

Disaster Preparedness Considerations in Long Term Planning Efforts with Case Studies Highlighting Experiences in and around Charleston, SC

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Introduction

When I first suggested that I might team with Norm Levine a geologist working teaching in the GIS lab in Charleston, I felt that it was definitely time that I, as a practicing Landscape Architect and preservationist involved on very practical problems on a field level, work on a larger scale. I have been enlightened by this collaboration and grateful to this organization for giving me a reason to do so.

The premise for this paper is that coastal, historic places like Charleston and New Orleans will need special planning efforts to face disasters and a perhaps dramatic, new vision of how to manage those threats. This vision should also make a contribution to the urban aesthetic and manage to cope with preservation needs to be effective. This is the tonic for the current lack of engagement, apathy, even denial that seems to permeate the popular discussion so far (See Figure 1).

We further make the case that planning for the next disaster is a way forward to think more creatively about how to deal with the day-to-day problems of infrastructure in an historic city like Charleston. Disaster preparation offers a less polarizing context in which to address some aspects of a longer-term situation directly and with some shared sense of urgency. To this end, we have

developed several maps reflecting the best information available to clarify the futures we face and the status of the historic resources we seek to protect. If we must retreat from the ocean and plan for rising waters, let us do so in a planned and careful way, basing what we do on what we know of a broader environmental context and broader notion of setting and of place.

Study area and proposal

The focus of this study is the tidal and riverine system that is the setting for Charleston. In fact, these rivers merge indistinguishably with the Stono, Edisto, Peedee complex held in check by Lakes Moultrie and Marion slightly upcountry and bounded by the Atlantic on the south and east. The proposal I am offering is based on the conflation of ideas from Clemson's recent study to think about the urban form of Charleston in the face of rising sea levels and the so-called "Dutch" ideas that are being discussed for the New Orleans area - that is the notion of a tiered level of coastal reinforcement in support of the current levee system. Our combined research and practical perspectives seem well suited to address this issue under the general idea of planning for disasters.

Background

It is not the point here to engage in an historical discussion about Charleston, but it is worth making a few points about this historic city. From its outset, Charleston has always had a direct visual and functional relationship with its rivers and the ocean. It is, thus, formed as much from its marsh and riverine landscape as from its celebrated 300 + year history of architectural forms (See Figure 2).

As one looks closely at much of the urban settlement of Charleston, it is to a remarkable extent a twentieth-century place (See Figure 3). With the advent of “industrialization” in the post-Civil War period of Reconstruction, Charleston “reclaimed” much of its land from the rivers for expansion. This illustration dramatically describes the recent development of these low lying areas. Even if these areas deceive the eye with older structures and historicist design moved to fill in these places, they lie in an area that was until recently under water (See Figure 4).

I am not proposing an overly “preservationist” outlook that might recommend discarding such “unhistoric” places, but rather the recognition of the cultures that created these places and move forward based on a more suitable vision—to place history in the uncomfortable role of informing and analyzing the future. Such a vision presumably would value open spaces if for no other reason than that they act as a protection from development.

Case Studies

Attempting to stop or slow development in these vulnerable areas, the regulatory environment is neither coordinated nor successful. It is our experience with disasters that, far from stopping development, they in fact clear land for new development. In the case of the major storms of 1911 and 1989 (Hurricane Hugo)—and looking at the traditionally rural settings where the storms landed—the amount of new development is striking (See Figure 5). This presentation of construction data also reflects - indirectly perhaps - the social costs.

Impacts of new development are also felt on the infrastructure. Harleston Green was developed in the 1980s as an early in-fill project in unused vacant land in the center of a block in Harleston Village (See Figure 6). It was touted at the time (in the days before neo traditional planning) as a way to maximize utilization of land for taxes, infrastructure development and increased density (in itself a self-evident good in urban areas). The reality of flooding in the development soon became evident. This area is lower than the surrounding area and tends to pond considerably. The somewhat expensive solution chosen here was pumping the storm water directly into the undersized storm sewer, thereby alleviating the development's flooding even if arguably making the surrounding older neighborhood more prone to flooding.

