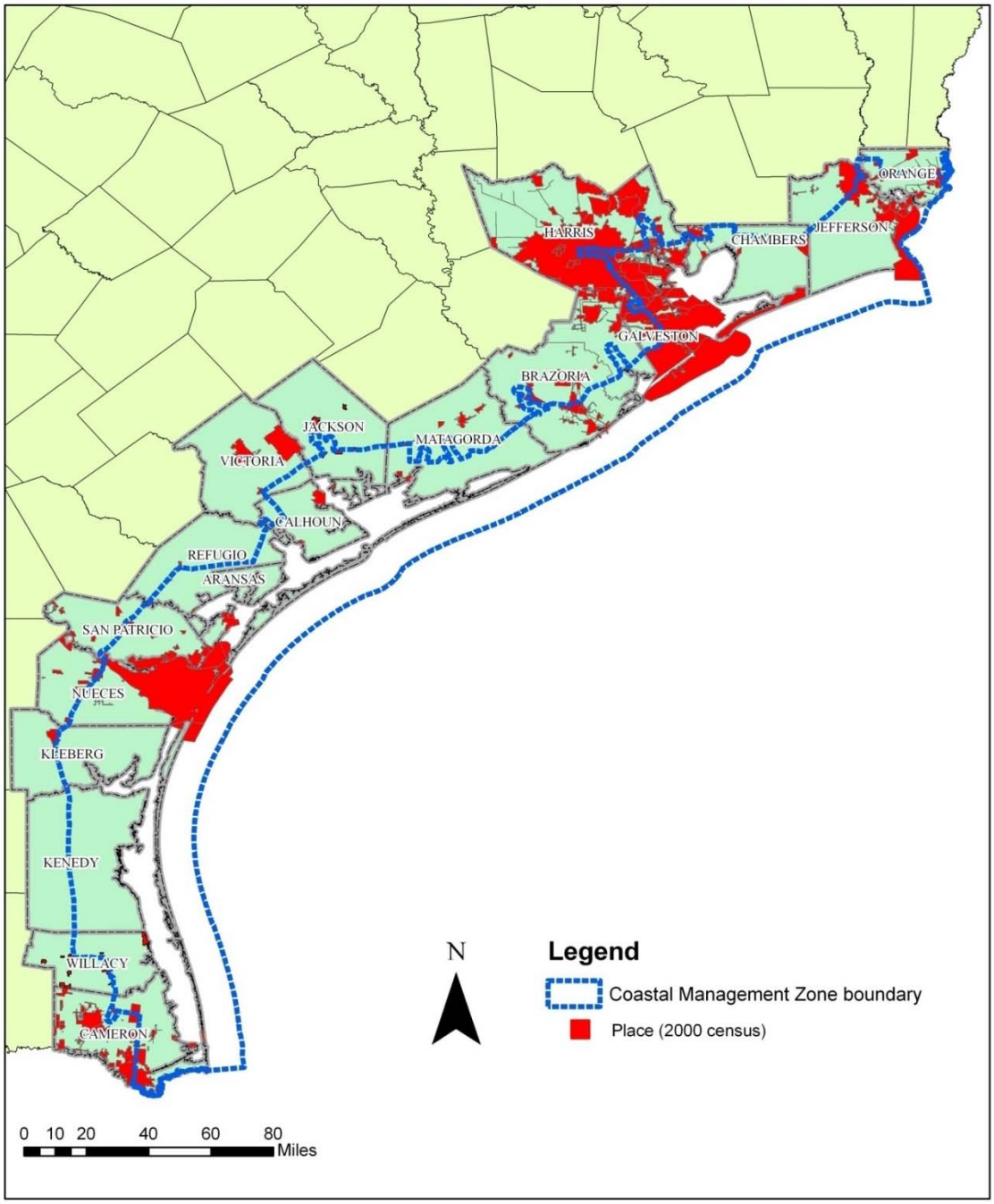
Given that counties have limited abilities to undertake mitigation planning, there are not statewide mandates for the adoption of a uniform building code, and that ultimately, it is at the municipal level that mitigation planning must be undertaken, it is important to examine the spatial distribution of mitigation policies to better understand the extent to which local policies reflect hazard exposure and risk. This report is undertaken as a preliminary step in gaining that understanding. First, it will assess the hazard exposure and risk of the 18 coastal counties in Texas, paying particular attention to areas within the coastal management zone (CMZ) as identified by the Texas General Land Office (TGLO). The focus of this assessment will be the coastal hazards associated with storm surge, high wind and flooding. Second, it will assess the adoption of mitigation policies, such as comprehensive planning, mitigation planning, and building codes, by coastal counties and, most importantly, municipalities within these counties. Again, a focus will be on municipalities within the CMZ. The ultimate question to be addressed is whether or not mitigation policies and planning tools are widely used and appropriately reflect the natural hazard exposure and risks associated with coastal Texas.

This report will be structured in the following manner. The following section (2) will discuss the coastal counties and their population distributions with respect to the Coastal Management Zone (CMZ) and municipalities. This assessment will examine current population sizes and projected growth patterns both within and outside the CMZ. Section 3 will present a variety of maps on coastal hazards and risk zones associated with wind, surge, and flooding. The goal will be to better understand what proportion of coastal counties and their CMZs are at risk to these hazards. The fourth section will present data on disaster losses associated with wind, surge and flooding experienced by Texas coastal counties over the last several decades. Section 5 will provide a detailed analysis of mitigation policies adopted or practiced in coastal counties. A primary emphasis of this analysis will be on municipalities in and outside the CMZ with a focus on how prevalent is the adoption and practice of these mitigation policies among coastal municipalities and what percent of the population at risk of experiencing the impacts of coastal hazards are covered by these policies. The final section will discuss the overall findings.

2. Coastal Counties, Coastal population distributions, and trends

The target area for this report consists of Texas coastal counties and the municipalities within those counties, with particular emphasis on the coastal management zone areas. Map 1 provides a visual representation of the area. Texas coastal counties extend from the northeast where Orange County boarders Louisiana, running southwest and then south ending with Cameron County which boarders Mexico. In total, there are 228 municipalities located in these 18 counties, although a number of these communities overlap two or three coastal counties and a few even extend into non-coastal counties as well.

Map 1: Coastal Counties, Municipalities, and the Coastal Management Zone



The blue line on Map 1 represents the Coastal Management Zone for the State of Texas. Generally the CMZ includes only part of each coastal county, with the exception being Aransas County which falls completely within the boundary. To get a better idea of the extent of the CMZ within each county, Table 1 presents data on the total square kilometers of each county, the

square kilometers of each county located within the CMZ, and the percentage of each county's area falling within the CMZ. As noted above, Aransas County is 100% within the CMZ, followed by Calhoun at 94.4%, Chambers at 82.7%, and Jefferson at 71.7%, followed closely by Galveston at 71.7%. In total, nine of the 18 counties have more than half of their land mass within the CMZ. When considering the total land area contained in these 18 counties, 47.6% of that area falls within the CMZ. While land area falling into the CMZ is important, perhaps more important is a consideration of the population of this area and its distribution.

Table 1: County Total and CMZ Areas*

County	Total Area	CMZ Area	CMZ Percent
Aransas	670.98	670.98	100.0
Brazoria	3,683.94	1,209.35	32.8
Calhoun	1,298.04	1,224.97	94.4
Cameron	2,367.47	1,097.31	46.3
Chambers	1,608.18	1,329.45	82.7
Galveston	978.16	701.08	71.7
Harris	4,547.72	813.08	17.9
Jackson	2,197.44	566.87	25.8
Jefferson	2,451.74	1,767.57	72.1
Kenedy	3,625.94	2,212.59	61.0
Kleberg	2,266.03	1,336.06	59.0
Matagorda	2,901.24	1,409.14	48.6
Nueces	2,148.52	1,265.17	58.9
Orange	936.50	522.37	55.8
Refugio	2,013.09	736.62	36.6
San Patricio	1,821.49	964.37	52.9
Victoria	2,297.51	151.59	6.6
Willacy	1,531.59	744.99	48.6
Totals	**39,345.58**	**18,723.56**	**47.6**

* Area measured in squared kilometers.

Table 2 presents the county population data for 1980, 1990 and 2000, along with the population projection data for 2010, 2020, and 2030. The former comes from the U.S. Census while the latter is from the State Demographer's website.[2] Estimating the percentage of each county's population located within the CMZ can be problematic. One approach would be to simply

[2] Projections for 2010, 2020, and 2030 are from the State Demographer website (http://txsdc.utsa.edu/tpepp/2008projections/2008_txpopprj_cntytotnum.php) using the .5 scenario and CMZ estimates based on average CMZ populations proportions for 1980, 1990, and 2000.

assume that the population is uniformly distributed in a county and then simply determine the population proportion in the CMZ based on the proportion of the county's land area located in the CMZ. However, a human population rarely distributes itself uniformly over any area. Instead, that population is concentrated into areas such as communities, while other areas are less densely occupied. To better estimate the CMZ population, census block data was employed. A census block is the smallest area of aggregation employed by the census therefore it was easier to cleanly separate census blocks into those inside and outside the CMZ, and for those few blocks split by the boundary, a uniform distribution was assumed. This method generates few areas containing smaller populations for which a uniform distribution must be assumed and is likely to be less problematic and give a more accurate assessment of the populations located in particular parts of a county. Thus, the estimates for the size of the population within the CMZ contain smaller errors. This procedure was employed for the 1980, 1990, and 2000 classification. The estimates of CMZ populations for the projection years were based on the average percentage of CMZ population for 1980, 1990, and 2000 for each county.

Table 2: County and Estimated CMZ Populations 1980, 1990, and 2000 and population projections for 2010, 2020, and 2030

	1980		1990		2000		2010		2020		2030	
County	**Total**	**CMZ**	**Total**	**CMZ**	**Total**	**CMZ**	**Total**	**CMZ**	**Total**	**CMZ**	**Total**	**CMZ**
Aransas	14,884	14,884	17,892	17,892	22,497	22,497	24,673	24,673	26,468	26,468	27,267	27,267
Brazoria	169,609	63,960	191,707	64,204	241,767	71,734	287,681	96,730	335,893	112,940	383,526	128,956
Calhoun	19,963	19,912	19,053	19,005	20,647	20,590	22,689	22,630	24,427	24,363	25,724	25,657
Cameron	209,653	64,512	260,120	89,632	335,227	121,592	415,304	140,511	499,380	168,957	587,063	198,623
Chambers	18,540	15,193	20,088	16,410	26,031	21,830	31,483	25,973	37,599	31,019	43,430	35,829
Galveston	195,620	168,302	217,399	180,306	250,158	201,278	269,189	223,816	286,321	238,060	297,335	247,218
Harris	2,409,307	489,407	2,818,199	522,581	3,400,578	593,224	3,947,727	740,871	4,530,034	850,152	5,161,416	968,644
Jackson	13,352	1,892	13,039	1,889	14,391	2,141	15,572	2,259	16,745	2,430	17,430	2,529
Jefferson	250,377	182,101	239,397	165,780	252,051	174,767	263,236	185,421	276,051	194,448	290,022	204,289
Kenedy	543	391	460	331	414	298	469	337	504	363	519	373
Kleberg	34,140	8,262	30,274	7,580	31,549	8,203	36,039	9,038	39,043	9,792	40,913	10,261
Matagorda	37,833	9,788	36,928	9,314	37,957	10,163	41,409	10,749	44,714	11,606	47,060	12,215
Nueces	268,306	241,703	291,308	263,379	313,645	282,925	354,063	319,486	394,002	355,525	426,926	385,233
Orange	84,543	60,308	80,509	53,915	84,966	54,740	89,367	60,390	92,239	62,331	92,452	62,475
Refugio	9,288	3,765	7,976	3,382	7,828	3,293	8,367	3,487	8,661	3,609	8,792	3,664
San Patricio	57,937	45,464	58,586	44,934	67,138	52,896	81,267	63,377	96,483	75,243	111,185	86,709
Victoria	68,893	1,134	74,361	1,130	84,088	1,438	94,228	1,531	104,269	1,695	112,417	1,827
Willacy	17,493	1,804	17,705	1,754	20,082	2,444	23,011	2,485	25,876	2,794	28,450	3,072
Totals	**3,880,281**	**1,392,782**	**4,395,001**	**1,463,418**	**5,211,014**	**1,646,052**	**6,005,774**	**1,933,764**	**6,838,709**	**2,171,795**	**7,701,927**	**2,404,842**

Estimates of CMZ populations are based on census-blocks in or out of CMZ boundary. Blocks split were assumed to have uniformed population distributions. Projections for 2010, 2020, and 2030 are from the State Demographer website (http://txsdc.utsa.edu/tpepp/2008projections/2008_txpopprj_cntytotnum.php) using the .5 scenario and CMZ estimates based on average CMZ populations proportions for 1980, 1990, and 2000.

