PLANNING FOR SUSTAINABILITY ON MARYLAND'S EASTERN SHORE: LINKING SOCIAL SUSTAINABILITY AND SEA LEVEL RISE

by

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ABSTRACT

ROBYN MELISSA BYERS STUBER. Planning for sustainability on Maryland's Eastern Shore: Linking social sustainability and sea level rise (Under the direction of DR. WEI-NING XIANG)

Sustainability science is a growing field that encompasses the study of the environment, the economy, and social equity. However, with the ever-growing literature base surrounding sustainability, defining the issue has continued to be elusive, especially concerning social sustainability, or equity concerns. In addition, complications to sustainability, such as sea level rise, have not been well understood within the discipline. The purpose of this dissertation is to add to the base of sustainability knowledge, specifically looking at how one coastal county understands sustainability, with an emphasis on social sustainability, in relation to sea level rise. Utilizing Wicomico County, Maryland, as a case study, this dissertation will explore comprehensive planning documents for sustainability content, a self-administered and unsolicited attitude survey for Wicomico County, and a vulnerability analysis of Wicomico County to determine the status for sustainability and sea level rise planning for the coastal county.

The results show that the inclusion of sustainability into the local knowledge base is growing in recent years, while no link between sustainability and sea level rise has been established. The most recent comprehensive planning documents show a higher inclusion rate for sustainability and sea level rise issues, although the inclusion rate for sea level rise issues remains low. This is supported by survey responses stating that sustainability is a priority, though sea level rise issues are not. There are the potentially significant impacts from sea level rise on the environment, economy, and social equity.

This research also highlights equity issues ranging from a high survey response rate for older white residents and low response rates for other races, while also highlighting potential equity issues with those areas possibly affected by sea level rise. Implications of the results are discussed.

DEDICATION

To my family who sustain me

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CHAPTER 1: INTRODUCTION

The Chesapeake Bay is a national treasure that has captured my passion since I was a child. Working through my undergraduate and masters level education, I focused on policy and watershed management in the bay, taking a cue from many of the programs and foundations in the region. However, working as a practicing planner in Maryland, I learned more about the unique cultures of the Chesapeake Bay region, specifically the culture of Maryland's Eastern Shore. In this region, many farmers and environmentalists conflict when it comes to 'what to do about the bay?' It is noted as a common rural conflict, one between longtime rural residents who wish to sustain their way of life and environmentalists that want to protect the beautiful regions at all costs (Tainter, 2006). Personally, I learned that there needs to be a compromise; there are families who have lived and worked in the region for centuries and do not want their livlihoods threatened, but at the same time, environmental quality is important to maintain for everyone.

When Hurricane Isabel hit Maryland in 2003, the storm started as a Category Five hurricane in the Carolinas, lessoning to a Tropical Storm between Virginia and Maryland (National Climatic Data Center, 2011). However, the storm did not hit the Atlantic coast of Maryland, but rather forged up the Chesapeake Bay, forcing water up the bay and its tributaries, causing a lot of coastal flooding and ancillary home destruction. This event caused me to realize what the most important thing in the Chesapeake Bay region is; its sustainability. With the threats of sea level rise in Maryland, along with the anticipation

of future storms mirroring Isabel's path, I feel it is essential that communities on the Eastern Shore adapt and become more sustainable.

It is in this vein that I undertook defining my dissertation research; the people matter just as much as the environment and measures can be taken to help protect both from climate change. While I came to this conclusion with respect to the Chesapeake Bay region, this is a useful lesson that can be applied to all regions. To be truly sustainable, the people should count just as much as the environment and the economy.

1.1 Sustainability Science as a Growing Interdisciplinary Topic

The challenges associated with sustainability have received much attention since 1987, when the World Commission on Environment and Development (WCED) published "Our Common Future," defining the term. Since then, research has only increased on the topic. A quick review of literature through the Web of Science, an online scholarly journal search engine, revealed 23,622 articles with a topic of "sustainability." Of those, 17,958 articles, or 76 percent, have been published between 2001 and 2010. Further, 13,146, or 55 percent, have been published since 2006. The number of researchers writing in the field has doubled every 8.4 years since 1974, while the vast majority of universities have established sustainability offices (Yates, 2012). In addition, an overwhelming majority (2/3) of surveyed businesses stated that sustainability was critical to being competitive, with 70 percent having sustainability as part of their management agenda (Yates, 2012).

While sustainability science is growing in popularity, it is also expanding in breadth. Actors for sustainability are from various business sectors and different academic disciplines, constituting sustainability as an interdisciplinary topic. And while

cross-disciplinary work is evolving with sustainability, there is also a move toward participation from non-academic stakeholders and government agencies along with academic efforts in the field (Wu, 2006). The topic elicits attention from waste management, climate change science, public health, land use and transportation planning, environmental professionals, engineering focused on green buildings, agriculture with local food and urban agriculture issues, energy, academic research in numerous disciplines, and more because sustainability issues are inherently interrelated (ICMA, 2005; Living Cities, 2009). Planners tend to be at the forefront of the movement toward sustainability because they work at the local level and have dealt with local sustainability issues for many decades (Weitz, 2010). For example, planners in Arizona have been ahead of the sustainability science boom largely due to the water issues they encounter every day (Weitz, 2010).

1.2 Intersection Between Geography, Hazards Management, and Planning

While sustainability science is interdisciplinary in nature, there are three broad disciplines that converge to create a basis for sustainability science; geography, natural hazards, and planning research. Several key principles in sustainability research include natural capital, vulnerability assessment and adaptive management, human and social capital, and the integration of policy, requiring cooperation amongst many separate departments (Living Cities, 2009; Duxbury and Dickinson, 2007).

Geography started as regional studies, or place studies, analyzing social and physical characteristics of a particular place. The quantitative revolution has changed the focus of geography to a more hard science-oriented discipline, but the fundamentals remain the same; an interplay of social and physical characteristics. This is evident as a

key aspect of sustainability when one looks at the cycle of environmental degradation and poverty, where a degraded environment tends to lead to lower socioeconomic status, which leads to over-exploitation of lesser expensive resources, leading to further degradation (Franceschi and Kahn, 2003). The spatial aspects of planning, in particular, are essential to promoting adaptation to climate change for a community (Hanssen, et al., 2012). This interplay is where sustainability lies.