Wraggborough in-fill project, on the other hand, began by filling an old marsh site rendered dysfunctional by downstream development (See Figure 7). This solved the drainage issue on site; however, it did raise several other issues related to flooding in the surrounding historic properties. This increased flooding potential and general wicking of the groundwater also served to raise the water table with concomitant issues with foundation and footing in this area. Fortunately, there have been no earthquakes to stress this weakened setting, although there continue to be problems with flooding and maintenance.

In recent development, several in-fill projects have been developed which manage to avoid these discrepancies of grade and drainage. On the other hand, these projects have paved the site completely including the open spaces. Runoff has been handled in a completely engineered fashion that is likely to be

problematic for the existing drainage during disasters (See Figure 8). The rationale for these projects has been based on the future presence of underground drainage structures, only one of which was built in the 1990s as a \$12 million tunnel, around 70 feet underground, pumped out during and after storm events. Unfortunately, the practical problem of water hammer and siltation has resulted in underperforming and costly facilities. This system, while allowing a dense urban pattern without reference to site, does not seem to be the answer to sea level rise and disaster mitigation.

Current Planning

City of Charleston Preservation Plan

The current oversight of the future of development works within a matrix of regulations laid out at a state and national level, but the plan's vision lies principally with the City itself. As such, the City has recently completed a Preservation Plan entitled **Vision, Community, Heritage** that seeks to curb sprawl, recognize rural value, and develop new village centers to provide both more urbanity and a way to continue to grow while holding the line of an urban growth boundary. Central tenets of this plan are something called "in fill" development and village centers. These are all well established neo-traditional methods that our city has whole-heartedly embraced and that work within today's formulations of livable, urban centers. Rather than a prescription of methods, as in past zoning methods, the Preservation Plan seeks to build a vision for the future (Page and Turnbull, 6).

While the report does mention the need to plan for disasters and global sea level rise, it stops short, it seems to us, of actively engaging the issue. Disaster preparation is a matter of documentation of history and prepositioning assets to rebuild after the event (Page and Turnbull, 124). As to the question of future urban form, it suggests that planners rely on the historic plans such as the Bridgens and Allen map of 1853 (See Figure 9). Therein lies the difficulty. Many of the areas that are most at risk are shown on this historic plan as impoundments and open water. It might be more useful to understand the difficulties we face dealing with the existing development in more detail and focus on those problems such new infill development might cause or exacerbate.

Clemson's Architectural Study

A recent report done by the Clemson Architectural Center entitled **Global Climate Change and the Charleston Peninsula** attempted to envision a one-, three-, six-, and twelve-foot sea level rise (See Figure 10). In this effort, their analysis was simply to draw a topographic reference boundary line which reflects those changes and suggests an urban form that works with those changes. At a one-foot sea level rise, they suggest a series of retention parks along the periphery of the City, together with conversion of parking facilities to accommodate storm water and new development to retain water at a higher standard. The three-foot scenario envisions development of encircling retention parks with greater high-density development in selected areas to help pay for it. In fact, even under the best-case scenario, new urban form is a virtual certainty by the year 2075-2100. At the six- or twelve-foot sea level rise, costly, long-range

commitment to engineered solutions need to be made, including armoring the harbor and development of canals in the fashion of Venice (Clemson Architecture Center in Charleston). While the emphasis of this study was primarily architectural, it does highlight the problem of considering these solutions in isolation from the entire watershed and its processes. In fact, even a cursory consideration of these scenarios in the area up and down the tidal and riverine systems points to the need to place any proposed buildings in a more comprehensive, multi-jurisdictional frame of reference. Each scenario would need to be accompanied by watershed-wide accommodations even at the one- and three-foot sea level rise scenarios. At the larger estimates of sea-level rise, it is deeply problematic that the city might exist cut off completely from its hinterland. The size and configuration not just of downtown but of the coast would be severely altered. The protection for urban resources would need to be greatly enhanced, and the size of the effected areas would expand exponentially. The latter scenarios would call for expanded measures all the way to Lakes Marion and Moultrie, and along the entire coastal zone. Given the lack of resources and the manner in which such works would likely be undertaken (that is, under duress in response to specific crises) saving the coastline would be hard to imagine. It seems likely that we would need to retreat from the coast altogether.