In 1980, coastal counties as a whole, had a population of approximately 3.9 million, with 1.39 million located in the CMZ. This represented nearly 36% of the coastal county population being located in the CMZ. By 2000, the total population located in coastal counties had grown to 5.2 million, representing a 34% growth in population since 1980. The total population located in the CMZ had risen to 1.64 million by 2000, representing just over an 18% growth rate. The difference in these rates suggests that the population within the CMZ was not growing as quickly at the population coastal county population outside the CMZ. In 2000, Harris County has the largest overall population of 3.4 million with nearly 600,000 individuals residing in the CMZ despite only 17.9% of its land area being in the CMZ. The next largest population located in the CMZ is Nueces County with just under 283,000. The projections for the next 30 years are quite dramatic. By 2030 it is projected that coastal counties will have a total population of just over 7.7 million, with a CMZ population of just over 2.4 million. The largest population concentrations within the CMZ by 2030 are projected to be in Harris (968,644), Nueces (385,233), Galveston (247,218), and Jefferson (204,289) counties.

Table 3 presents the growth rates for each county and county CMZ for two periods:1980 to 2000 and the projected rates from 2000 to 2030. While Cameron (59.9%), Aransas (51.1%), Brazoria (42.5%) and Harris (41.1%) were the four fastest growing counties from 1980 to 2000, Cameron (88.5%), Aransas (51.1%), Chambers (43.7%), and Willacy (35.5%) were the counties with the fastest growing CMZ populations. Interestingly, while overall coastal county population grew by 34.3%, the CMZ population grew by only 18.2% between 1980 and 2000. Again, this suggests that population growth was higher in those parts of coastal counties outside the CMZ. However, we see different projections from 2000 to 2030. Coastal counties are projected to grow by 47.8% from 2000 to 2030 but, even more alarming, is the projection that the coastal CMZ population is projected to grow at nearly the same rate (46.1%). This suggests very high growth rates for coastal and CMZ populations over the next twenty years. The highest CMZ population growth rates are projected for Brazoria (79.8%), Chambers (64.1%), San Patricio (63.9%), Cameron (63.4%) and Harris (63.3%) counties.

Table 3: Actual and Project Population Growth Rates for Coastal Counties and County CMZs

1980 to 2000				2000 to 2003			
County	**Pop. Growth**	**CMZ**	**Pop. Growth**	**County**	**Pop. Growth**	**CMZ**	**Pop.Growth**
Cameron	59.9%	Cameron	88.5%	Cameron	75.1%	Brazoria	79.8%
Aransas	51.1%	Aransas	51.1%	Chambers	66.8%	Chambers	64.1%
Brazoria	42.5%	Chambers	43.7%	San Patricio	65.6%	San Patricio	63.9%
Harris	41.1%	Willacy	35.5%	Brazoria	58.6%	Cameron	63.4%
Chambers	40.4%	Victoria	26.7%	Harris	51.8%	Harris	63.3%
Galveston	27.9%	Harris	21.2%	Willacy	41.7%	Nueces	36.2%
Victoria	22.1%	Galveston	19.6%	Nueces	36.1%	Victoria	27.1%
Nueces	16.9%	Nueces	17.1%	Victoria	33.7%	Willacy	25.7%
San Patricio	15.9%	San Patricio	16.3%	Kleberg	29.7%	Kenedy	25.4%
Willacy	14.8%	Jackson	13.2%	Kenedy	25.4%	Kleberg	25.1%
Jackson	7.8%	Brazoria	12.2%	Calhoun	24.6%	Calhoun	24.6%
Calhoun	3.4%	Matagorda	3.8%	Matagorda	24.0%	Galveston	22.8%
Jefferson	0.7%	Calhoun	3.4%	Aransas	21.2%	Aransas	21.2%
Orange	0.5%	Kleberg	-0.7%	Jackson	21.1%	Matagorda	20.2%
Matagorda	0.3%	Jefferson	-4.0%	Galveston	18.9%	Jackson	18.1%
Kleberg	-7.6%	Orange	-9.2%	Jefferson	15.1%	Jefferson	16.9%
Refugio	-5.7%	Refugio	-2.5%	Refugio	12.3%	Orange	14.1%
Kenedy	-3.8%	Kenedy	-3.8%	Orange	8.8%	Refugio	11.2%
Total	**34.3%**	**Total**	**18.2%**	**Total**	**47.8%**	**Total**	**46.1%**

Another important consideration regarding the dispersion of coastal county populations, both inside and outside the CMZ, is to consider their locations in municipalities versus those in unincorporated areas. The reason this is particularly important in Texas is because municipalities have the capacity, due to home rule, of establishing more effective land-use planning, zoning, and building regulations among the many types of policies that have mitigation potential than do unincorporated areas within counties. Table 4 displays 2000 census data on the 228 municipalities in coastal counties and whether the municipality is located completely or partially inside the CMZ. In 2000, just over four million individuals or 77.5% of the coastal population was located in a municipality, with the remaining 22.5% (1.17 million) residing outside these municipalities. When considering the 228 municipalities, 128 of them are located wholly or partially in the CMZ. These 128 municipalities have just over 3.5 million inhabitants, representing 87.4% of the coastal metropolitan population and 67.7% of the total coastal population.

Table 4: CMZ Location of 228 Coastal Municipalities and 2000 Populations

Municipalities	No. of Municipalities	Population	Percentage
In CMZ	99	1,153,694	22.1%
Partially in CMZ	29	2,375,270	45.6%
Out of CMZ	100	508,038	9.7%
Not in a Municipality		1,174,012	22.5%
Totals		**5,211,014**	**100.0%**

3. Coastal Counties, the CMZ, and Wind, Surge, and Flooding Hazards

This section will focus on the hazard exposure of coastal counties, paying particular attention to areas located in the CMZ. Since the focus is on coastal hazards, this section will examine the risks associated with hurricane winds, hurricane surge and flooding. For each hazard, well-established hazard maps will be employed to estimate areas within each county and county's CMZ subject to specific hazards.

3a. Wind Risk

Map 2 displays a wind field map for the 18 coastal counties along with the CMZ boundary. The wind fields represent the Maximum Envelopes of Wind (MEOW) that an area is at risk of experiencing given a category 4 tropical storm as it moves inland at a moderate speed of 12 kts. These results are based on a model[3] developed by Mark DeMaria and John Kaplan, displaying the maximum sustained surface wind as a storm moves inland and the winds decay or reduce due to increased surface resistance and other factors. The highest risk area (4) is dark brown on the map, representing areas likely to experience sustained winds of 127 mph (110kts). The next highest risk area (3) is a lighter brown on the map, representing areas likely to experience winds of 109 mph (95 kts). Similarly, next risk area (2) is the tan area on the map representing areas likely to experience sustained winds of 92 mph (80kts) and finally the lowest risk area (1) is in yellow with potential sustained winds of 75 mph (65kts). As can be clearly seen, the vast majority of areas in the CMZ are in the highest two wind risk zones (5 and 4) representing areas likely to experience sustained hurricane winds of 109mph or higher.

[3] See http://www.nhc.noaa.gov/aboutmeow.shtml for more information.

Map 2: Wind Risk Zones

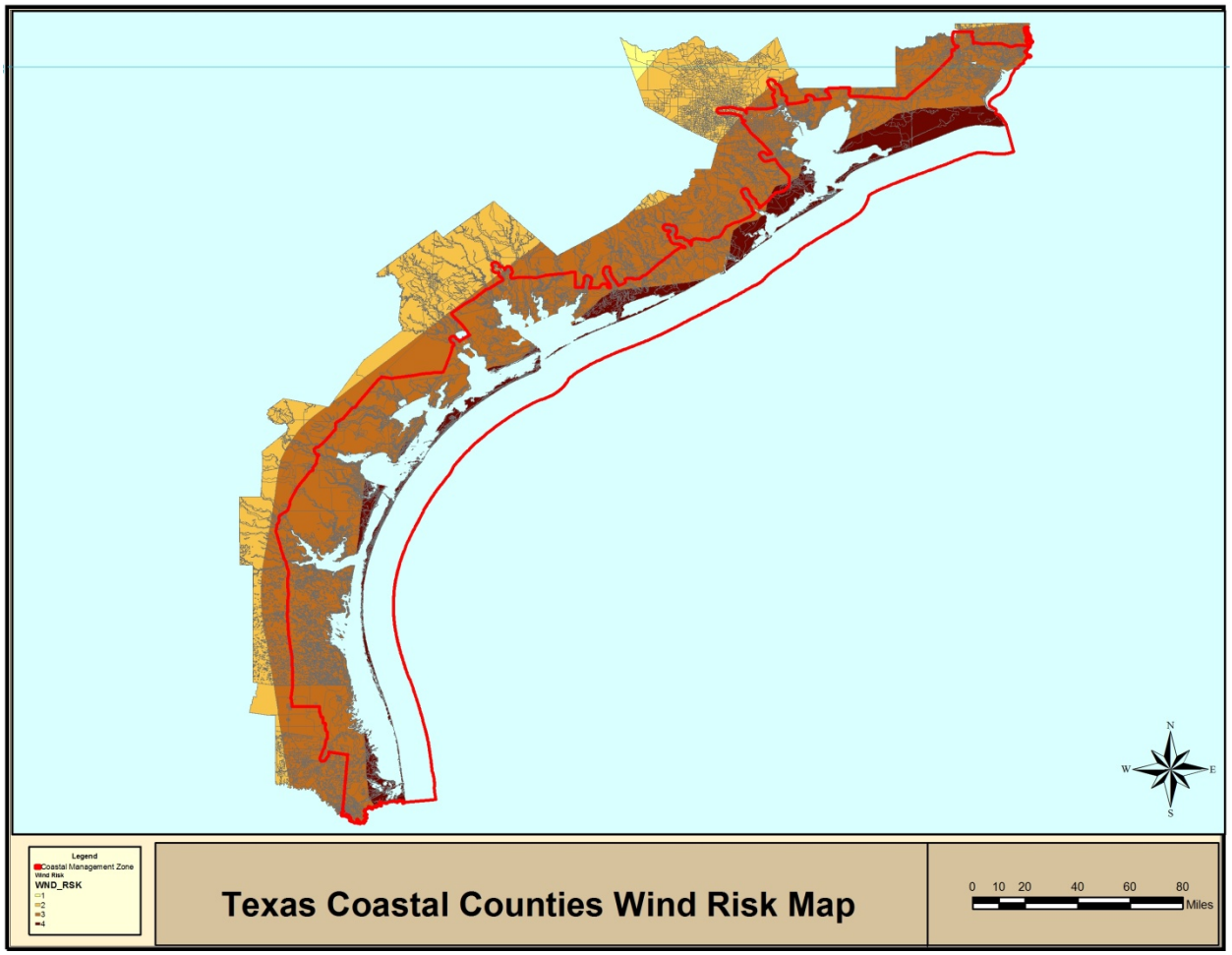


Table 5 presents the estimated percentages of each county and county's CMZ located in each of the four wind risk zones. As suggested by the map a number of counties have sizable percentages of their area in the highest risk zone. These include Galveston (50.3%), Jefferson (41.7%), and Chambers (31.3%), Matagorda (20.3%) and Aransas (18.4%) counties. Furthermore, with the exception of Victoria, Harris, and perhaps Jackson, the remaining 15 counties all have the vast majority of their areas included in wind risk areas of 3 or 4, meaning that these areas are likely to experience sustained hurricane force winds of 109 mph or greater. Similarly, when just focusing on the areas within each county's CMZ, it can clearly be seen that across counties on average 99.3% of the CMZ areas fall within the highest two hurricane wind risk areas. In other words, all of these counties are at high wind risk, with sizable proportions being located within the highest two categories. Furthermore, the CMZs of these counties all fall within the highest two wind risk categories.