When discussing the geography of sustainability, one would be amiss to not include the growing literature in climate change and associated hazards, such as sea level rise (Finn and McCormick, 2011). In recent history, nine (9) out of ten (10) disasters are related to the climate, having serious consequences across different economies, societies, and natural systems (Hay and Mimura, 2010). Therefore, it is critical to include discussions of risk, or the probability of an event happening, and vulnerability, a function of risk and the capacity to cope with the event, into sustainability discourse (Schneider, 2006; Hay and Mimura, 2010). If the practice of climate change adaptation can rely on the background of research in hazards management, not just geography, then new research can build on the past and potentially advance adaptation implementation and improve overall sustainability (Hay and Mimura, 2010).

Planning is a field that takes the geographic and scientific knowledge, including hazards management, and applies it to communities through adopted plans and land use patterns (Rittel and Webber, 1973). Sustainable development is hyped as the new major planning agenda, with planners largely taking the lead in the sustainability movement (Berke and Conroy, 2000; Weitz, 2010). Regional studies, along with information gathered from engineers and other scientists, create the basis for planning. Adopted plans

are wide ranging, covering economic opportunity, environmental justice and quality of life, and natural resource use, allowing these plans to serve as a model for sustainability (Berke and Conroy, 2000; Conroy and Berke, 2004; Berke and Godschalk, 2009). Similarly, land use can determine the quality of the surrounding resources, presenting a unique venue to implement policies advancing sustainability (Conroy and Berk, 2004; Potschin, 2009). It is necessary to have geographic and scientific research inform planners and give them the best available information possible to create sustainable plans and land use patterns.

Ultimately, in order to work toward sustainability, we as a society need to adapt the way we view and interact with our environments, having our social structure evolve along with our physical environments (Beddoe, et al., 2009). Geographers, hazards managers and planners all work together at the local scale for sustainability due in part because all regions are unique, all disasters are local, and planners interact directly with their society. We will need this background from our geographers and hazards managers along with the skills of our planners to help us adapt in a deliberate manner, or we will move forward uncontrolled, leading to the potential for disaster (Beddoe, et al., 2009).

1.3 Framework for Research

The purpose of this research is to augment the comprehension of sustainability science focusing on the inclusion of sea level rise as a complicating factor. In order to help a coastal region strive for sustainability in light of sea level rise, one must analyze what challenges or opportunities sea level rise brings to sustainability planning. To accomplish this study, I will focus first on a content analysis of a specific region's comprehensive planning documents. This analysis will help inform researchers about

whether sustainability and/or sea level rise issues are a priority for the region. Secondly, a survey of randomly selected citizens in Wicomico County, Maryland, will be conducted to elicit a direct response answering whether sustainability and sea level rise are important for the community. Lastly, the content analysis and survey will feed into a model that will assess possible sustainability issues and whether sea level rise will impede sustainability.

Because this research relates to human perception, it is imperative to gather a well-rounded understanding of perception of the residents. However, this understanding can only be obtained with the cooperation and participation of the residents. In addition, every resident has a different background, through experience and education, which will influence the understanding of sustainability and sea level rise; this is integral to gathering a localized concept of sustainability. It will be part of the research to obtain demographic data that may shed light on to patterns of perception.

These three questions come together to form my research, a regional study of Wicomico County, Maryland, a coastal county, in three parts, to qualitatively analyze sustainability and sea level rise through the understanding of this region's public perception. It is the intention of this proposal that this research provide ample opportunity for three distinct publishable manuscripts to be submitted to appropriate journals of academic research.

While the details of these challenges and questions make the sustainability issues in Wicomico County unique, they also exist in many other coastal communities. This study focuses on how to determine a locally relevant understanding of sustainability and apply that equitably to current conditions. Therefore, while I am presenting a regional

study for my research, the implications for my research are far-reaching to other thriving coastal communities concerned with sustainability.

The rest of this paper is organized as follows, a literature review will comprise chapter two (2), including a discussion on defining and measuring sustainability, as well as social sustainability and equity. Next, chapter three (3) will further define my research question and three objectives set forth above. Chapter four (4) will include an in-depth discussion of my study area, data, and methodology. In chapter five (5), I will discuss the results of the research, while in chapter six (6) I will present a formal discussion of the results. Chapter seven (7) will conclude this paper detailing implications, including limitations of this research.

CHAPTER 2: LITERATURE REVIEW

2.1 Sustainability Science

The human impact on the natural world is currently equal or greater than nature's impact on humans, requiring a link to bridge the gap (Jerneck, 2010; Yates, 2012). That link is sustainability science (Jerneck, 2010). With our modern understanding of environmental and socioeconomic issues, we can look back and see that our history is a series of decisions to move from one unsustainable way of life to another, seemingly unknowingly (Yates, 2012). Knowing this now, we are in a state of flux trying to determine how to live without destroying ourselves or the systems that we depend on for life, causing worry and uncertainty (Haughton, 1999; Yates, 2012). Because of this uncertainty, people are attracted to the term sustainability, as the term encompasses a hope for a better future (Yates, 2012).

Sustainability is one of, if not the, most complex issues facing citizens in the twenty-first century. It falls under what Rittel and Webber (1973) call a "wicked problem." Sustainability does not stop, it continues on indefinitely, constantly changing with new knowledge, technologies and perceptions (Rittel and Webber, 1973; Xiang, 2013). The concept has no true or false solution, nor is there a way to test the possible solutions without changing the underlying conditions of the problem; every solution leaves a consequence that cannot be undone, some more visible, such as environmental degradation, than others (Rittel and Webber, 1973; Sneddon, et al., 2006; Xiang, 2013).