“Dutch” Model

In this discussion of apocalyptic change, I am ever more drawn to talk about what we can comprehend and predict based on historical models. In New

Orleans, the Dutch consultants recommend that storm protection be conceived as a tiered series of defenses beginning with the barrier islands, extending through the natural and man-made features that reduce storm runoff and deal with the need to elevate properties and maintain clear local evacuation in major events (New Orleans Times Picayune). How much we can depend on the natural defenses is uncertain; however, New Orleans has dramatically reminded us of the unreliability of purely engineered solutions (Hernandez).

A Practical Suggestion

The need for a broader context and vision

This paper suggests that the area of study must expand to include the entire watershed and those regulations and policies must cross political and jurisdictional boundaries. As sea level rises, the effected areas increase in size. As a practical matter, the less dire scenarios are likely to be the bases of planning our way forward. As such, we need to expand the vision of required changes to include the area of the entire watershed. Even that becomes slightly problematic as various riverine systems cross circulate in the flat swampy terrain of the low country. The way forward seems to me to involve not only expanding the frame of reference as seen in the Dutch model, but also a greater attention to environmental change at a landscape level—that is a “holistic” approach wrapped into smaller scale site analysis. In this matter at least, the heightened concerns associated with storm planning are coincident with concerns about global sea level rise.

The new City Preservation Plan does reference this Clemson study and suggests some post disaster preparations, but it does not address the preplanning efforts in any substantive way (Page and Turnbull, 124-127). It wholeheartedly approves in-fill development for its benefits to the urban environment and the efficiency it creates (Page and Turnbull, 36-41). It also refers to the need to maintain historical block morphology as well as building typology (Page and Turnbull, 258). Certainly, this level of planning has the increased environmental benefits associated with diminished per capita loading but it does beg the question of sustainability and the carrying capacity of an already strained infrastructure.

Furthermore, the city plan deals with disaster planning almost exclusively from a post-event status, which leaves much to be desired. It seems that there is still considerable unwillingness to accept much less to act on the scientific certainty of global sea level rise. As such, the conclusion that is postulated here for your consideration is to unite the two approaches: a tiered system of defenses suggested by the Dutch consultants for New Orleans and a newer vision of urban form suggested by the Clemson study.

Futures

In order to isolate the areas of the entire coast that are most vulnerable, the USGS has compiled geomorphology, historical shoreline changes, coastal slope, mean tidal range, and wave height to assemble a large scale model (Theiler). The presentation shows the Charleston area with considerable areas at high risk (See Figure 11). Trying to understand that risk on a more local level is

problematic. Information is scarce on a more localized area except in a generalized format such as this.

The City of Charleston, FEMA, the State, and others are all engaged in planning for a changing relationship with the water. The need to plan for storms and earthquakes, global sea level rise and the associated changing geomorphic setting - together with continuing development pressures on the historic fabric - calls for some type of collective discussion. The City of Charleston has just finalized a Preservation Plan. FEMA and the county government are in the process of clarifying the flood insurance rate maps, the state is in charge of shoreline change policy and the home of the “takings” legislation is now looking for a return bout to prohibit repair in coastal situations where the damage to structures has exceeded 50% (Kolnitz). They are also adamant about prohibiting armament of the coastline which reflects their general policy of retreat rather than of fighting the rising tide (Dyckman). Academic institutions are engaged in the discussion as well. They are taking a rather different view of protecting places, showing the development of alternatives for a place that we all want to save which does envision armament (Clemson Architecture Center).

We conclude for now with a consideration of this vision for the peninsula. The sea level rise shown here threatens directly the new development along the periphery of the City (see Figure 12). Armoring the edge is, of course, problematic as there would be no end to it going up the coast. Furthermore, even the retention ponds expressed in the Clemson Report would provide minimal

protection given the high water table and low lying nature of the area. Thus, we need to expand the area and scope of consideration.