Table 5: Estimate percent of County and County CMZ in specific Wind Risk Zones

	County					County CMZ		
County	**Risk 4 (127mph)**	**Risk 4-3 (≥109mph)**	**Risk 2-4 (≥92mph)**	**Risk 1-4 (≥75mph)**	**% of County in CMZ**	**Risk 4 (127mph)**	**Risk 4-3 (≥109mph)**	**Risk 2-4 (≥92mph)**
Aransas	18.4	100.0	100.0	100.0	100.0	18.4	100.0	100.0
Brazoria	11.0	97.2	100.0	100.0	32.8	33.1	100.0	100.0
Calhoun	14.8	100.0	100.0	100.0	94.4	15.7	100.0	100.0
Cameron	13.7	92.4	100.0	100.0	46.3	29.7	100.0	100.0
Chambers	31.3	100.0	100.0	100.0	82.7	37.9	100.0	100.0
Galveston	50.3	95.0	100.0	100.0	71.7	72.5	100.0	100.0
Harris	0.0	26.9	95.1	100.0	17.9	0.0	92.5	100.0
Jackson	0.0	43.0	100.0	100.0	25.8	0.0	94.5	100.0
Jefferson	41.7	100.0	100.0	100.0	72.1	57.8	100.0	100.0
Kenedy	2.5	87.1	100.0	100.0	61.0	4.1	100.0	100.0
Kleberg	8.0	70.0	100.0	100.0	59.0	13.6	100.0	100.0
Matagorda	20.3	100.0	100.0	100.0	48.6	41.9	100.0	100.0
Nueces	9.6	84.1	100.0	100.0	58.9	16.2	100.0	100.0
Orange	0.0	93.3	100.0	100.0	55.8	0.0	100.0	100.0
Refugio	0.0	80.4	100.0	100.0	36.6	0.0	100.0	100.0
San Patricio	1.1	78.2	100.0	100.0	52.9	2.0	100.0	100.0
Victoria	0.0	14.8	100.0	100.0	6.6	0.0	100.0	100.0
Willacy	1.2	83.3	100.0	100.0	48.6	2.5	100.0	100.0
Average	**12.4**	**80.3**	**99.7**	**100.0**	**54.0**	**19.2**	**99.3**	**100.0**

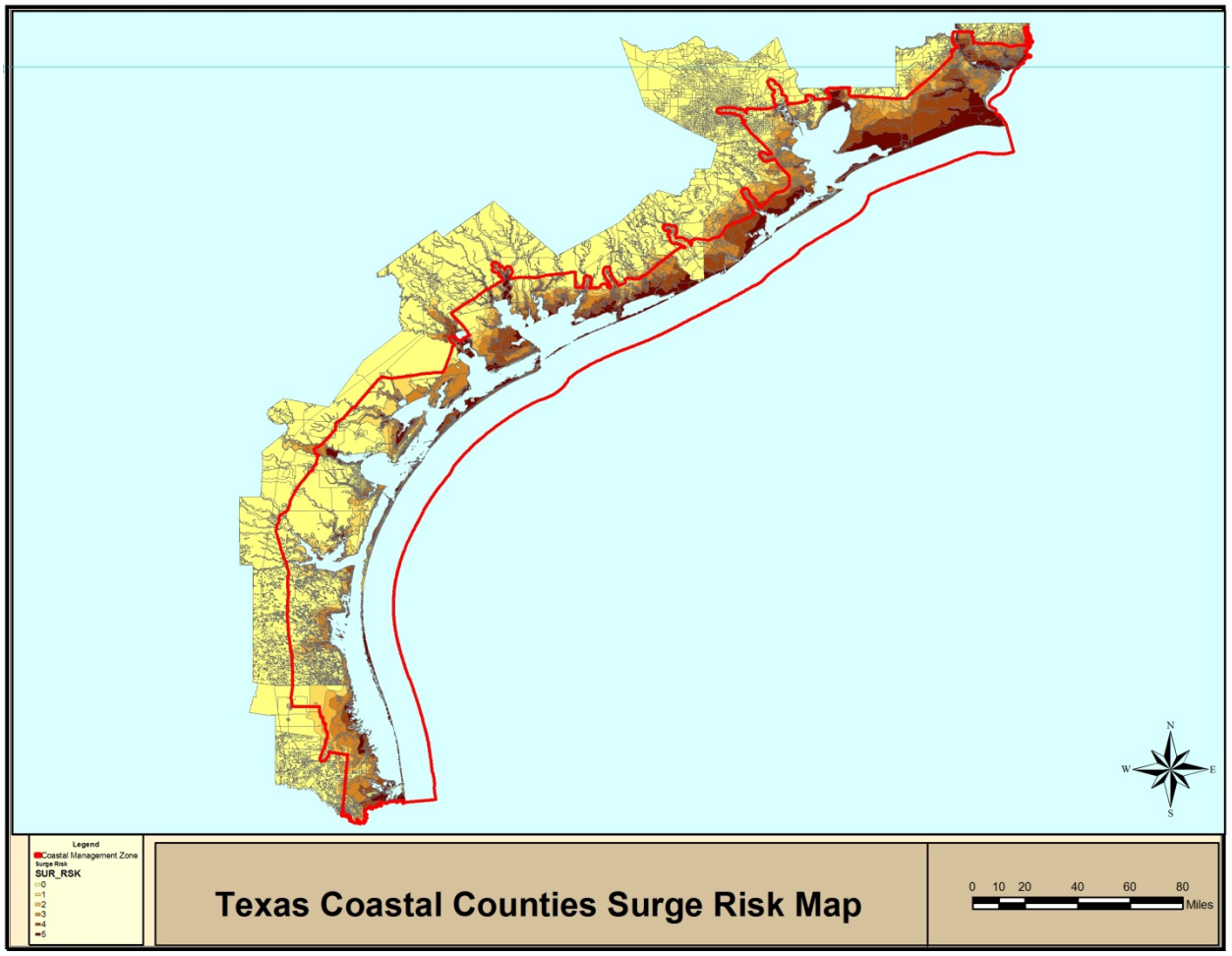
3b. Surge Risk

Map 3 displays predicted surge risk areas[4] for hurricanes of different intensity ranging from category 1 – 5 based on the Saffir/Simpson scale. As with the wind risk map, areas in darker brown are areas of highest risk, termed risk zone 5 for surge. The highest risk areas – in dark brown – areas are subject to surge for all categories of storms. The colors are again graduated from dark brown up to yellow, representing areas with no surge risk. These risk areas are created by running the sea, lake and overland surge for hurricane (SLOSH) model, which was developed by the National Weather Service to estimate potential storm surge. In this case, the model is run multiple times for storms systematically varying in speed, track, and direction for storms of varying intensity creating the maximum storm surge associate with each category of storm. These maximums are then linked together creating a maximum envelope of water that might inundate an area. So, the dark brown area indicates maximum predicted surge inundation for a

[4] These data are from the National Coastal Data Development Center. See http://www.ncddc.noaa.gov/cra/gislibrary.

Csategory 1 storm, the lighter brown for Category 2 storms through to the dark yellowish-tan representing the possible indication for category 5 storms.

Map 3: Coastal County Hurricane Surge Risk Zones



A visual inspection of the surge map suggest that the northeastern coastal area associated with Jefferson, Chambers and Galveston counties has areas of high risk due to storm surge, although the areas associate with Matagorda and Calhoun counties are also subject to high levels of surge. It is also interesting to note that, in a variety of areas, the surge zones extend a good deal beyond the CMZ. This is particularly evident in Galveston and Brazoria counties. To get a better idea of the size of these surge areas relative to the county and county CMZs, Tables 6 and 7 offer the estimated percentages of county and county CMZ falling into surge risk zones. Examining first the percentages of each county in a surge zone, it can be seen that on average across the 18 counties, 47.1% of the county areas are located in surge zones. The highest percentage is in

Galveston where 94.5% is in a surge zone, followed by Aransas (89.7%), Calhoun (87.1%), Jefferson (82.8%), Orange (79.9%), and Chambers at (78.6%). The smallest relative percentage is in Harris County (9%), but it must be remembered that given its population, this small percentage is associated with thousands of individuals and households.

Table 6: Percent of County in specific Surge Zones

County	Cat 1	Cat 1 & 2	Cat 1-3	Cat 1-4	Cat 1-5
Aransas	19.0	30.4	77.7	84.3	89.6
Brazoria	5.3	19.3	28.2	36.2	37.8
Calhoun	21.0	52.7	71.8	80.8	87.1
Cameron	7.9	14.2	28.8	38.5	47.2
Chambers	21.8	43.5	62.3	73.8	78.6
Galveston	24.2	38.0	81.8	81.8	94.5
Harris	1.1	1.4	3.7	6.5	9.0
Jackson	2.9	5.9	9.2	13.2	21.0
Jefferson	24.5	51.2	68.9	75.8	82.8
Kenedy	2.1	4.4	9.2	14.4	25.1
Kleberg	1.2	4.1	5.6	10.1	25.6
Matagorda	13.2	26.1	36.3	42.4	49.3
Nueces	2.6	4.2	8.5	12.0	18.3
Orange	15.3	32.3	56.8	68.8	79.9
Refugio	1.5	2.3	10.4	12.4	23.1
San Patricio	3.3	3.8	10.5	14.4	24.1
Victoria	0.5	2.4	4.9	6.6	9.6
Willacy	3.8	7.4	19.5	29.2	44.7
Mean	**9.5**	**19.1**	**33.0**	**39.0**	**47.1**

Table 7: Percent of County CMZ in specific Surge Zones

County	Percent in CMZ	Cat 1	Cat 1 & 2	Cat 1-3	Cat 1-4	Cat 1-5
Aransas	100.0	19.0	30.4	77.8	84.4	89.6
Brazoria	32.8	16.1	51.7	66.2	69.5	69.5
Calhoun	94.4	21.1	52.7	72.3	81.6	87.9
Cameron	46.3	17.1	33.4	64.4	80.4	90.8
Chambers	82.7	26.1	52.0	74.5	87.9	92.5
Galveston	71.7	33.8	53.1	96.6	96.6	98.1
Harris	17.9	6.3	7.8	20.8	36.2	49.3
Jackson	25.8	11.1	22.3	35.0	49.4	75.9
Jefferson	72.1	51.7	88.8	95.8	100.0	100.0
Kenedy	61.0	3.5	7.1	15.0	23.6	40.9
Kleberg	59.0	2.1	6.9	9.6	17.1	43.5
Matagorda	48.6	27.2	53.7	76.3	84.2	90.8
Nueces	58.9	4.3	7.2	13.7	18.1	27.1
Orange	55.8	26.4	55.0	90.9	97.8	100.0
Refugio	36.6	4.2	6.2	28.4	33.6	60.9
San Patricio	52.9	6.2	7.2	17.0	23.5	40.7
Victoria	6.6	5.9	14.2	14.4	14.7	24.6
Willacy	48.6	7.7	15.3	40.0	57.2	76.9
Average	**54.0**	**16.1**	**31.4**	**50.5**	**58.7**	**70.0**

Table 7, again, presents the estimated percentage of each county's CMZ that falls within a surge risk zones. As would be expected, much higher percentages of each CMZ falls within a risk zone due to its smaller area and it association with the coast. On average across the 18 counties 70% of their CMZs are associated with surge zones. Seven counties – Aransas, Cameron, Chambers, Galveston, Jefferson, Matagorda, and Orange – have approximately 90% or more of their CMZs falling into a surge area. Several counties – Galveston, Jefferson and Orange – have 90% or more of their CMZs falling into category 1, 2, or 3 surge zones, even without extending to higher category surge zones. Clearly, hurricane storm surge is a major hazard risk for areas within the CMZ, not to mention coastal counties as a whole.