There can either be good solutions or bad solutions, but that may not be known until well after the solution has been implemented (Rittel and Webber, 1973). Essentially there is no trial and error with a wicked problem because every trial changes the base circumstances and may require a completely different set of solutions or cause another problem altogether (Rittel and Webber, 1973). Unfortunately, wicked problems, such as sustainability, are all unique, cannot be readily defined, and therefore, have no set solutions that are known to solve the issues (Rittel and Webber, 1973; Xiang, 2013).

However, sustainability may not have to be solved, as Haughton (1999) states that sustainability is as much a process as a final state, focusing on building relationships (McDaniels and Lanham, 2010). Literature is coming to a consensus that wicked problems, such as sustainability, are social at their core and would, therefore, benefit from solutions that are inherently adaptive, participatory, and transdisciplinary (Xiang, 2013). This process requires communities to look at the issues and figure out a way to move past them, favorably, or become unsustainable and decline (Beddoe, et al., 2009). In order to move forward, however, one must determine what is meant by "sustainability."

2.1.1 Defining Sustainability Science

The World Commission on Environment and Development (WCED) defined sustainable development as development that "meets the needs of the present generation without compromising the ability of future generations to meet their own needs," recognizing three pillars to sustainability, namely attention to the environment, economy, and equity, and how they are interlinked (1987). Since then, this definition has been the standard-issue definition, due to its inclusion of ecological integrity, human well-being

and equitable resource distribution (WCED, 1987; Sneddon, et al., 2006). The definition further implies a temporal scale in the inclusion of intergenerational equity, the future generation (WCED, 1987; Berke and Conroy, 2000; Johnston, et al., 2007).

The WCED was tasked with defining sustainability for the world, having to create a definition that encompassed the developed world's need to curb environmental problems and the developing world's need for economic development (WCED, 1987; Yates, 2012). Yet at the same time, the WCED definition discusses needs, which is a concept that is subjective (Wheeler, 2000). Because of this, the WCED definition is generally accepted, but also debated by researchers (Conroy and Berke, 2004).

Numerous researchers have condemned the WCED for creating a vague definition that cannot be readily applied to a specific jurisdiction or operationalized (Berke and Manta, 1999; Berke and Conroy, 2000; Sneddon, et al., 2006; Johnston, et al., 2007). Some have argued that the definition is contradictory, stating that the three pillars cannot all be satisfied, suggesting one or two can be achieved at the expense of the third (Sneddon, et al., 2006; Johnston, et al., 2007). Research has shown that development can lead to environmental degradation, environmental protection or restoration can lead to economic losses and that all of these can affect society's livelihoods (Ellis, 2011).

Because of its vagueness, the WCED definition has been redefined to suit the needs of those in research or power (Johnston, et al., 2007). Over 300 different definitions of sustainability exist, all focusing on different sectors or disciplines (Johnston, et al., 2007). Moreover, the sheer number of different definitions demonstrates that there is a lack of consensus on the issue, allowing for the manipulation

of the term "sustainability," making it meaningless to many communities (Alberti, 1996; Marshall and Toffel, 2005; Johnston, 2007).

There have been cases where sustainability has been misconstrued to support development patterns that conflict with the general purpose of sustainable development (Johnston, et al., 2007). The conflict in definition has also lead many communities to fear that sustainability is used to support restricting liberties in the United States, such as private property rights (Yates, 2012). Furthermore, many communities in the United States have gone as far as to reject Agenda 21, a sustainability policy supported by the United Nations, as they believe it is a way to encourage socialist goals (Yates, 2012).

Defining sustainability has become a large topic in part because each definition causes further discord and reduces the overall support and importance of sustainability. In a time when environmental policy and sustainability issues have been trumped by security concerns and a lack of political will, it is important to have a consensus on the definition to increase the likelihood of action (Sneddon, 2006).

While the vague nature of the WCED definition causes such discord, the motivation behind sustainability as a social and environmental movement may outweigh any reason to not pursue sustainability (Thompson, 2010). The literature shows just as many studies that uphold the WCED definition and use it as a starting point to build operational goals (Alberti, 1996; Sneddon et al., 2006; Johnston, 2007; Tanguay, et al., 2010). There needs to be a point where each study stops redefining sustainability for its own purposes and, instead, uses the WCED definition to guide progress (Johnston, 2007).

Generally, the literature shows that there is agreement on the three pillars, all expressing that sustainability should include diverse goals dealing with environmental

protection, social equity, and economic development, as each pillar cannot be fully understood without inclusion of the other three (Alberti, 1996; Conroy and Berke, 2004; Marshall and Toffel, 2005). In order for the current generation to strive for sustainability, social and economic systems have to come together to support stewardship of the environment, through proving that the environment can be conserved in a way that harnesses economic well-being and social justice (Haughton, 1999). While there is a global call for increased sustainability, many developing countries have a direct conflict between economic development and ecological awareness, as industrial revolution is seen as the only way to increase economic development (Sneddon, et al., 2006). If the environment cannot be sustained, there will be a decline in resources people depend upon, ultimately leading to a decline in equity. This decline in equity may be evidenced by an increase in poverty, which, in effect, leads to an unsustainable use of the environment, as those who have access to resources will exploit those resources to gain wealth, continuing to the cycle (Haughton, 1999; Padilla, 2002; Franceschi and Kahn, 2003; Tainter, 2006).

This cycle proves that it is the people of the community that determine sustainability. It is up to the community, therefore, to operationalize sustainability. The general public makes decisions based on their perceptions, values, and emotions, not necessarily facts (Murray, Dey, and Lenzen, 2006; Tainter, 2006). People will sustain what they value and pressure is placed upon their local governments, congressmen and other politicians for change (Murray, Dey, and Lenzen, 2006; Tainter, 2006). In order to fully institute sustainability, new rights and obligations need to be supported by the general public (Haughton, 1999). Because each community will have its own public to

serve with different geographic, historic, and political characteristics, it must be accepted that there will not be a specific and stable definition of sustainability across geographic or temporal scales (Holifield, 2001).