These maps do not, however, present several important components of disaster preparation. First, we do not deal with tidal surge associated with hurricanes for the higher base elevations. This is an obvious consideration especially in the zone of development subject to the direct action of wind and waves, known as the “V” zone. Next, the map does not consider the elements of the geomorphology of the area. Certainly, this type of analysis would also suggests liquefaction of the soils and generally unstable foundation conditions during earthquakes and should certainly be part of a site suitability analysis for these retention ponds as well as buildings’ foundations.

To assist in visualizing the area, we developed a smaller scale map to contextualize the discussion (See Figure 13). This map is based on accepted numbers of sea level rise that also shows a range of possibilities associated with the unpredictable effects of large scale sheet ice melting (USGS). An area wide context map reflecting the current accepted elevation levels at first glance does not seem significant. The sea level rise predicted from thermal expansion of the ocean waters is predicted to reach 0.32 meters by 2050 and 0.64 meters by 2100. What is not shown are the associated tide levels with those base line elevations. In fact, the green areas on this map reflect both the high tides for 2050 and 2100. Many of these areas are not currently inundated; there are many problems this poses for existing development; and there are water quality

issues associated with inundation of these previously unsaturated lands.

Furthermore, these areas are no longer mostly marsh; they are underwater.

The olive and brown areas show the effects of the melting of the sheet ice of Greenland. The olive areas simply show half of the sheet ice melting as another possibility. The areas that are orange and tan are our new barrier islands. The rest is high ground. The new coast line is somewhere between 10 and 20 kilometers back from existing coast lines.

There are several conclusions one might reach from a map such as this. First, the city of Charleston and most of its hinterland has a direct stake in the global conversation about sea level rise. Second, the future studies shown by the Clemson study need to be expanded to consider this broader context and, as the Dutch model suggests, see the value of these new marsh areas as our first line of defense. The development left in the outlying areas is even more vulnerable to storm damage. Third, this map does not consider storm water runoff, which will be increasingly difficult to manage. Given the certainty of the sea level rise in the next century, the City should develop the “Retention” Park model for urban form and seek to limit in a more aggressive way the allowable runoff from new development. We would, however, encourage a broader focus area and greater consideration of disaster planning. Fourth, the inundation of the developed areas in the entire riverine area argues for greater development control of runoff and in some instances actual retreat. Finally, the stake that all coastal areas have to limit greenhouse gases and try to slow down global warming could not be higher. This then engages us with the highest level of community, the global one.



Figure 1: The premise for this paper is that coastal, historic places like Charleston and New Orleans will need special planning efforts to face disasters and a perhaps dramatic, new vision of how to manage those threats (photo by author).

Charles Fraser, early 19th Century



Ashley River & Lumber Mills,
1802



Fort Mifflin, July 4, 1796



South Bay-Foot of Greenhill



Savage's Green, 1796

Figure 2: Charleston has always had a direct visual and functional relationship with its rivers and the ocean.