3c. Flood risk

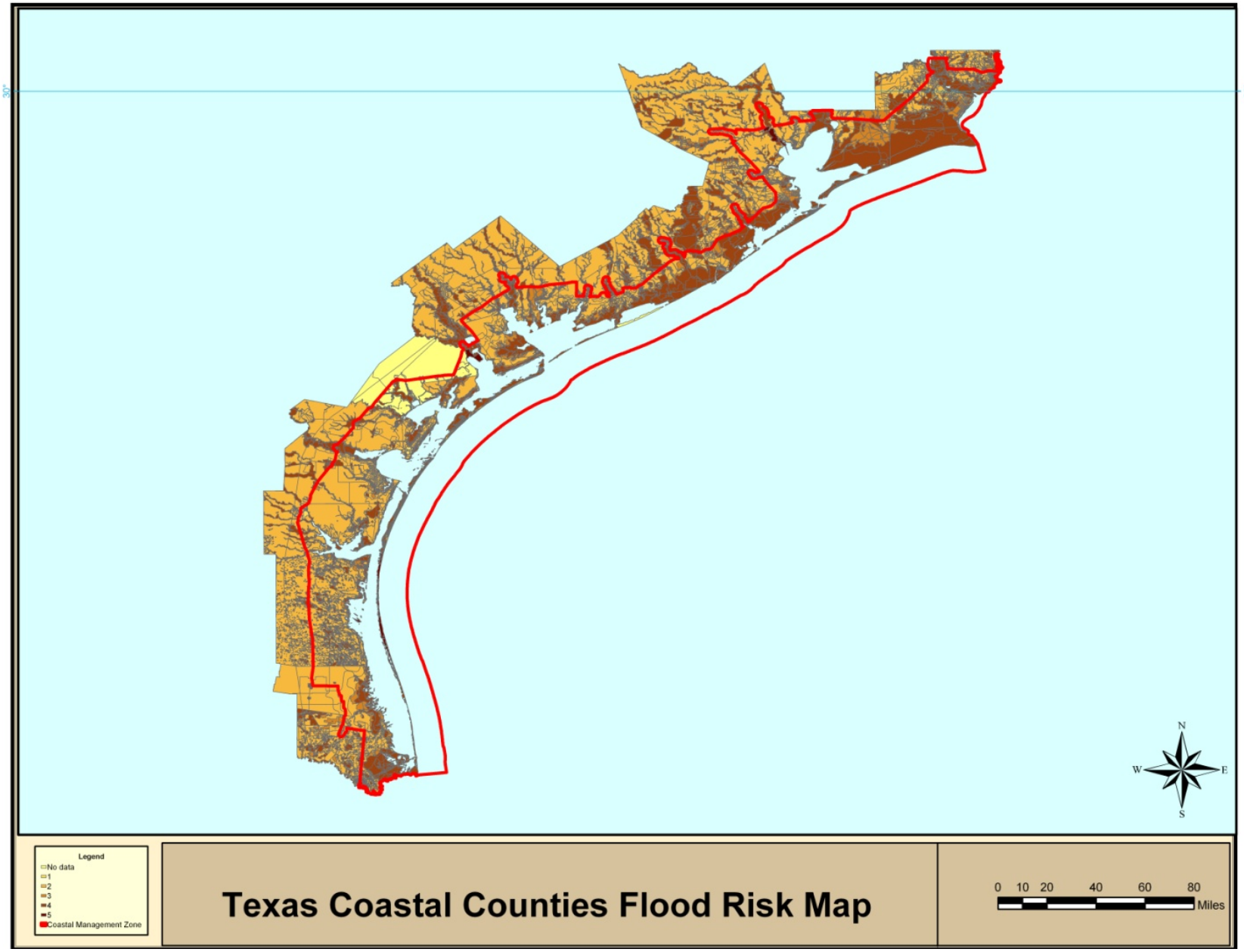
Map 4 presents flood risk zones based on the FEMA's Q3 Flood Risk Data.[5] More specifically these data are sometimes referred to as the Flood Insurance Rate Map (FIRM) data from FEMA, that are utilized to assess flood risk within each county and as a basis for floodplain management, mitigation, and insurance underwriting for the National Flood Insurance Program

[5] These data were also acquired from NOAA's National Coastal Data Development Center: http://www.ncddc.noaa.gov/cra/gislibrary.

(NFIP). Risks are mapped in a manner similar to wind and surge above, in that the dark brown areas have the highest risk (risk level 5) through the lowest level of risk (risk level 2) in dark yellowish-tan. The yellow areas indicate no data and risk level 1, is simply non-designated flood risk. Risk level 5 are areas most likely to flood during storm event[6] and are subject to wind driven waves and high velocity water movement such as associated with surge. Risk 4 are areas very likely to flood and generally include the 100-year flood plain management areas, risk 3 include the so called 500-year flood plain, while areas outside these zones, subject to flooding, are risk 2 areas. It should be noted that FIRM maps are often older flooding maps. They have been subject to some critical debate regarding their accuracy and utility, particularly in areas that have experienced development. Development can radically change the permeability of soil, is often associated with loss of wetland services to protect against flooding, and can otherwise radically change the probabilities of flooding. In addition, these data do not include large portions of Refugio counties.

[6] It is curious that there is a marked inconsistency between SLOSH model output and flood risk maps.

Map 4: Coastal County Flood Risk Zones



Even a cursory examination of the flood risk map suggests that all coastal counties are at risk of flooding. Indeed, whether focusing on the entire county or just a county's CMZs, the entire area is, generally speaking, at risk of flooding, much of that in the 100-year flood plain (risk zone 4). Table 8 displays the estimated percentages of each county in specific flood risk zones. On average, nearly 32% of these counties are located in 100-year flood plain, with rather high percentages in Jefferson (58.6%), Brazoria (48.3%), Orange (46.6%) and Galveston (46.1%) counties. Broadening the assessment to include 500-year flood plains results in an overall average of nearly 40% of all counties being located in these zones and many of counties formerly mentioned now display very high percentages, such as Chambers at 74%, Jefferson at 66.4%, and Galveston at 60%. Indeed, if the final flood risk category (2) is included, then essentially all county areas are now located in a flood risk zone. Not surprisingly, when considering only CMZ areas for each county, the percentages of the CMZs that are subject to flooding risks are very high. As can be seen in Table 9, when considering areas that are subject to 100 and 500 year floods, the average CMZ area included in these zones across counties is nearly 50% and the percentages for individual counties are a good bit higher than they were in Table 8. Now Brazoria, Chambers, Jefferson, and Galveston are all hovering around 80%.

Table 8: Percentage of County in Flood Risk Zones

County	Risk 5	Risk 4-5	Risk 3-5	Risk 2-5
Aransas	0.0	41.2	55.2	99.8
Brazoria	0.0	48.3	57.5	100.0
Calhoun	0.0	33.9	47.1	100.0
Cameron	0.0	33.2	43.5	99.8
Chambers	0.0	50.8	74.0	99.4
Galveston	0.0	46.1	60.0	99.7
Harris	1.1	21.6	24.5	100.0
Jackson	0.0	17.0	22.8	100.0
Jefferson	0.0	58.6	66.4	100.0
Kenedy	3.1	20.9	23.2	100.0
Kleberg	0.0	19.8	20.0	99.1
Matagorda	0.0	27.2	31.9	100.0
Nueces	0.0	17.9	20.7	99.7
Orange	0.0	46.6	57.1	100.0
San Patricio	0.0	16.8	18.4	98.3
Victoria	0.0	21.5	22.1	100.0
Willacy	0.0	9.4	14.6	100.0
Average	**0.2**	**31.2**	**38.8**	**99.8**

Note: Refugio is not included because of partial data.

Table 9: Percentage of County CMZ in Flood Risk Zones

County	Percent in CMZ	Risk 5	Risk 4-5	Risk 3-5	Risk 2-5
Aransas	100.0	0.0	41.2	55.3	99.8
Brazoria	32.8	0.0	68.8	77.2	100.0
Calhoun	94.4	0.0	38.5	52.3	99.7
Cameron	46.3	0.0	46.6	56.4	100.0
Chambers	82.7	0.0	57.9	79.0	99.5
Galveston	71.7	0.0	61.0	78.3	99.6
Harris	17.9	1.1	20.8	22.0	100.0
Jackson	25.8	0.0	26.3	45.8	100.0
Jefferson	72.1	0.0	72.0	82.5	100.0
Kenedy	61.0	5.1	26.4	30.2	100.0
Kleberg	59.0	0.0	23.0	23.3	98.7
Matagorda	48.6	0.0	50.2	58.6	100.0
Nueces	58.9	0.0	14.7	19.2	99.8
Orange	55.8	0.0	62.4	73.2	100.0
San Patricio	52.9	0.0	18.5	20.9	98.0
Victoria	6.6	0.0	14.0	14.0	100.0
Willacy	48.6	0.0	18.4	29.1	100.0
Average	**55.0**	**0.4**	**43.9**	**48.1**	**99.7**

Note: Refugio is not included because of partial data.

In summary, it is very clear that large areas of the 18 coastal counties, and their respective CMZs, are highly vulnerable to coastal risks associated with wind, surge, and flooding. When considering wind, essentially all of the over 5 million coastal inhabitants area subject to wind risks and nearly all of the 1.6 million that live in the CMZ are at risk to winds in excess of 109 mph. While surge zones are not as extensive, they nevertheless extend into sizable proportions of the CMZs. Indeed on average 70% of the coastal county CMZs fall into one of the surge risk zones. Finally, flooding risk is also a major concern. Essentially all coastal counties are located in flood risk zones and on average 99.7% of all county CMZs are also located in a flood hazard risk zone.

4. Coastal Hazard Impacts

In addition to risk data, it may also be useful to examine actual losses due to coastal hazards experienced by coastal counties to get a better sense of the nature of potential losses. Two data sources are employed in this descriptive analysis. First, the Spatial Hazard Event and Losses Database for the United States (SHELDUS) will be employed. These data were compiled by the Hazards and Vulnerability Research Institute at the University of South Carolina through grants

from the National Science Foundation.[7] For the purposes of this examination data on injuries, deaths, and total losses (in constant 2007 dollars) due to coastal hazards, wind events, flooding, and severe storms were downloaded for the years 1960 through 2007. Unfortunately more recent data is not available, which means that recent events such as Hurricane Ike are not included in this assessment. The unit of analysis for the SHELDUS data is the county; hence, it is not possible to easily disaggregate these data to the municipality level.[8] In addition, another limitation of these data is that they only include events with losses in excess of $50,000 or that had more than one fatality.

In addition to the SHELDUS data, data from the National Flood Insurance Program (NFIP) was also compiled for the years 1996 through 2007. These data represent the insured losses paid out by the NFIP program for individual policies related to structural and content damage due to flooding. While these data only give limited information related to one type of hazard, flooding, and for only one type of loss, insured losses, they have the advantage of being available at the municipality level.

Table 10: Injuries, Deaths, and Losses 1960 – 2007, Texas Coastal Counties

Dates	Injuries	Deaths	Damage ($)
1960 - 1969	274	43	485,138,177
1970 - 1979	201	55	1,320,582,653
1980 - 1989	1072	48	1,381,191,030
1990 - 1999	102	15	393,932,143
2000 - 2007	69	19	2,648,787,945
Totals	**1718**	**180**	**6,229,631,948**

Table 10 presents the SHELDUS data on all injuries, deaths, and damage in constant 2007 dollars due to coastal hazards, wind events, and sever storm events from 1996 and 2007 for the 18 counties along Texas's gulf coast. The data have been grouped into five decades, although it in important to note that the final "decade" consists of only the years from 2000 to 2007 and, importantly, that the figures for that time interval do not include losses related to Ike. The latest report on Ike from the National Hurricane Center (Berg 2009) suggests that there were 20 people who died in Texas directly due to the storm, 64 that died due to indirect reasons (electrocution, carbon monoxide poisoning, and pre-existing medical complications) and 34 people remain missing. Current damage estimates are $19.3 billion dollars.

[7] For additional information see http://webra.cas.sc.edu/hvri/products/sheldusmetadata.aspx.
[8] It should also be noted that for complex events, extending beyond a county that losses are often split between or among counties impacted.

Over the entire period from 1960 to 2007, there were 1718 injuries and 180 deaths in coastal counties due to what natural hazard events. The 1980s generated more injuries than other decades. The 60s, 70s, and 80s have roughly comparable deaths which drop considerably in the 90s. However, given what is already know about Ike's impact, the deaths will likely be, at a minimum, back in the mid 40s if not well into the 80s when the final official numbers are determined. Between the 60s to 70s, and then 80s, damage figures display a general increase, although the 90s were clearly a period of reprieve. The total damage figure for the entire period from 1960 to 2007 was 6.2 billion, but this figure will balloon when Ike's numbers are included. Given the damage figure between 2000 and 2007, and what is already estimated for Ike, it is clear that the first decade of the new century will represent an extraordinary increase in losses. On the whole, and despite the low losses in the 90s, the overall trend in hazard damage is generally toward higher losses across these decades. This trend toward ever increasing losses is consistent with similar trends for the United States.