The general lack of specificity with regards to sustainability should not be a barrier to sustainable development; however, it should be used to guide useful research and policy (Holifield, 2001). In light of this, this paper supports the WCED definition of sustainability and uses it as the working definition for sustainability, which more than adequately covers sustainability in its entirety. At the basic level, sustainability means to continue indefinitely, implying a temporal scale that has been divorced from many definitions of sustainability, but is captured in the WCED definition with reference to allowing future generations the same general opportunities as currently exist (Johnston, 2007). There may still be critics of upholding the WCED definition, but the original definition is the best attempt to define a topic that is so important to so many different groups of people. While this definition is vague in nature, it is an inclusive starting point from where each community can adapt the definition to their own unique circumstances.

Moving forward will require each community to operationalize sustainability simply, drawing on their own experiences (Wheeler, 2000). Residents and officials need to come together and discuss their understanding of their environments, economy, and society (Holifield, 2001). Yates (2012) further explains that the community's understanding of sustainability will depend upon their cultural logic, or how progress is perceived, i.e. typical western thought is that progress equals growth. This logic directly affects how sustainability is measured.

2.1.2 Measuring Sustainability

Practically, the WCED definition of sustainability is too broad to offer concrete solutions and there is little agreement on how to translate this elusive concept into practice (Berke and Manta, 1999; Pope, et al., 2004; Finn and McCormick, 2011). Because measuring sustainability depends on how it is defined, it can then be determined that assessment is equally as difficult (Alberti, 1996). Similar to defining sustainability, there is little consensus on what is meant by sustainability assessment (Hacking and Guthrie, 2008).

What is known about sustainability assessment is that it is a tool used to encourage sustainability (Pope, et al., 2004). Since uncertainty is a hallmark of sustainability, it is also an inherent feature of assessment (Hacking and Guthrie, 2008). Assessment tends to have a wider scope than policy assessment in reference to spatial and time dimensions and should be useful for social learning and analysis (Graymore, et al., 2008; Hacking and Guthrie, 2008).

2.1.2.1 Assessment Methods

The literature surrounding sustainability assessment is just as varied as the literature on what constitutes sustainability, but the majority of assessment methods circle around multi-criteria analysis using indicators (Spangenberg, et al., 2004; Roseland, 2005; Murray, Dey and Lenzen, 2006; Colantonio, 2007; Lyytimäk and Rosenström, 2008; Huby, et al., 2009; Mascarenhas, et al., 2010). The process of how to define these indicators and how to interpret them, however, is not unified. What follows is a discussion of three studies using indicators to assess sustainability, as well as a review of five additional indicator-based sustainability assessment techniques.

First, Lyytimäki and Rosenström (2008) discuss the use of indicators for sustainability assessment, starting with numerous indicators and narrowing them down as goals get more focused. This method is commonly used because of the ambiguity of the definition of sustainability. Once a myriad of indicators are gathered, refinement can take place to include those indicators that are most appropriate to the locality. The process of refinement will continue until the selected indicators are resonant with policy systems, aligning the indicators with the goals of the local, state, or national governments (Lyytimäki and Rosenström, 2008). The authors stress the idea of having common indicators for all regions. While it will not show the individual needs of each location, common indicators will lead to common terminology and allow for comparison to other locations (Lyytimäki and Rosenström, 2008).

Murray, Dey and Lenzen state that indicators are simple and are easier to communicate to the public (2006). The authors discuss the difference between endpoint and midpoint indicators (Murray, Dey and Lenzen, 2006). Endpoint indicators are those that are aggregate measures detailing several converging impact pathways, such as life span or loss of life indicators (Murray, Dey and Lenzen, 2006). Midpoint indicators are those that can be observed along the path of impacts, such as measures of sea level rise and population dislocation (Murray, Dey and Lenzen, 2006). The authors show that while endpoint indicators are stronger indicators for public dissemination, midpoint indicators show the policy possibilities that may affect the impact (Murray, Dey and Lenzen, 2006).

Lastly, Mascarenhas, et al. (2010), discuss how indicators are used widely in sustainability assessment because sustainability can be operationalized through

indicators, increasing accountability of the locality, engaging the stakeholders, and ensuring access to information. The authors also say that indicator assessment allows for vertical integration from local to state and even national level aggregate assessment (Mascarenhas, et al., 2010). The local stakeholders can decide indicators for each locality; however, macro scale indicators should also be included to allow for the ease of vertical integration (Mascarenhas, et al., 2010).

Graymore, et al., (2008) analyzed additional indicator-based assessment methods including wellbeing assessment, developed by the World Conservation Union (Graymore, et al., 2008). This method uses a holistic set of indicators, encompassing ecosystem and human system analysis (Graymore, et al., 2008). Scores for indicators were given and then aggregated in a way to standardize the data, using either a weighted average, unweighted average or veto method, ultimately creating a sustainability index (Graymore, et al., 2008). While this method used locally-relevant indicators and proved to be effective for county assessment, vertical integration may be more difficult at larger scales, which could cause important data to be lost (Graymore, et al., 2008).

Quality of life (QoL) assessment is an indicator assessment based upon trends in data (Graymore, et al., 2008). The indicators cover a wide range of data, including at the basic level, environmental, economic and social indicators, including health, population, wealth, equity, natural environment, transportation, etc. (Graymore, et al., 2008). While all aspects of sustainability can be accounted for with this method, there is a large dataset that may be too resource intensive for many localities, as the data needs to be capture on a regular basis, yearly, every two to five years, every decade, etc. (Graymore, et al., 2008). In addition, the author explains that there is no formalized way for this method to

aggregate its data, unless specified by each QoL manager, which does not allow for easy comparison or vertical integration (Graymore, et al., 2008).

The discussion of vertical integration is an interesting one that brings up the disparity in spatial scales when assessing social sustainability. For instance, there are some common indicators used at the micro scale, such as education, income and social contacts, whereas macro scale indicators are largely income distribution indicators and state or regional assets (Spangenberg, 2004). Additionally, the difference in scales between different indicators could make regional assessment extremely difficult (Huby, et al., 2009).