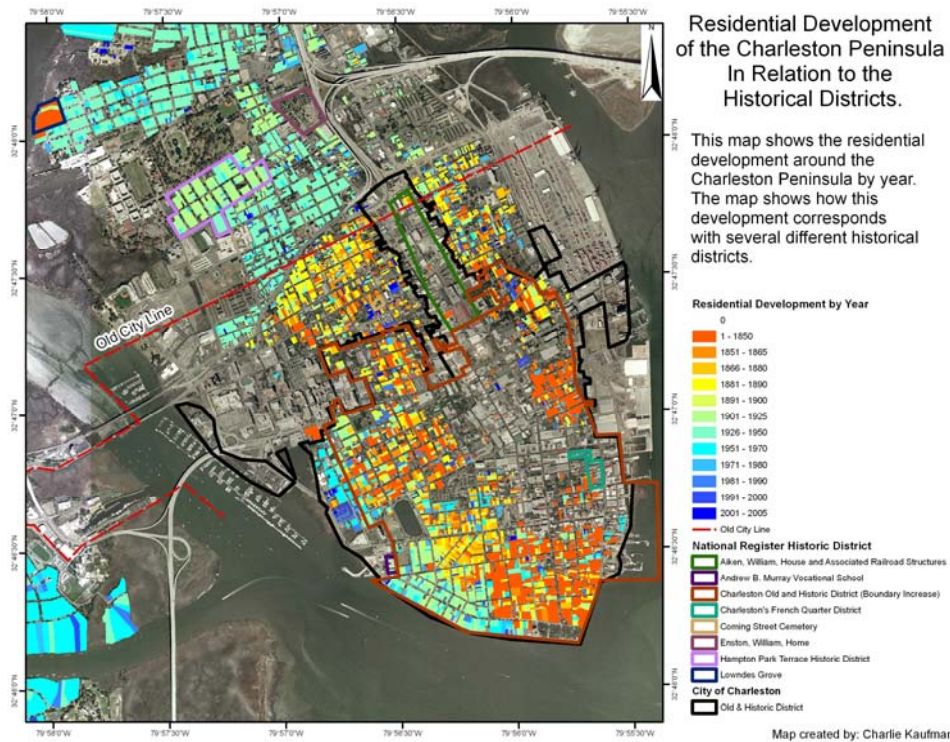


Figure 3: Charleston, especially along the Ashley River, is to a remarkable extent a twentieth-century place (College of Charleston GIS lab, current Charleston County RMC data).

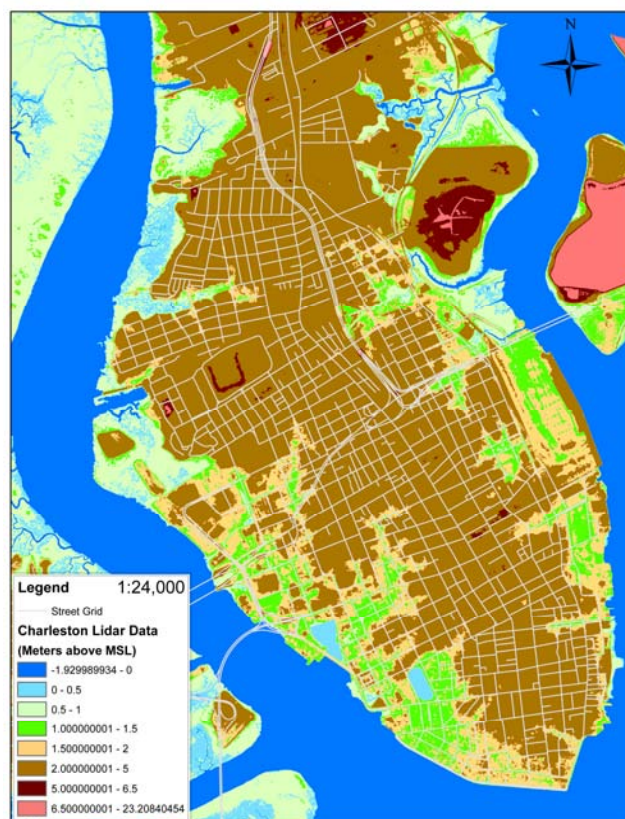


Figure 4: Even if these areas deceive the eye with older structures and historicist design moved to fill in these places, they lie in an area that was until recently under water (College of Charleston GIS lab).