Table 11: Coastal Hazard Impacts for Texas Coastal Counties: 1960 – 2007

	Injuries	Deaths	Total Property Damage	Ave. Pop. 1960 - 00	Injury Rate* 1960-07	Death Rate* 1960-07	Per-Capita 1960-07
Aransas	86	2	113,367,253	14,111	6.06	0.12	8,033.74
Brazoria	133	4	705,780,060	157,515	0.85	0.03	4,480.71
Calhoun	88	6	112,570,081	18,739	4.68	0.32	6,007.13
Cameron	48	5	324,590,385	219,308	0.22	0.02	1,480.07
Chambers	92	9	542,744,021	17,445	5.25	0.52	31,112.44
Galveston	193	22	763,598,371	194,735	0.99	0.11	3,921.23
Harris	356	61	1,416,252,830	2,322,679	0.15	0.03	609.75
Jackson	95	2	134,503,047	13,559	7.04	0.16	9,919.54
Jefferson	163	11	589,080,005	246,564	0.66	0.05	2,389.16
Kenedy	13	2	60,708,782	596	21.15	2.82	101,894.57
Kleberg	17	3	88,141,226	31,680	0.52	0.08	782.25
Matagorda	106	7	142,356,811	33,274	3.19	0.22	4,278.32
Nueces	73	33	346,810,886	266,424	0.28	0.12	1,301.72
Orange	21	0	426,655,946	76,168	0.27	0.00	5,601.51
Refugio	94	5	119,788,633	9,112	10.31	0.56	13,145.67
San Patricio	25	3	115,183,261	55,242	0.45	0.05	2,085.07
Victoria	101	3	128,781,230	65,499	1.54	0.05	1,966.14
Willacy	15	2	98,719,120	18,187	0.80	0.11	5,427.94
Total	**1718**	**180**	**6,229,631,948**	**3,760,838**	**0.46**	**0.05**	**1,656.45**

* Injury and death rates are per 1000 individuals.

Table 11 breaks down the impacts for the entire period from 1960 to 2007 by county[9], presenting total injuries, deaths, and damage as well as injury and death rates (per 1000) and per-capita damage. The rates and per-capita measures are calculated based on the average population for each county employing the 1960, 1970, 1980, and 2000 census population figures. Perhaps not surprisingly, Harris County has the highest number of injuries, deaths, and damage for the entire period, although it is again likely that Galveston will surpass these counts and damage figures when the final Ike numbers are included. Indeed, Galveston was already second in injuries and damage while being third in deaths even without considering Ike. Other counties along the northwest coast – Brazoria, Chambers, and Jefferson – also display very high total property damage figures, and relatively high injuries and deaths.

A very different picture emerges when considering the injury and death rates per 1000 population along with the per-capita losses. The county with the highest injury and death rates, along with this highest per-capita losses was Kenedy, which despite its very low population, generated sizable, at least in relative terms, damage, deaths and injuries. Other notable counties, particularly for per-capita damage, included Chambers, Refugio, Jackson, and Aransas. Clearly, these results are in part due to the relatively low populations in these counties, however when one notes that Chambers County, which has the fifth lowest population, yet generates the 5th highest total losses, the second highest per-capita losses and very high injury and death rates, this deserves a closer examination, particularly since it is also anticipated to experience very high growth rates during the first part of this century. In addition, these relative figures also suggest that mitigation efforts in these areas can have relatively high per-capita pay-offs.

Table 12 displays the NFIP losses from 1996 through 2007 for 112 of the larger municipal areas[10] located in the 18 coastal counties and the remainder of the area in constant dollars. Together these 112 municipalities had 3.6 million residents in 2000 representing 89% of the coastal population residing in municipalities and 69.6% of the total coastal county population in 2000. The data are presented for 112 municipalities that are either partially inside the CMZ, completely inside the CMZ or outside the CMZ, with "remainder" category includes the residents of the smaller municipalities and unincorporated areas of coastal counties. The relative sizes of the entire coastal population associated with each area/population categories are: outside of CMZ 6.8%, inside the CMZ 18.5%, partially inside the CMZ 44.2%, and remainder 30.4%. The data have been arbitrarily presented for four year groupings – 1996-1999, 2000-2003, and 2004-2007 – for the 12-year period to simplify the presentation. Again, it should be noted that these data do not include NFIP losses due to Hurricane Ike.

Overall there are no clear patterns to these data. For the period of 1996-99 total NFIP losses were just over $148 million, climbed markedly to over $1.1 billion during 2000-2003, and then fell back to $169 million during 2004-2007. Of course, we know that the next period will show a

[9] More detailed breakdowns for each county for each decade are also available in appendix A.
[10] These 112 municipalities will be discussed more completely in the next section.

very large jump, when Ike's losses are included. Not surprisingly losses for municipalities partially in the CMZ and for the remaining areas were the highest, but this is simply due to the relative numbers of individuals, and ultimately households in these areas. Nevertheless, with considering both municipalities wholly or partially in the CMZ, it is evident that their insured losses are much higher than for municipalities outside the CMZ. The per capital losses displayed in the lower panel of Table 12 perhaps better captures the relative losses for different areas/populations. While there are some variations when comparing per-capital losses within each period, overall the highest per-capita losses occurred in municipalities partially in the CMZ, followed by areas outside the CMZ. However, overall these variations are not that dramatic. The fact that there are few consistent and substantive differences among these areas/populations is perhaps due to the widespread pattern of flood risk throughout coastal counties. In other words, flooding is not simply a CMZ phenomenon, but rather a pervasive risk throughout coastal counties.[11] Nevertheless, it should be reiterated that insured flooding losses are higher throughout this period particularly when the losses of communities wholly or partially within the CMZ are combined.

Table 12: National Flood Insurance Program Payout 1996-2007 for 112 Coastal Municipalities and 18 Coastal Counties

	Total Insured (NFIP) Flood Losses			
Area/pop.	**1996-1999**	**2000-2003**	**2004-2007**	**1996-2007**
Partial CMZ	41,045,241	627,316,685	52,496,143	720,858,069
In CMZ	39,157,154	111,897,017	68,635,309	219,689,480
Out CMZ	10,427,026	80,509,348	8,287,622	99,223,996
Remainder	57,654,900	295,819,778	39,678,559	393,153,236
Total	**148,284,322**	**1,115,542,828**	**169,097,631**	**1,432,924,781**
	Per-Capita loses			
Partial CMZ	17.80	272.11	22.77	312.69
In CMZ	40.60	116.02	71.16	227.78
Out CMZ	29.25	225.81	23.24	278.30
Remainder	36.38	186.68	25.04	248.10
Total	**28.46**	**214.07**	**32.45**	**274.98**

[11] In addition, it should also be remembered that the NFIP has a cap for losses, currently set at $250 thousand dollars, limiting exposure and truncating losses in areas heavily impacted by flood damage.

5. Coastal Mitigation Policy

From the forgoing sections, it is clear that coastal counties in general and their CMZ areas in particular, have very high exposure and risk to wind, surge, and flooding hazards. Furthermore, the previous section suggests that the losses to coastal hazards have been considerable since the 1960s. In addition, while there was clearly a lull in losses during the 1990s, there has been a trend toward increasing losses, made even more significant given the recent impacts of Hurricane Ike. Indeed, Ike clearly suggests that regardless of the tends, exposures are so significant, it only takes one major event to drive home the importance of anticipating future disasters by seeking to make coastal areas more disaster resistant and resilient.

It is in that context that this section explores the mitigation policy mosaic of coastal counties in Texas. Specifically, this section will examine the extent to which municipalities and counties are undertaking planning activities that lend themselves, either directly or indirectly, to undertaking coastal hazard mitigation. For example, as noted above, mitigation planning generally occurs as part of a comprehensive community or county plan or as a standalone or independent plan (Burby 1998). There are advantages to the former, in that mitigation actions can be more comprehensive and more fully integrated into the overall planning efforts of an area. On the other hand, a local mitigation action plan is generally undertaken to meet FEMA mitigation requirements. The latter, as a freestanding plan, may be quite comprehensive, but more often focus narrowly on addressing minimum planning requirements set out by FEMA and on identifying future mitigation actions that might be undertaken with additional funding after a disaster is declared. As a result they generally are not fully integrate into more comprehensive planning efforts. On the other hand, if there are no or only limited planning efforts undertaken by communities in the first place, a freestanding mitigation action plan may be an important step in the direction toward more comprehensive mitigation planning. The question however is what areas along the Texas coast are engaged in comprehensive community planning efforts or mitigation planning efforts of any ilk in the first place.

The spectrum of planning activities examined for the report include: 1) comprehensive planning, 2) floodplain management, regulation or a flood damage prevention planning, 3) storm water or drainage management planning or ordinances, 4) zoning, 5) subdivision ordinances or development regulations, 6) Community Rating System (CRS) participation, 8) mitigation planning and 9) building codes. Gathering and assembling data on these issues can be extremely difficult, particularly in Texas, in part because the state does not impose jurisdiction over, regulate, or mandate these types of planning activities. As a consequence there are few, if any, agencies or central depositories for these data. Hence, gathering these data can demand primary data collection, rather than simply assembling the data from secondary sources. As part of the next phase of the Status and Trends project, systematic primary data collection will be undertaken to more gain a more complete understanding of the mitigation planning policies being practiced and promulgated along the Texas coast. For the purposes of this report data from

a variety of sources were gathered and assembled to begin the process of better understanding the mosaic of planning policies and programs along the Texas coast.

The core data for this report were gathered from the detailed analysis of 12 coastal hazard mitigation plans that was undertaken as part of the Status and Trends project (See Peacock et al., 2009). These plans included information on a host of planning activities that the 18 coastal counties and 112 participating municipalities were undertaking or have adopted to address hazard mitigation issues. This information was supplemented by information from a variety of sources including the internet, the Texas Department of Insurance (TDI), the International Code Council (ICC) website, and FEMA. Table 13 provides an overview of the various data sources utilized in the following discussion.

Table 13: Data Sources for Mitigation Policy Assessments

Data	Sources
Comprehensive Planning	12 Hazard mitigation plans and internet
Floodplain management	12 Hazard mitigation plans and internet
Storm Water management	12 Hazard mitigation plans
Capital improvements plans	12 Hazard mitigation plans
Zoning ordinance	12 Hazard mitigation plans
Subdivision ordinance/regulations	12 Hazard mitigation plans
Building Codes	TDI Building code survey and ICC website: www.iccsafe.org/government/adoption.html
CRS participant and ratings/scores	FEMA CRS 2009
NFIP participant and damage	FEMA (1996-2007)
Hazard Mitigation Plan	Hazard mitigation plan assessments (Peacock et al 2009)

Before proceeding it is important to assess the quality and coverage of these data. As mentioned above the core data for this assessment come from the detailed assessments of the 12 hazard mitigation plans undertaken as part of this project. These 12 mitigation plans included the participation of all 18 coastal counties and 112 municipalities within these counties. The 112 municipalities represent only 49.1% of the 228 municipalities found in coastal counties, however that under represents their impact in terms of population. Table 14 presents additional information on these 112 communities, relative to the 116 municipalities not included in the "sample" and the remaining county populations. In total, the 112 communities contained 69.5% of the 2000 population residing in the 18 coastal counties. The other 116 coastal municipalities only include 7.9% coastal population residing in the 18 counties. The remaining 22.5% of the population are in unincorporated areas of the 18 counties, for which the mitigation plans do also