In one particular study, Huby, et al., study how the Modifiable Area Unit Problem (MAUP) causes inconsistency in statistical output (2009). For instance, income deprivation and barriers to housing indicators, in the study, decrease in inequity as the spatial unit is increased, leaving the authors to conclude that the effects of social indicators that describe a local area can be lost at the regional scale (Huby, et al., 2009). Additionally, many socio-environmental indicators are collected based on physical regions and not political boundaries, causing a regional boundary issue when trying to compare those indicators; the authors use geographic information systems (GIS) to help remedy this situation (Huby, et al., 2009). It is the conclusion of the authors that, although indicators should still be conceptual in nature, statistical considerations with respect to regional boundaries need to be considered prior to study (Huby, et al., 2009).

A new way to assess social sustainability has been to evaluate community level sustainability because it is the main delivery point for associated policy (Colantonio, 2007). This concept looks at social sustainability as a function of the society as a

collective being, based upon community and neighborhood characteristics (Colantonio, 2007). Likely indicators for sustainability of communities include community interaction and social networks, community participation, pride, sense of place, community stability and crime (Colantonio, 2007). Indicators are not only quantitative, such as crime, but also include qualitative research on sense of place and social networks based on surveys and questionnaires (Colantonio, 2007). By qualitatively assessing the community's perceptions, one will have a better understanding of what sustainability looks like for the community.

However, there is a missing link between assessment literature trying to quantitatively measure social sustainability with indicators and possible qualitative assessment. Colantonio is perhaps the only researcher to discuss this issue in her research; however, more research is needed in the field of quantitative assessment before it can be widely applied. It stands to reason that if social sustainability is as much a matter of citizen value judgment, then quantitative measures just cannot capture the data needed for assessment.

2.1.2.2 Scenarios

Scenarios are future-based iterations of different policy alternatives, allowing planners to ask "what if" (Wiek, Binder, and Scholz, 2006; Duinker and Greig, 2007). Xiang and Clarke (2003) state that good scenarios include alternatives, consequences, causations, time frames and geographic footprints. All of these pieces come together to create storylines of different alternatives for each community's future (Brewer, 2010; Pontius and Neeti, 2010). Brewer (2010) further states that scenarios are key in future-oriented policy research due to the ability to describe not only the outcomes, but also the

context for each outcome in an easily understandable format (Duinker and Greig, 2007). They also balance two errors that are common in decision-making, under-prediction and over-prediction (Duinker and Greig, 2007). As such scenarios create the bridge for individuals to see the pathway from current conditions to possible future conditions, handling issues with uncertainty and allowing them to visualize the future, ultimately influencing decision-making (Ness, et al., 2007; Nicholls, et. al., 2008; Raskin, 2008; Brewer, 2010).

Specifically, scenarios are constructed based on baseline conditions with the addition of specified assumptions, typically referring to possible policy implementation. Because of this, scenarios are not considered to be predictive, as they are merely run to show possible outcomes from policy implementation (Nicholls, et. al., 2008; Brewer, 2010; Pontius and Neeti, 2010). Scenario construction should specify the function of the iterations and the goals used to construct the scenario, with clearly identified steps used in processing (Wiek, Binder, and Scholz, 2006). In addition, assumptions and different inputs need to be specifically identified in the construction stage (Nicholls, et. al., 2008). Scenarios can use both quantitative and qualitative data as input measures, which improves its functionality, especially in the planning field (Wiek, Binder and Scholz, 2006; Walz, et. al., 2007).

Xiang and Clarke (2003) determined principles for scenario use in land use planning; however, these principles are still applicable to scenarios used in sustainability planning. First, scenarios should be plausible and surprising, showing comprehensiveness and diversity in viewpoint (Xiang and Clarke, 2003; Wiek, Binder, and Scholz, 2006). Secondly, scenarios should have informational vividness, meaning

that the scenarios exude emotional interest and provoking imagery that relates directly to the individuals served by the scenarios (Xiang and Clarke, 2003). The third principle is an ergonomic design where users interact effectively and in a safe environment. This principle includes using different time frames, themes, and sizes (Xiang and Clarke, 2003). The final principle by Xiang and Clarke (2003) is that scenarios include trade offs among credentials, to ensure that the scenarios are balanced. Further expanding Xiang and Clarke's last principle, Pontius and Neeti (2010) state that scenarios need to be meaningfully different, based on assumptions and inputs, as opposed to different models or methods.

These principles create a basis for scenario use, but do not discuss how scenarios have been used in sustainability planning. Using the scholarly journal search engine Web of Science, a search provided 105 articles that had a topic of "scenario use" and "sustainability." These vague keywords were used to ensure any and all articles relevant to the subject were included in analysis and to ensure recent work, the earliest year of publication was set at 2000. From these 105 articles, 76 were cut from the analysis due to the article discussing things other than scenarios. For instance, some articles discussed projections, not scenarios. Other articles focused on models that feed into scenarios, but not the scenarios themselves. Quite a few articles represented simulations, which are used to imitate solutions over and over to obtain likelihoods or probabilities of outcomes, as opposed to establishing possible future outcomes of policy implementation. Lastly, two articles were removed from the study because they dealt with business sustainability and not sustainability as in the context of this paper.

The remaining 29 articles were reviewed to see how the scenarios were used in terms of which pillar of sustainability, or all three, was the focus. Twenty-two (22) out of 29 articles focused on environmental sustainability only (Balocco and Grazzini, 2000; Nijkamp and Vreeker, 2000; Lisson, et. al., 2000; Castilla and Defeo, 2001; Gentile, et. al., 2001; Rose and Adiku, 2001; Schreider and Mostovaia, 2001; Zofio and Prieto, 2001; Gomez-Sal, et al., 2003; Larson, et. al., 2003; van Vuuren, et. al., 2003; Moser, 2005; Lienert, et al., 2006; Metzger and Schroter, 2006; Gomi, et. al., 2007; Brooke, 2008; van Storch and Woth, 2008; Irandoust, 2009; Larson and Gunnarsson-Ostling, 2009; Marques, et. al., 2009; Quay, 2010). These articles ranged from agricultural use, to climate change scenario formation, to environmental recovery, to greenhouse gas emissions, to land use and resource management.