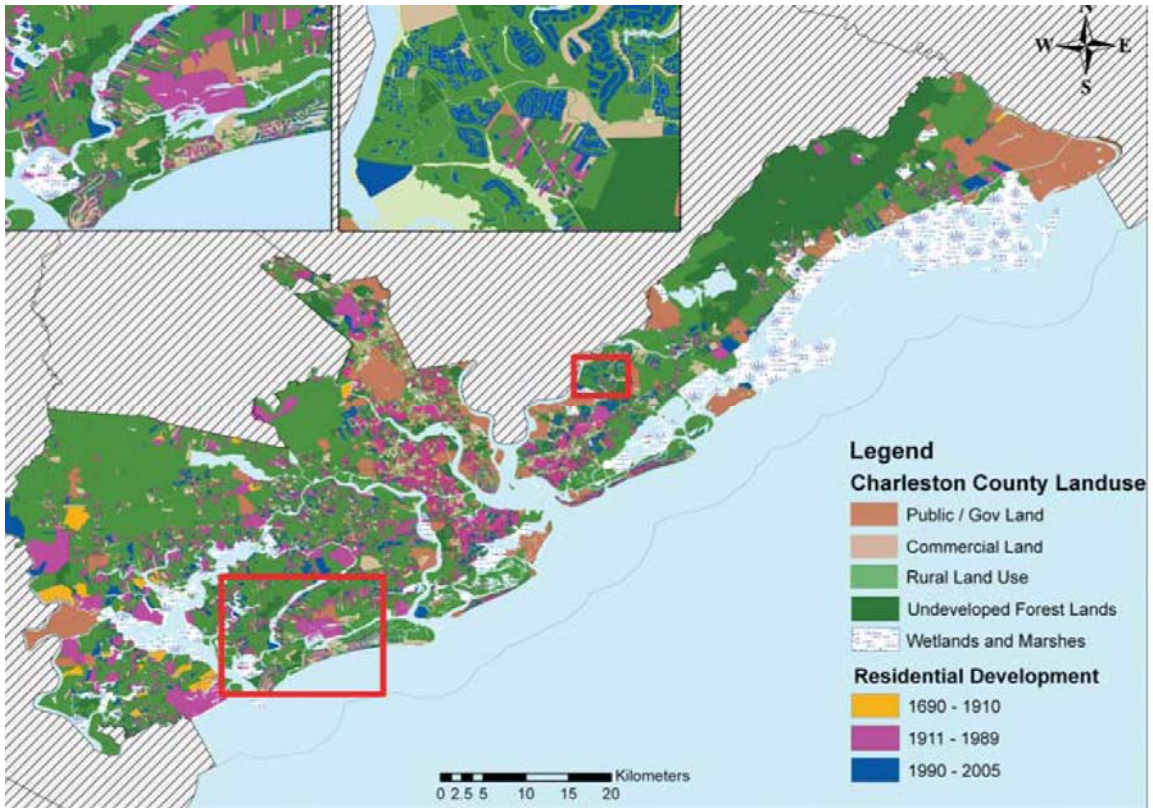


Figure 5: It is our experience with disasters that, far from stopping development, they in fact clear land for new development. In the case of the major storms of 1911 and 1989 (Hurricane Hugo)—and looking at the traditionally rural settings where the storms landed—the amount of new development is striking (Hurley, 6).



Figure 6: Harleston Green was developed in the 1980s as an early in-fill project in unused vacant land in the center of a block in Harleston Village (Aerials by Google Earth and photography by author)



Figure 7: Wraggborough in-fill project, on The other hand, began by filling an old marsh site rendered dysfunctional by downstream development (Aerials by Google Earth and photography by author).



Figure 8: On the other hand, these projects have paved the site completely including the open spaces. Runoff has been handled in a completely engineered fashion that is likely to be problematic for the existing drainage during disasters (Charleston Waterkeeper).



Figure 9: As to the question of future urban form, it suggests that planners rely on the historic plans such as the Bridgens and Allen map of 1853.



Figure 10: A recent report done by the Clemson Architectural Center entitled **Global Climate Change and the Charleston Peninsula** attempted to envision a one-, three-, six-, and twelve-foot sea level rise. In this effort, their analysis was simply to draw a topographic reference boundary line which reflects those changes and suggests an urban form that works with those changes.