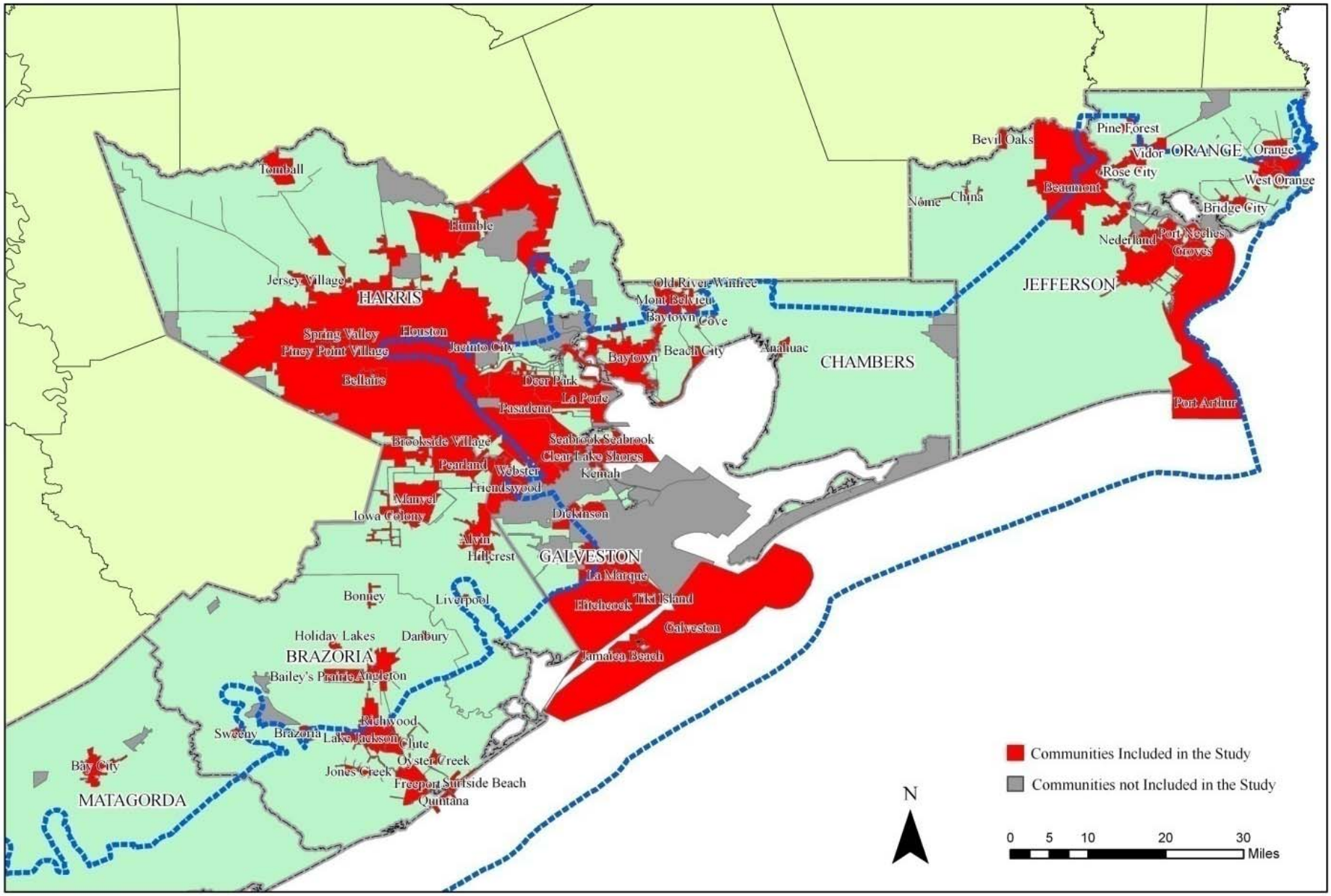
provide information. Thus, in total, the information provided by the mitigation plans have the potential of providing information on areas associated with 92% of the coastal population.

Table 14: Sample Communities

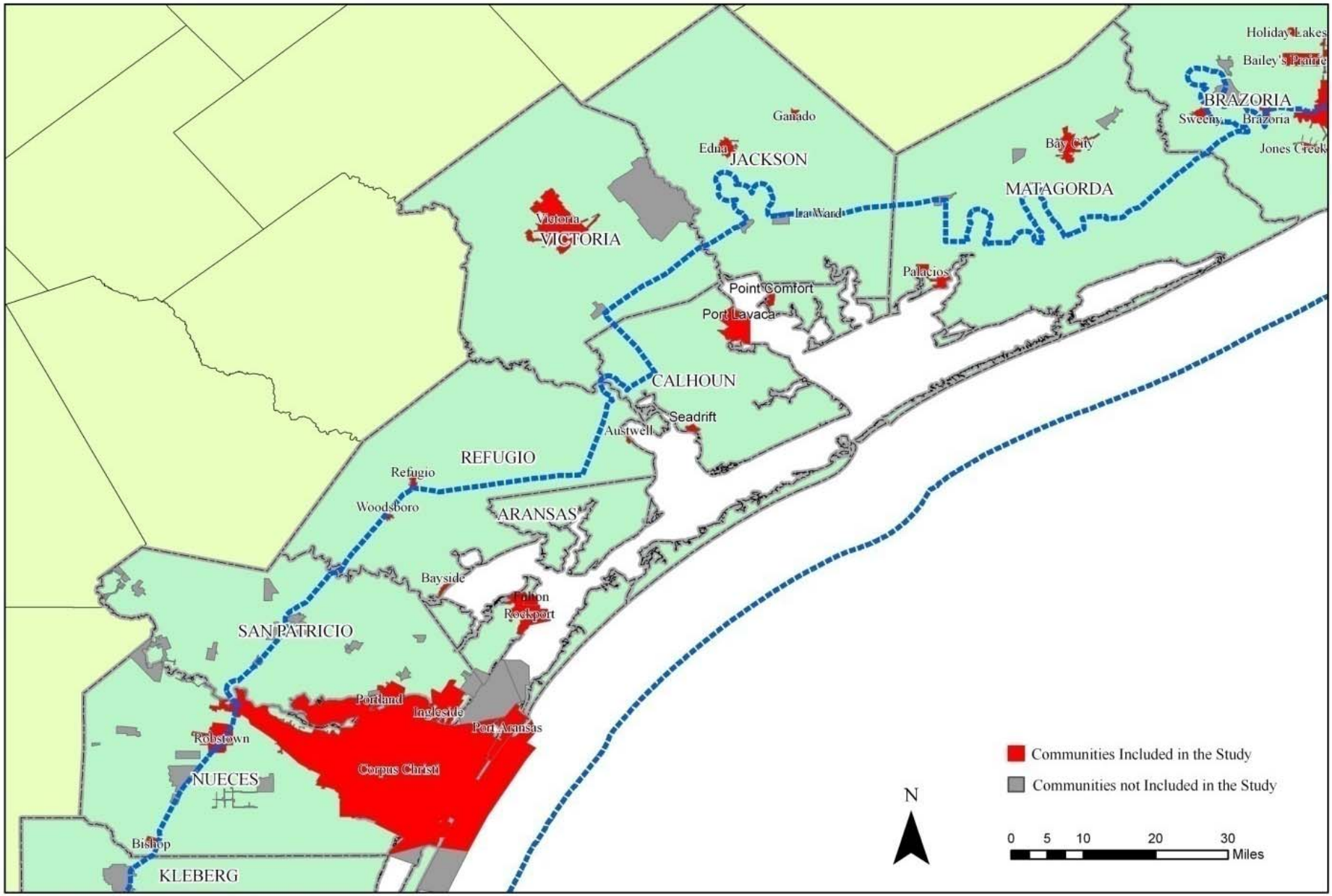
	Location	2000 Population	Percent
112	outside CMZ (38)	356,535	6.8%
Sample	inside CMZ (59)	964,465	18.5%
Municipalities	partial CMZ (15)	2,305,348	44.2%
Not in sample	116 municipalities	410,654	7.9%
In sample	Unincorporated Co.	1,174,012	22.5%
Total coastal population		**5,211,014**	**100.0%**

In addition, the 112 municipalities include 38 municipalities that fall outside the CMZ, 59 communities completely inside the CMZ and 15 partially in the CMZ. The latter group includes very large municipalities such as Houston, Brownsville, and Beaumont, which due to their very large populations have boundaries that fall both inside and outside the CMZ. To better given an idea of the location of the 112 municipalities included in this assessment, the coastal county and CMZ boundary map displayed in earlier has been broken up into three more detailed maps for the northeastern counties (Study Area I, see Map 5), the central coastal counties (Study Area II, see Map 6), and the southernmost coastal counties (Study Area III, see Map 7). In each of these maps, municipalities that were part of the mitigation plans and therefore make up the core data for this report (i.e., “sample communities”) are in red.

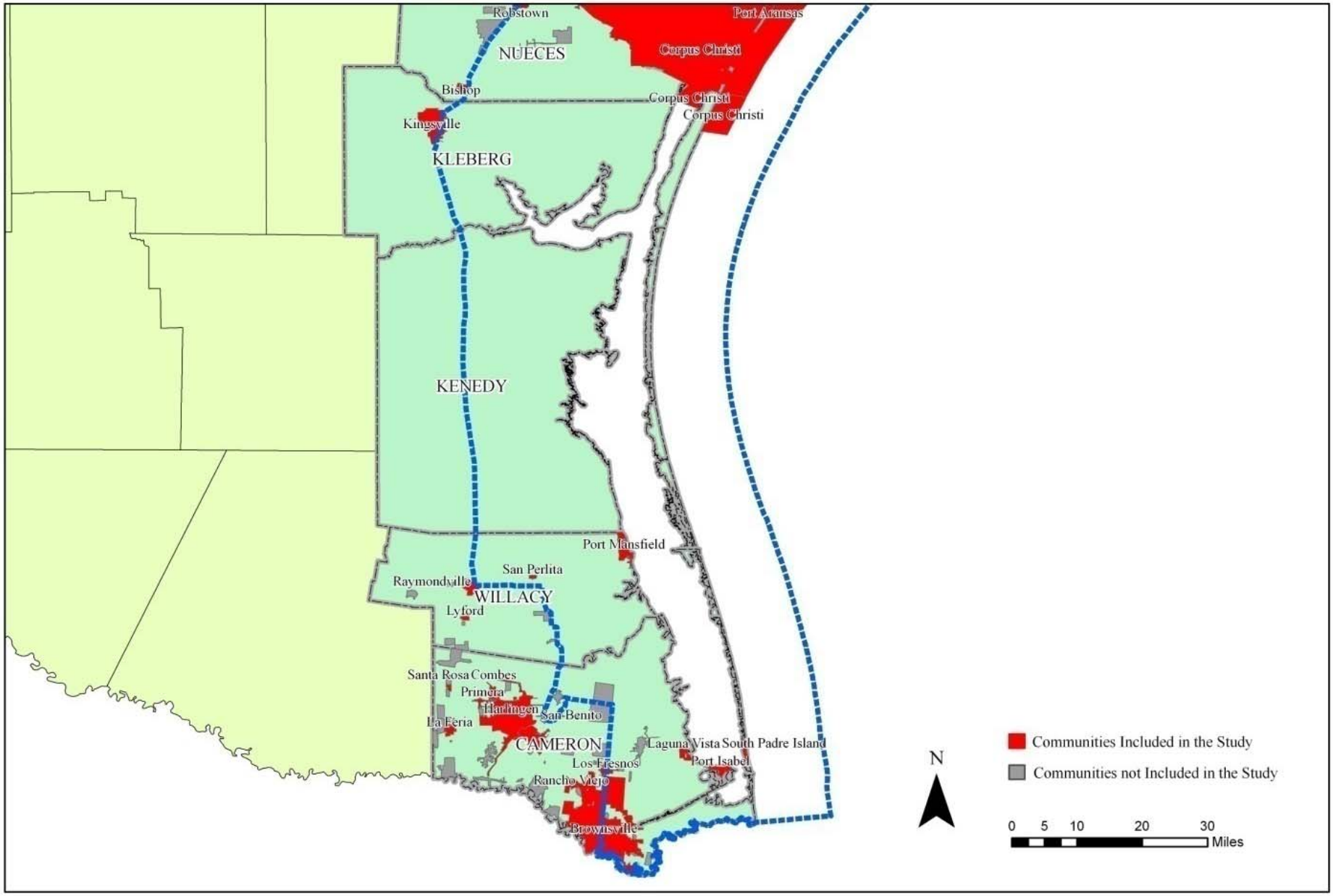
Map 5: Study Area I



Map 6: Study Area II



Map 7: Study Area III



Throughout the following discussion the focus will be primarily on information regarding the 112 municipalities. The reason for the focus on municipalities is because, as discussed above, in Texas municipalities have home rule, hence may mitigation planning activities can only be carried out effectively by a municipality. Counties on the other hand lack home rule, and hence, while there area attempts at regulating land-use, particularly with respect to floodplain issues, the power they have is often limited. Hence, planning at the municipality level carries with it the greatest ability to address mitigation. In addition, information at the municipality level provides the greatest opportunity for addressing difference between areas within and outside the CMZ with some degree of confidence. Simply stated, it is easier to place populations within or outside CMZ boundaries when working with the municipality data.