Three scenario articles dealt specifically with the economic pillar of sustainability. Galinis and van Leeuwen (2000) dealt specifically with medium-term time frames for fuel prices and nuclear potential and how those affected economic activity. Gerlagh and Keyzer (2001) used scenarios to determine conservation enforcement and how different enforcement levels affected environmental degradation. This may seem environmental, but the scenarios were run in terms of cost of environmental degradation and enforcement, emphasizing the economy of environmental degradation (Gerlagh and Keyzer, 2001). Lastly, Casarico and Devillanova (2003) used scenarios as a way to determine the economic sustainability of communities based on pension levels and migration rates.

There were no articles that dealt specifically with the social equity pillar of sustainability directly, but five articles included all three pillars of sustainability.

Lorenzoni, et. al. (2000) used scenarios as a way to analyze outcomes based on different adaptation techniques using vulnerability assessments. This study used inputs from the economic, environmental and social sectors (Lorenzoni, et. al., 2000). Spangenberg, Omann, and Hinterberger (2002) detailed the environmental, economic, and social impacts of different growth patterns. A 2006 study analyzed four existing scenarios concerning sustainability in terms of policy-making from the European Union and different European nations (Westhoek, van den Berg and Bakkes). Nicholls, et. al., 2008 discussed the implications of the International Panel on Climate Change (IPCC) emissions scenarios. And lastly, de Vries and Petersen (2009) analyzed how value orientations and interpretations of sustainability problems influences scenario construction.

Figure 1 shows the focal differences in these articles, showing a large majority of articles discussing environmental factors as a main focus of scenario use. While these studies show an increase in the use of scenarios for sustainability science, the comparison to scenario use for other pillars or sustainability as a whole shows a gap in the literature. Given the nature of scenario use, it is uniquely apt for studying sustainability issues and the lack of literature shows that scenarios have not been used to their full potential.

2.1.3 Participation

It has become increasingly documented that participation in sustainability planning is essential, as sustainability depends upon what citizens value and perceive as sustainable (Alberti, 1996). Having a common and accepted view of sustainability is extremely powerful in achieving it (Mulder, 2007). There are numerous interpretations of sustainability determined by the concerns of the citizens that need to marry in order to

make progress toward a sustainable future (Brewer, 2010). Problems create the methods and the solutions, all based on human experiences and expectations (Brewer, 2010). In order to fully explore all issues associated with sustainability, multiple perspectives are needed as sustainability needs to be relevant to the citizens and the environment where they live (Johnston, et al., 2007; Brewer, 2010).

Defining sustainability for a region requires the public to voice its perceptions and opinions, as public awareness and education are essential in sustainability (El-Sabh, Demer, and Lafontaine, 1998). While awareness does not necessarily mean that the residents have a sufficient understanding for decision-making, knowing the awareness level of the average citizen allows for a sustainability baseline to be drawn (Myatt, Scrimshaw, and Lester, 2003). This also allows planners to focus on improving social capital, which will allow citizens to cope better with unexpected events, gain a greater sense of community and empowerment, and support complementary policy initiatives (Wheeler, 2000; Conroy and Berke, 2004; Duxbury and Dickinson, 2007).

Fully understanding a resident's perception requires the analysis of their experiences with past disasters and with each term, be it "sustainability," "climate change," or "sea level rise" (Frazier, et al., 2010; Cronon, 1996). When discussing the term "nature," William Cronon (1996) discusses how a person's judgments, values and choices come together to form the term's definition. The same can be said for "sustainability," as the definition has many different meanings based on different cultures. Understanding residents' constructions of "sustainability" requires researchers to examine the motivations that shape actions; it is a study of culture and social characteristics, not a study of the environment alone (Cronon, 1996; Ellis, 2011).

It is through participation that researchers and planners can gain a valuable interpretation of sustainability for a community. However, instead of focusing on defining the issue and then figuring out what to do about it, the literature also supports determining the solution at the same time as defining the problem (Rittel and Webber, 1973; Pope, et al., 2004). Traditionally, planners have strived to define a concept of sustainability and then determine valuable criteria to improve, a top-down approach (Pope, et al., 2004). However, it is becoming increasingly popular to elicit goals for sustainability and use those terms to create a customized definition, a bottom-up approach (Pope, et al., 2004)

2.2 Social Sustainability – Equity

Within the field of sustainability, research into social sustainability, or equity, is rare (Finn and McCormick, 2011; Oden, 2010). Lack of inclusion may be due to the elusive definitions of sustainability, leading to a poorly defined pillar. However, numerous scholars refer to these equity issues under the term environmental justice (Finn and McCormick, 2011). This term comes from a shift that followed the Environmental Protection Agency's transition from the term "environmental equity" to environmental justice in the 1990s (Holifield, 2001). Regardless of terminology, the next phase of the environmental justice or equity movement proves to be within the sustainability movement (Warner, 2002).

There has been no established, clear concept of equity in the sustainability literature, and without this concept, progress is unlikely (Oden, 2010). Because of the lack of social sustainability in many studies, holistic planning has not been achieved (Finn and McCormick, 2011). Equity, instead, as been a distant third concern, falling

behind environmental and then economic concerns, or even not addressed at all aside from utilizing the term when politically valuable (Oden, 2010; Finn and McCormick, 2011).

Within sustainability, equity needs to be incorporated because natural resource consumption and environmental degradation will be the cheaper option without social costs taken into account (Oden, 2010). In addition, there is a need for more theoretical engagement and methodological approaches in the literature featuring equity issues in order to re-establish the value within sustainability (Ellis 2011; Haughton, 1999). Further, it will be essential to monitor social equity issues that arise while the climate is changing; specifically paying attention to stakeholder interests and equity assistance to those most at-risk (APA, 2008). In fact, many still do not fully believe in the science of climate change and could, therefore, be more at risk to its effects and impacts.