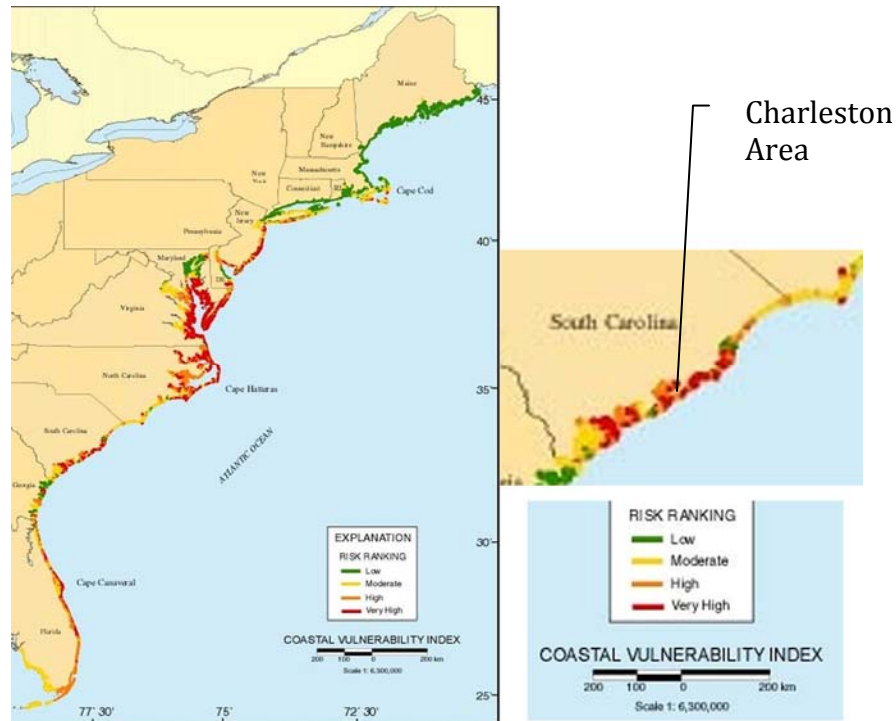


Figure 11: In order to isolate the areas of the entire coast that are most vulnerable, the USGS has compiled geomorphology, historical shoreline changes, coastal slope, mean tidal range, and wave height to assemble a large scale model. The presentation shows the Charleston area with considerable areas at high risk (USGS Open-File Report).

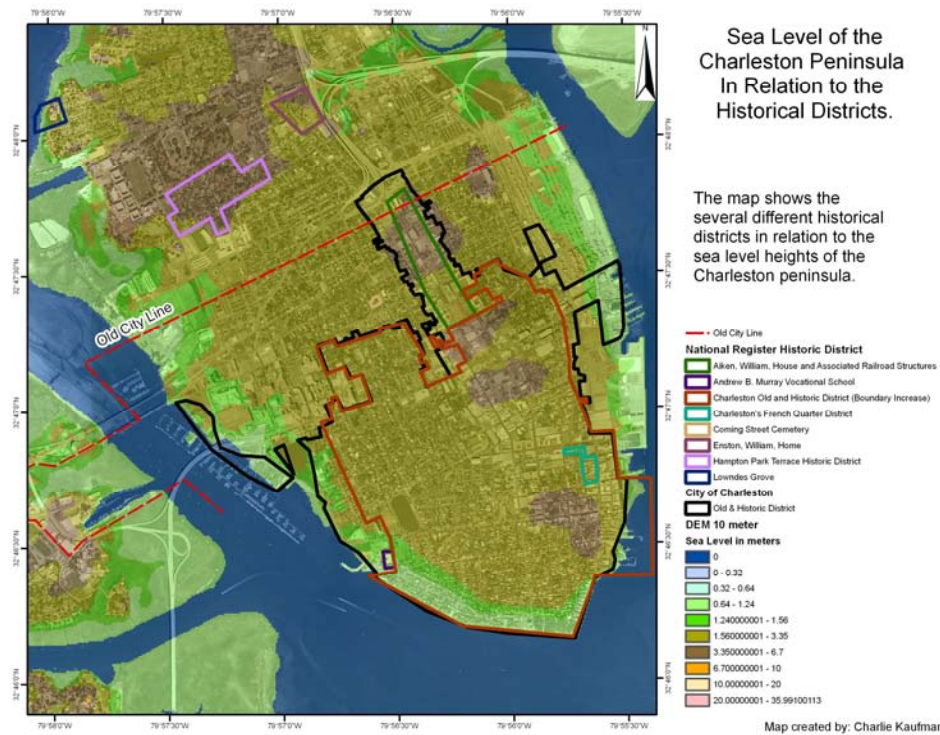


Figure 12: The sea level rise threatens directly the new development along the periphery of the City (College of Charleston GIS lab using enhanced USGS 10m2 data).