One final and major caveat regarding the quality and interpretation of these data: The data employed in this section all come from secondary sources and documentation prepared for other reasons and not under normal measurement, validity, and reliability procedures utilized in primary data collection protocols. As a consequence, the information provided was not necessarily recorded in the documents or websites by others in a systematic or uniform manner. For example, we cannot be sure that every community was specifically asked about use of zoning ordinances or even if that information was always requested in the same manner. As a consequence, it cannot be consistently determined if the failure to mention or record zoning means that the community does not have zoning ordinances. Hence, for each for each policy examined, information as to whether or not a particular policy is employed or has been enacted, is reported only if it was explicitly mentioned or somehow verified from additional information (internet searches, etc). If we were unsure, the information was coded as *missing*. Many times these missing values are actually a 'no' response, (meaning that the municipality does not have or employ a particular policy) but the conservative interpretation of *missing* will be adopted for this report. Data from the primary data collection activities to be undertaken this year as part of phase 3 will help clarify these *non-responses*.

5a. Comprehensive Planning.

Table 15 presents data on comprehensive planning by communities. The top panel presents the overall results for all 112 communities. In total, 36 communities, representing only 19% of the population in these 112 communities actually engage in comprehensive community planning. It should be noted that 27 communities failed to provide information on comprehensive planning, which again may mean that they do not engage in comprehensive planning. Interestingly nearly 60% of the populations residing in communities completely located in the CMZ do have comprehensive plans and over 50% of the population in communities outside the CMZ also resides in municipalities that engage in comprehensive planning. Unfortunately for populations located in the often very large urban areas that straddle the CMZ boundary, less than 2% are covered by a comprehensive plan. In light of the literature that suggests that mitigation planning within a comprehensive plan offers a very powerful mechanism for effective mitigation planning, these findings, particularly for the large urban areas that are partially in the CMZ, are

of concern. On the other hand, for those communities within the CMZ, comprehensive planning is well established.

Table 15: Comprehensive Plans

Area	Planning	Municipalities	Population	Percent
ALL	Yes	36	795,709	19.1%
	No	49	692,193	21.9%
	Missing	27	2,138,446	59.0%
	Total	**112**	**3,626,348**	**100.0%**
CMZ	Yes	19	576,529	59.8%
	No	27	305,817	31.7%
	Missing	13	82,119	8.5%
	Totals	**59**	**964,465**	**100.0%**
Partial CMZ	Yes	3	36,336	1.6%
	No	7	296,208	12.8%
	Missing	5	1,972,804	85.6%
	Totals	**15**	**2,305,348**	**100.0%**
Out CMZ	Yes	14	182,844	51.3%
	No	15	90,168	25.3%
	Missing	9	83,523	23.4%
	Totals	**38**	**356,535**	**100.0%**

5b. Flood Plain management, Regulation, or Flood Damage Prevention Planning

As can be seen from the uppermost panel of Table 16, while 53 communities engage in some form of flood plain management and regulation, this constitutes only 30% of the total population residing in the 112 communities being considered. Fortunately, 66% of the population residing in communities located inside the CMZ is residing in community that does flood plain management. However and yet again, only a small percentage (13.7%) of the population residing in the often large urban areas partially in the CMZ address flood plain management issues. These low figures are fortunately offset somewhat by the findings from the counties, which as noted above, often do engage in floodplain management in Texas. Specifically, 8 counties (Aransas, Brazoria, Chambers, Harris, Matagorda, Orange, San Patricio, and Willacy) do undertake flood management planning policies. The fact that Harris county, wherein Houston falls, is in this list is particularly significant. Then again, counties like Cameron, Galveston, Jefferson, and Nueces do not address floodplain management and planning issues.

Table 16: Flood Plain management, Regulation, or Flood Damage Prevention Planning

Area	Planning	Municipalities	Population	Percent
ALL	Yes	53	1,086,556	30.0%
	No	27	336,633	9.3%
	Missing	32	2,203,159	60.8%
	Total	**112**	**3,626,348**	**100.0%**
CMZ	Yes	32	636,699	66.0%
	No	12	237,398	24.6%
	Missing	15	90,368	9.4%
	Totals	**59**	**964,465**	**100.0%**
Partial CMZ	Yes	7	315,512	13.7%
	No	3	17,032	0.7%
	Missing	5	1,972,804	85.6%
	Totals	**15**	**2,305,348**	**100.0%**
Out CMZ	Yes	14	134,345	37.7%
	No	12	82,203	23.1%
	Missing	12	139,987	39.3%
	Totals	**38**	**356,535**	**100.0%**

5c. Storm water management

Storm water management can be particularly important for addressing flooding issues in area that are undergoing rapid growth, because development can have major consequences for altering the permeability of the soil thereby changing its ability to absorb water and, most distressing, altering wetlands and the services that they can provide to reduce flooding. Table 17 presents data on storm water management and planning activities. Overall 34 communities, representing only 24.6% of the population in all 112 communities, engage in this form of planning. Not surprisingly, given results to this point, 19 communities within the CMZ, representing nearly 66% of the population of these communities, do engage in storm water management planning. But yet again, and equally unsurprising, only 4 of the 15 communities residing partially in the CMZ and representing only 7.9% of population, engage in storm water management. Fortunately, Harris, as well as Nueces, Aransas, and San Patricio counties do address storm water issues, but these represent the only counties that do so. Clearly storm water management issues are not wide spread.

Table 17: Storm Water Management.

Area	Planning	Municipalities	Population	Percentage
ALL	Yes	34	891,805	24.6%
	No	38	1,428,089	39.4%
	Missing	40	2,428,101	67.0%
	Total	**112**	**3,626,348**	**100.0%**
CMZ	Yes	19	633,060	65.6%
	No	21	132,934	13.8%
	Missing	19	198,471	20.6%
	Totals	**59**	**964,465**	**100.0%**
Partial CMZ	Yes	4	181,279	7.9%
	No	5	37,399	1.6%
	Missing	6	2,086,670	90.5%
	Totals	**15**	**2,305,348**	**100.0%**
Out CMZ	Yes	11	77,466	21.7%
	No	12	136,109	38.2%
	Missing	15	142,960	40.1%
	Totals	**38**	**356,535**	**100.0%**

5d. Zoning

Zoning can also be a particularly effective mitigation measure for addressing and limiting exposure and by helping appropriately locate development. For example, through zoning, residential development can be kept out of particularly hazardous areas, thereby limiting exposure of people and housing. The effectiveness of zoning, however, is generally limited to new development, unless through recovery planning, redevelopment is shifted away from high hazard areas through rezoning activities. Regardless of its potential effectiveness, the use of zoning is relatively isolated and limited, slightly below comprehensive planning. Overall, of the 112 communities, only 39 practice zoning and these constitute only 18.6% of the population. This is also one of those questions where communities in the *missing* category are much more likely to actually be in the *no* category. Again, zoning appears to be much more prevalent in communities located in the CMZ, indeed, 25 communities, holding nearly 61% of population located in CMZ communities to engage in zoning as a tool for planning. Unfortunately, only one of the communities partially located in the CMZ, and a very small community at that, practices zoning. Not surprisingly, no county addresses zoning issues, since they do not have that capacity. On the whole, zoning represents the least prevalent of all planning tools utilized.

Table 18: Zoning Ordinances

Area	Planning	Municipalities	Population	Percentage
ALL	Yes	39	673,692	18.6%
	No	13	196,933	5.4%
	Missing	60	2,755,723	76.0%
	Total	**112**	**3,626,348**	**100.0%**
CMZ	Yes	25	586,406	60.8%
	No	7	150,842	15.6%
	Missing	27	227,217	23.6%
	Totals	**59**	**964,465**	**100.0%**
Partial CMZ	Yes	1	25,575	1.1%
	No	4	10,099	0.4%
	Missing	10	2,269,674	98.5%
	Totals	**15**	**2,305,348**	**100.0%**
Out CMZ	Yes	13	61,711	17.3%
	No	2	35,992	10.1%
	Missing	23	258,832	72.6%
	Totals	**38**	**356,535**	**100.0%**

5e. Subdivision ordinances

Subdivision ordinances, much like zoning, offer a tool for shaping future and on-going development. Essentially these are ordinances that offer ability and flexibility to developers to allow them, through design and location, keep development within a subdivision isolated to those areas that have lower hazard exposure. These ordinances can also help ensure features like wetlands and greenways that can provide mitigation services through water retention for example, are maintained, enhanced, and perhaps even created. Overall subdivision ordinances are practiced in 44 of 112 municipalities, representing just over 24% of the population. Again, this planning tool is quite prevalent among the communities located completely in the CMZ, where 26 communities, representing nearly 80% of the population, utilize this tool. Unfortunately, only five very small communities partially in the CMZ utilize this tool. However, seven counties, including Harris, Nueces, Galveston, and Brazoria do employ subdivision ordinances, which certainly offset the lack of use within municipal areas to a certain extent.

Table 19: Subdivision Ordinances

Area	Planning	Municipalities	Population	Percentage
ALL	Yes	44	877,530	24.2%
	No	7	195,243	5.4%
	Missing	61	2,706,906	74.6%
	Total	**112**	**3,626,348**	**100.0%**
CMZ	Yes	26	770,823	79.9%
	No	5	15,242	1.6%
	Missing	28	178,400	18.5%
	Totals	**59**	**964,465**	**100.0%**
Partial CMZ	Yes	5	10,099	0.4%
	No	4	25,575	1.1%
	Missing	6	2,269,674	98.5%
	Totals	**15**	**2,305,348**	**100.0%**
Out CMZ	Yes	10	96,608	27.1%
	No	16	1,095	0.3%
	Missing	12	258,832	72.6%
	Totals	**38**	**356,535**	**100.0%**

5f. NFIP and CRS

Perhaps it should not be surprising, particularly given the wide spread flooding risk for the coastal area and the wide spread acceptance of the NFIP nationally, that with the exception of two very small communities (China in Jefferson County and Port Mansfield in Willacy) all communities and counties are participating in the NFIP. What is perhaps surprising is that only 13 municipalities participate in the Community Rating System (CRS). The CRS is a program whereby a jurisdiction can undertake mitigation activities and thereby reduce the premium associated with their flood insurance policies. Table 20 displays the 18 activities which are clustered into 4 categories associated with the CRS program. These mitigation activates include: public information, mapping and regulations, flood damage reduction, and flood preparedness. The higher the score a community earns by engaging in these activities, the lower the NFIP premiums will be for households within a community.

Table 20: CRS Flooding mitigation Activities

Category	Activities
Public Information (Series 300 activities)	310: Elevation certificates
	320: Map information service
	330: Outreach projects
	340: Hazard disclosure
	350: Flood protection information
	360: Flood protection assistance
Map and Regulation (Series 400 activities)	410: Additional flood data
	420: Open space preservation
	430: Higher regulatory standards
	440: Flood data maintenance
	450: Storm-water management
Flood damage reduction (Series 500 activities)	510: Floodplain management planning
	520: Acquisition and relocation
	530: Flood protection
	540: Drainage system maintenance
Flood preparedness (Series 600 activities)	610: Flood warning program
	620: Levee safety
	630: Dam safety

Table 21: CRS Participation

	CRS Participant	Number Municipalities	Population	Percent
All	Yes	13	2,516,312	69.4%
	No	99	1,110,036	30.6%
	Total	**112**	**3,626,348**	**100.0%**
CMZ	Yes	9	480,362	49.8%
	No	50	484,103	50.2%
	Total	**59**	**964,465**	**100.0%**
Partial CMZ	Yes	2	1,982,668	86.0%
	No	13	322,680	14.0%
	Total	**15**	**2,305,348**	**100.0%**
Outside CMZ	Yes	2	53,282	14.9%
	No	36	303,253	85.1%
	Total	**38**	**356,535**	**100.0%**

Table 21 presents the findings with respect to municipalities that are participating in the CRS program. While only 13 of the 112 communities in our sample are participating in the CRS, they represent nearly 70% of the population in these communities. The primary reason for this very high percentage is that Houston is one of the 13 participating communities, indeed Harris County also represents the only county that is participating as well. Interestingly for the first time the percentage of population residing in communities practicing this mitigation planning activity in the CMZ is actually lower than the percentage of those partially in the CMZ. Again, the participation by Houston accounts for this result.