The lack of inclusion of equity issues in the sustainability literature may lead one to wonder if equity is important in this emerging field. Unfortunately, the environmental aspects of sustainability are not greatly improving and part of the reason may be that the environmentalists are leaving the people who live in these areas out of the sustainability equation (Cronon, 1996; Conroy and Berke, 2004). Without addressing those individuals and handling their needs, it will be difficult to shift their focus to concerns that may not have a clear direct impact on their lives.

However, negative effects of unsustainable practices often affect the poor community first and most (Ellis, 2011). These citizens also often lack access to natural and political resources, as well as services, exacerbating the overall inequality (Alberti, 1996; Oden 2010). Without this access, planners may find a loss of valuable insight into

their community's sustainability issues, and lose potentially critical information (Oden, 2010). It should be noted, however, that while this paper encourages access for citizen improvement, the ultimate responsibility for lifestyle improvement lies with the individual (Oden, 2010).

While there has been an overall lack of discussion on equity issues within social sustainability, there have been a few scholars who have identified different types of equity issues that may be addressed (Bullard, 1994; Haughton, 1999; Holifield, 2001; Finn and McCormick, 2011;). These researchers divide social sustainability into intergenerational equity; intra-generational equity, or social equity; geographic equity; procedural equity; and inter-species equity (Holifield, 2001; Haughton, 1999). The following sections describe each sub-class in depth.

2.2.1 Intergenerational Equity

Intergenerational equity is the most identified sub-class of equity issue within sustainability science, as it is called out specifically by the WCED in their definition of sustainable development (WCED, 1987). That being said, it is difficult to operationalize the needs of a future generation, which lends to its exclusion from mainstream sustainability research. It is the viewpoint of this author that intergeneration equity should refer to the overall availability of future generations to sustain themselves, namely, that the current generation should not hinder the ability of future generations to survive and maintain health and overall life expectancy.

2.2.2 Social Equity

Intra-generational equity, termed by Haughton (1999), is synonymous with the modern term social equity; this paper will use "social equity" from here forward in place

of intra-generational equity for the purpose of clarity. This sub-class deals specifically with marginalized groups and the underlying causes of social injustice (Haughton, 1999). Factors that should be taken into account include race, ethnicity, culture, lifestyle, political power, income, language, among other location-specific socio-economic factors (Bullard, 1994; Finn and McCormick, 2011). The ultimate goal of social equity is to maximize the benefit per unit of economic output across different sectors of the population (Alberti, 1996).

2.2.3 Geographic Equity

The spatial configuration of communities constitutes the main concern of geographic equity (Bullard, 1994; Haughton, 1999; Finn and McCormick, 2011). Geographic equity issues can range from neighborhood level concerns associated with the dumping of hazardous materials to global issues of acid deposition and rainforest depletion (Haughton, 1999). This sub-class includes issues of proximity to locally unwanted land uses (LULUs), i.e. landfills, sewage treatment plants, nuclear power plants, as well as proximity to desired land uses such as parks, transit, medical care, and food sources (Bullard, 1994; Finn and McCormick, 2011). And while many studies lend itself to reviewing local geographic equity, most, if not all, cities will also suffer negative effects from global issues (Alberti, 1996). Therefore, the key to geographic equity is to not ignore externalities, no matter the scale (Haughton, 1999).

2.2.4 Procedural Equity

While not a concern that researchers set out to address explicitly, procedural equity describes the equity of how sustainability is addressed (Bullard, 1994; Haughton, 1999; Holifield, 2001; Finn and McCormick, 2011). Public participation is the hallmark

of procedural equity, requiring equal access to information, multiple forms and channels of engagements, and include a wide breadth, or who, and depth, or level of control, of participation (Haughton, 1999; Holifield, 2001; Conroy and Berke, 2004). Procedural equity refers to fairness in the way decisions are made and the way these plans are implemented (Haughton, 1999; Bullard, 1994). Specifically, planners have been striving for procedural equity for decades, with many states requiring certain participation criteria (Finn and McCormick, 2011).

2.2.5 Inter-Species Equity

Inter-species equity is perhaps the least discussed equity sub-class with virtually no literature detailing concerns in sustainability. While literature has been published in biodiversity and habitat restoration, there is little known about how inter-species equity affects overall sustainability for a region (Haughton, 1999). It is important to note that while goals for this sub-class include stewardship, inter-species equity does not necessarily mean that all species have the same intrinsic rights as human beings (Haughton, 1999).

2.3 Sea Level Rise

Climate change is not necessarily perceived to have drastic impacts, requiring attention. Residents may be skeptical of changing their lifestyles to accommodate uncertain climate change (Lehtonen and Peltonen, 2006; Wilbanks and Kates, 2010). As human beings, we rarely take responsibility when we find ourselves as a victim, but have no problem pointing out problematic behavior in others, such as criticizing residents who reside in a flood zone while building our house on a fault line (Cronon, 1996). Nor is the best available data widely available or disseminated, causing a disconnect between public

education and science, further perpetuating inaction or the victim mentality (Wilbanks and Kates, 2010). However, discussing sea level rise and sustainability with the citizenry could potentially increase the community resiliency of the region, allowing the residents to better prepare for, anticipate, and respond and recover from the key issues they have identified as problematic for their community's sustainability (Wilbanks and Kates, 2010). Afterall, resiliency is based upon the community's physical, social and economic character, making it ultimately unique (Wilbanks and Kates, 2010).

2.3.1 Coasts

More than half of our nation's population, and nearly two thirds of the world's population, lives and/or works within the coastal zone, an ecosystem adjacent to the coastline with heavily linked social-ecological systems encompassing less than 10 percent of the US land mass (El-Sabhh, Demers, and Lafontaine, 1998; Reed, 2002; Kittinger and Ayres, 2010). With an estimated 3.1 billion people living within 100 km of coastlines by 2025, and a defined seasonal increase in summer population effectively doubling the population, it is important to ensure the sustainability of the coastal zone, if not for the sake of the ecosystem, then for those families that call this region home (Duxbury and Dickinson, 2007; Dame, et al., 2000). The natural and anthropogenic systems are linked in such a way that separating the human effects from the natural processes is next to impossible due to thresholds, feedback loops, and time lags, requiring research that studies the human effects on natural processes and vice versa (Kittinger and Ayres, 2010). It should be noted that these areas are already at risk for tropical storms, hurricanes and associated tornadoes, and degradation of this transitional area may only

increase these risks, decrease resilience, and perhaps even allow natural hazards to become natural disasters (Dame, et al., 2000; Kittenger and Ayres, 2010).