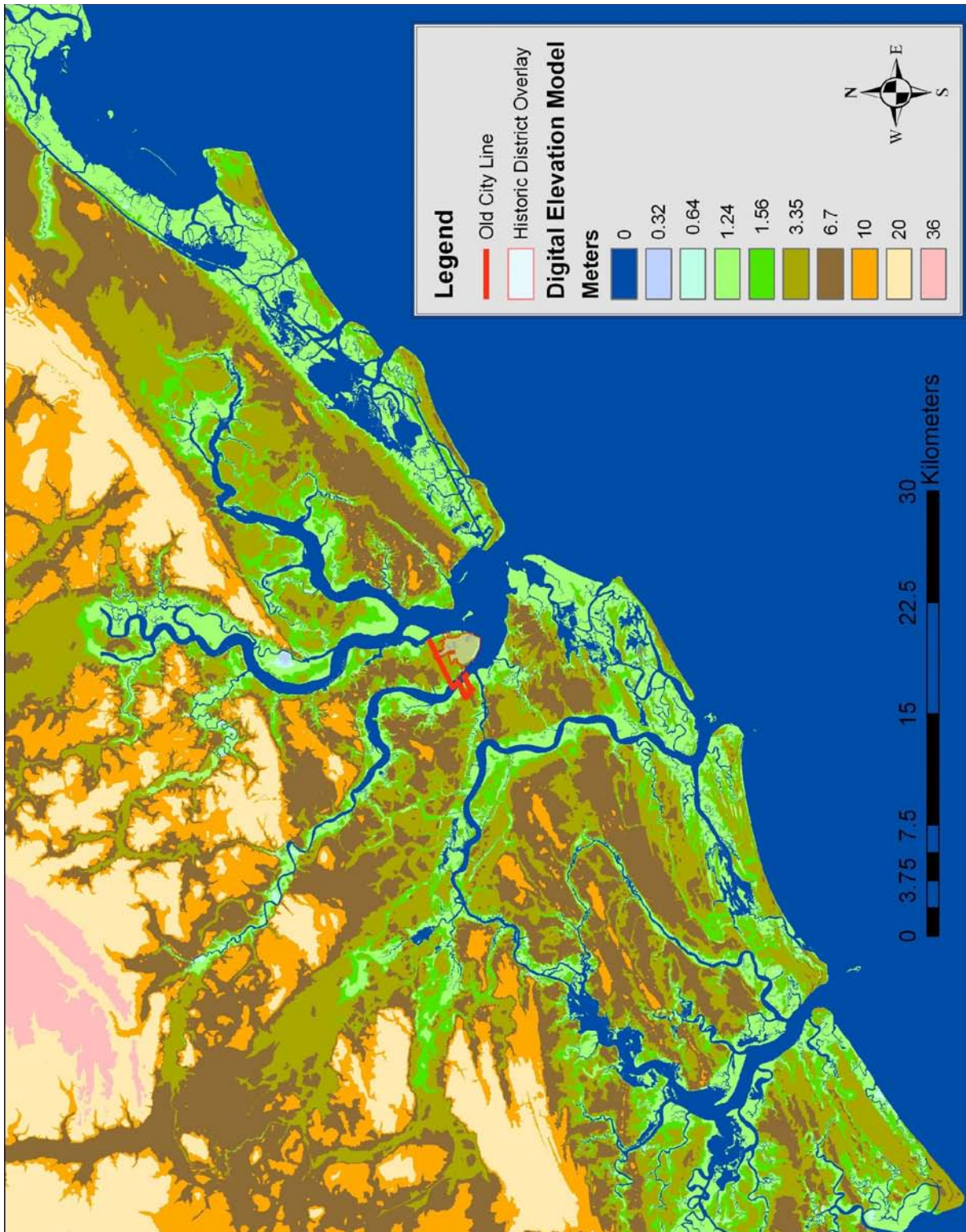


Figure 13: This map is based on accepted numbers of sea level rise that also shows a range of possibilities associated with the unpredictable effects of large scale sheet ice melting (College of Charleston GIS lab using enhanced USGS 10m2 data).

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