5g. Mitigation Plans

All 112 communities for which data is available are part of one of the 12 mitigation action plans evaluated earlier by this project. These plans were evaluated based on 30 planning elements that assessed 7 planning components: 1) vision statement, 2) planning process, 3) fact basis, 4) mitigation goals & objectives, 5) inter-organization coordination and capacities, 6) mitigation policies and actions, and 7) implementation. Each of the 30 planning element that assessed these 7 areas was coded and the resulting plan quality scores (PQS) ranged from a high of 53.3 to a low of 28.7. These plan quality scores reflect the percentage of total points achieved or obtained by a mitigation action plan. To get a sense of the nature of the quality of scores achieved by municipalities in each area, average scores weighted by population were calculated. The results are presented in Table 22. The overall average weighted PQS for the entire population was only 40.08. This suggests that only 40% of the possible points that could have been garnered in the 7 planning component areas were obtained on average. As noted in the earlier report on these mitigation plans, there is significant room for improving these scores. The results for the municipalities are not dramatically different. The highest average score was obtained for municipalities outside the CMZ, with the lowest for communities partially in the CMZ. The average PQS for populations in unincorporated areas within the 18 counties was 44.2%.

Table 22: Mitigation Plan Quality Scores

Area	Municipality County	Pop 2000	Mean Score
All	112	3,626,348	40.08
Inside CMZ	38	964,465	42.58
Partial CMZ	59	2,305,348	38.23
Outside CMZ	15	356,535	45.26
Unincorporated	18	1,174,012	44.17

On the whole, all of these scores are perhaps lower than one might like to see given that all areas within coastal counties have relatively high natural hazard risk. As was the conclusion of the plan assessment report in the first place, there is much room for improvement as these plans evolve and hopefully improve through time.

5h. Building codes.

Increasing building standards through building code improvements are an important element of hazard mitigation in a variety of states. Indeed, insurance companies have also recognized the importance of strong building codes, particularly for wind related hazards, and are offering incentives through premium reductions to households that have adopted mitigation technologies such as shutters for windows, reinforced garage doors, roof tie-downs, etc. As mentioned earlier in this report, the State of Texas, through the Texas Department of Insurance has promoted the creation of new building codes and product testing to improve the codes, as well as the adoption of these building codes. The latest building code promulgated by the Department of Insurance is the 2006 International Residential and Building Code (2006 IRC/IBC). Unfortunately, there is little the TDI can do to mandate the adoption of building codes by local municipalities.

Table 23: Building Codes

	Type of Code	Municipalities	Population	Percent
ALL	2006 IRC/IBC	11	201,848	5.6%
	2003 IRC/IBC	36	2,934,699	80.9%
	2000 IRC/IBC	5	103,765	2.9%
	SBC	2	23,151	0.6%
	None	2	4,586	0.1%
	Missing	56	358,299	9.9%
	Totals	**112**	**3,626,348**	**100.0%**
CMZ	2006 IRC/IBC	7	179,027	18.6%
	2003 IRC/IBC	21	503,031	52.2%
	2000 IRC/IBC	3	24,495	2.5%
	SBC	0	0	0.0%
	None	2	12,069	1.3%
	Missing	26	245,843	25.5%
	Total	**59**	**964,465**	**100.0%**
Partially in CMZ	2006 IRC/IBC	1	2,787	0.1%
	2003 IRC/IBC	6	2,238,742	97.1%
	2000 IRC/IBC	0	0	0.0%
	SBC	1	12,727	0.6%
	None	1	2,941	0.1%
	Missing	6	48,151	2.1%
	Total	**15**	**2,305,348**	**100.0%**
Out of CMZ	2006 IRC/IBC	3	20,034	5.6%
	2003 IRC/IBC	9	192,926	54.1%
	2000 IRC/IBC	2	79,270	22.2%
	SBC	0	0	0.0%
	None	0	0	0.0%
	Missing	24	64,305	18.0%
	Total	**38**	**356,535**	**100.0%**

Table 23 presents the results for building code adoption. A variety of building codes have been adopted among municipalities in coastal counties. They include the 2006, 2003, and 2000 IRC/IBC along with a couple versions of the old Southern Building Code. By far the most prevalent code in effect among the 112 communities is the 2003 IRC/IBC which has been adopted by 36 communities whose combined population represents 80.9% the 112 municipalities. In total 11 communities have adopted the 2006 IRC/IBC, 5 are still relying on the 2000 IRC/IBC, and two communities report relying on a version of the old SBC. Among

communities located entirely inside the CMZ, the 2003 IRC/IBC is the most prevalent, adopted in 21 communities, representing 52.2% of the population among these communities. A significant number of communities, 7, representing 18.6% of the population, have already adopted the 2006 IRC/IBC. The 2003 IRC/IBC is in effect for slightly more than 97% of the population of communities partially located in the CMZ. While the 2003 IRC/IBC is the dominant code employed among communities outside the CMZ, a substantial percentage (22.2%) still depend upon the 2000 IRC/IBC.

These finds, in general, bode well for the nature of new construction in these coastal communities. The majority of this population is at least covered by the 2003 IRC/IBC. However, there are a number of major caveats. First building codes only work for new construction, or if substantial renovation or repair work is needed on existing structures. The important point is that, particularly for many of the larger urban areas, a large proportion of existing housing was built under older codes. Hence, building codes reflect what will be not what is in existence. In addition, it must be remembered that the 112 communities sampled represent only 69.5% of the population located in coastal counties, for the 22.5% in unincorporated areas and 7.9% in very small communities the situation is even more uncertain.

5i. Summary

Table 24 offers a summary of the findings with respect to potential mitigation planning policies for the 112 communities that have been the primary focus of this policy assessment. The most pronounced and obvious pattern evident from even just a cursory glance at this table is that larger percentages of the population residing in communities completely located within the CMZ are more likely to have adopted or be practicing planning activities that are generally recognized for their mitigation potential. Nearly 80% of the residents of these municipalities are located in areas with subdivision ordinances, followed by 70.8% under newer version so of the international building code (IRC/IBC 2003 or greater), and approximately 66% are residing in areas that engaged in flood plain and storm water management. Particularly surprising was the relatively high percentage of the population that are residing in communities that utilize zoning (60.8%) and comprehensive planning (59.8%). Unfortunately, the 59 communities completely located within the CMZ only account for 18.5% of the coastal county population as a whole.

The reality is that when considering communities partially located in the CMZ, many of which are very large urban areas such as Houston, Beaumont, and Brownsville, and comprise just over 44% of the coastal population, the mitigation planning percentages are very low for comprehensive planning (1.6%), Subdivision ordinances (.4%), zoning (1.1%) and even for issues like floodplain management (13.7%). On the bright side, the higher levels of participation in the CRS and the fact that many counties, Harris County in particular, do have major efforts addressing flooding issues offset the very low levels of flood plain and storm water management, but the simple fact is that comprehensive planning, zoning, and subdivision ordinances are rarely practiced in these communities.

The exceptions to the general pattern of greater CMZ community participation, does not hold for CRS and building codes, both of which are more likely to cover substantial proportion of municipalities that are partially in the CMZ, rather than those completely in the CMZ. However, and again on the bright side, the percent of population coverage among residents of communities inside the CMZ, is not terribly low particularly with respect to building codes. The overall picture, when considering the total population within all 112 municipalities is quite positive for CRS and NFIP participation as well as for building code coverage. However, when considering other approaches to natural hazard mitigation, particularly comprehensive planning and zoning, the picture is bleaker and more disconcerting.

Table 24: Summary of Municipalities and Population Percentages Adopting or Engaging in Specific Form of Mitigation Planning or Management

	All Municipalities		CMZ Municipalities		Partial-CMZ Municipalities	
	Num.	**Pop %**	**Num.**	**Pop %**	**Num.**	**Pop %**
Comp. Plan	36	19.1	19	59.8	3	1.6
Floodplain	53	30.0	32	66.0	7	13.7
Storm water	34	24.6	19	65.6	4	7.9
Zoning	39	18.6	25	60.8	1	1.1
Subdivision	44	24.2	26	79.9	5	0.4
CRS	13	69.4	9	49.8	2	86.0
IRC/IBC 03-06	47	86.5	28	70.8	7	97.2
Municipalities	**112**		**59**		**15**	
Population	**3,626,348**		**964,465**		**2,305,348**	

6 Summary

In 1980 the coastal population was approximately 3.9 million, with 36% (1.39 million) located in the CMZ. By 2000 the coastal population grew by 34% to 5.2 million, with 1.64 million located in the CMZ. Projections for the future are for rapid growth of coastal populations by 2030. By that time it is projected that 7.7 million will live in coastal counties, with over 2.4 million being located in the CMZ. The highest CMZ population growth rates between 2000 and 2030 are projected for Brazoria, Chambers, San Patricio, Cameron, and Harris counties. In other words, the projects are for substantial growth in coastal populations, particularly within the CMZ. The areas where this growth is projected, are areas with high risk to coastal hazards.

All coastal counties are at high wind risk zones, with sizable proportions being located within the highest two wind risk zones. Furthermore, the CMZs of these counties all fall within the highest two wind risk categories which are areas likely to experience sustained winds greater than 109

mph, with sizable areas likely to experience winds of 127 mph or greater. Furthermore, while all coastal counties are subject to surge risk, that risk is particularly evident in each county's CMZ. Seven counties – Aransas, Cameron, Chambers, Galveston, Jefferson, Matagorda, and Orange – have approximately 90% or more of their CMZs falling into surge risk zones. In addition, Galveston, Jefferson and Orange counties have 90% or more of their CMZs falling into category 1, 2, or 3 surge zones, even without extending to higher category surge zones. While wind seemingly captures the attention of the media during and after a hurricane event, surge is the real killer. In fact the old adage from hurricane safety is that you evacuate from surge, not wind. The future suggest much higher concentrations of population within these high risk surge zones in the CMZ. Much like wind, flooding risk is pervasive in coastal counties and these risks are particularly evident in the CMZ. On average 49.7% of all CMZ areas fall into the top three flooding risk zones with virtually 100% of all CMZ areas fall into flooding risk zone. Clearly, wind, surge, and flooding risks are pervasive in coastal counties and ubiquitous in the CMZ.

When comparing losses from the SHELDUS data, it appears that there is a general trend toward increasing losses, despite a lull during the 1990s. Indeed, when Hurricane Ike's losses are included there is not just a trend toward increasing losses, but a dramatic increase during the first decade of this century. Insured flooding losses between 1996 and 2007 show no clear trend through this short term time period. Nevertheless, it is clear that insured flooding losses are higher for communities completely or partially within the CMZ in comparison to those of other municipalities outside the CMZ.

The picture that emerges is one of anticipated higher growth and concentrations of population in coastal counties and their CMZs. These are also areas that are at very high hazard risk with respect to wind, surge, and flooding. The question is, do we see mitigation planning efforts that are consistent with these risks?

On the whole, the picture that emerges is one of a rather elaborate mosaic of mitigation planning efforts that could perhaps be better characterized as a multi-layered patchwork. Some layers are paper-thin, while other layers are more substantial and comprehensive. Regardless of the general characteristics of these layers, thin or substantial, they all display rents and gaps, sometimes substantial gaps, that reflect areas and populations that are not effectively covered. When it comes to more traditional planning methods and tools such as comprehensive planning, zoning, and subdivision regulation, the layers are paper thin, more ghosts like than substantial, with large gaps. Very few areas are utilizing these tools, methods or approaches. The floodplain and storm water management layers are more wide-spread, particularly with respect to counties, but combining these two can be critical for effective flood control. This is often lacking, particularly in urban areas, and the question of how well counties and municipalities work together on these issues is an open question. The NFIP and CRS layers are also more substantial, in that there appears to be good potential coverage, and much more could be done to enhance CRS participation which would yield good mitigation payoffs. Also, coverage does not always mean participating. As we see again and again, a county or municipality may participate in the NFIP,

but whether or not actual people participate by purchasing flood insurance is yet another open question. Finally, there is good spread of building code coverage, which bodes well for the ability of future construction to withstand hazard risks. However, even here, it should be remembered that the population residing in the 112 communities for which building code and other mitigation planning issues were discussed represent approximately 69.5% of the total population residing in coastal counties. Thus the gaps mentioned above could possibly be even larger than suggested by these findings. While there is room for optimism, the thin policy layers and major gaps must be of major concern and should be addressed. We clearly are a long way from insuring that Texas coastal communities, particularly those in the CMZ, are effectively addressing the very real risks to coastal hazards they face.

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