Duxbury and Dickinson (2007) have categorized major coastal issues into seven (7) main problems.

1. Coastal population growth – There is an increase in demand for housing, largely among retiring populations in the United States. This increase in population density is creating stress on water supplies, which may lead to saltwater intrusion of already strained freshwater aquifers (Dame et al., 2000; Duxbury and Dickison, 2007).
2. Lack of sustainable development – The increased demand for housing has lead the economy to stress anthropogenic development on the coast without regard to preservation (Duxbury and Dickinson, 2007; Feagin, et al., 2010).
3. Degradation of coastal ecosystems – Degradation of the coastal ecosystems, which has led to wetland loss and barrier island ruin, has increased coastal town vulnerability to storm events, erosion, saltwater intrusion and potential negative effects of sea level rise (Duxbury and Dickinson, 2007).
4. Coastal resource management – There is a separation between science, policy, and coastal residents which lead to conflicts and stress surrounding land use decisions (Duxbury and Dickinson, 2007). In addition, in the United States, the high water line, or the shoreline at high tide, defines the property boundaries, leading many property owners to believe they can buy the shore (Feagin, et al., 2010). However, in Spain, for example, the country owns 100 meters from the

shoreline, voiding the conflicts of who controls the shoreline (Feagin, et al., 2010).

5. Mitigation Planning – Degraded ecosystems cannot offer natural protection from coastal hazards, which may lead to an increase in disasters, potentially rendering emergency response units unable to perform duties (Duxbury and Dickinson, 2007).
6. Socio-economic issues – As described in previous sections, the cycle of degradation includes disadvantaged populations lacking access to environmentally sound information and action, further degrading ecosystems (Duxbury and Dickinson, 2007). In addition, if there is a lack of communication, these populations may also lack the forethought and know how to prepare for coastal issues, hazards, and disasters,
7. Decision-making and weather-related catastrophes – With an increase in population and development in the coastal hazard-prone areas, there is an increased potential for damage, with the average annual losses from coastal hazards exceeding $7.6 billion (Duxbury and Dickinson, 2007).

This means that sustainability for the coastal zone cannot be planned or accomplished without the inclusion, coordination, and cooperation of the community, as any change in these zones will affect the overall habitability of the coast (El-Sabhh, Demers, and Lafontaine, 1998; Hopkinson, et al., 2008). With regional differences in the quality of the ecosystem as well as the socio-economic conditions, it is essential to make the local communities aware of their circumstances (El-Sabhh, Demers, and Lafontaine, 1998; Kittinger and Ayres, 2010). Beyond awareness, which may not fully prepare residents

with adequate information for decision-making, communities should examine their existing conditions, as well as potential future conditions such as sea level rise (El-Sabhh, Demers, and Lafontaine, 1998; Myatt, Scrimshaw, and Lester, 2003).

2.3.2 Sea Level Rise

Whether you agree with climate change research or not, the sea level is rising noticeably on the east coast of the United States. If residents baulk at climate change and write off what is being said as false, they could increase their vulnerability to a multitude of sea level rise-related concerns, such as increased storm surge and flooding, much less increased soil erosion. As Kaiser and Godschalk (1995) ascertain, there needs to be a way to accurately and fairly communicate information to the public, without any bias or triggering rejection.

Sea level rise has been widely studied and discussed because it is one of the first visible effects of climate change and has been experienced by many on the coast. Though sea level rise is an outcome of the rising temperatures, due to thermal expansion of the water (steric) and added water due to melting ice (eustatic), it is considered a climate change effect due in part to the fact that sea levels are rising in every open water system, not just one ocean, and will have varying impacts on coastal communities (Schneider, 2006; Hopkinson, et al., 2008). That being said, relative sea level rise expected in different regions may vary, some dramatically, due to the inclusion of other localized factors, such as land subsidence (Reed, 2002).

It is important to note that while the climate is changing, it is very difficult to pinpoint precise changes that will occur with a large degree of accuracy. There is a strong sense of certainty that the sea level is rising; however, exact measures of sea level change

are still projected with uncertainty. There is "little argument about whether there will be climate change impacts, but rather the argument lies in the size and implications of those impacts," (DEAT, 2004). Ultimately, sea level rise and human development will compete for the same coastal land (Dame, et al., 2000).

2.3.3 Adaptation

As emphasis continues to grow on climate change, the focus in climate change science is more than just the climate; it encompasses society and adaptation (Head, et al., 2011). While response to climate change is largely still reactive, current trends are favoring proactive and holistic approaches consistent with adaptation methods (Myatt, Scrimshaw, and Lester, 2003; Hanssen, et al., 2012). A community that is vulnerable to climate change issues, especially on the coast, has to prepare, otherwise the community may unintentionally increase their vulnerability (Hay and Mimura, 2010; Hanssen, et al., 2012). After all, a community that is sustainable is one that learns and modifies behaviors in response to change (Alberti, 1996).

Adaptation itself is the change in behavior in response to a stimulus (Easterling, Hurd, and Smith, 2004). Though mitigation is quite necessary to alleviate climate change impacts, some amount of climate change is still expected to occur, leaving society the responsibility to adapt to those unavoidable consequences (APA, 2008). A lack of detailed information concerning the long-term impacts of climate change is considered a constraint of adaptation; however, waiting until better information is available could be more costly than taking the leap to long-term sustainable responses now (Keeney and McDaniels, 2001; Easterling, Hurd, and Smith, 2004).

Adapting to stimuli is a fundamental human trait, occurring everyday in different social processes, and is natural concerning human-nature interactions (Easterling, Hurd, and Smith, 2004; Brooke, 2008; Head, et al., 2011). The process, in total, includes being aware of the risks, having the analytical capacity to convert the risks into planning and management techniques, and taking action (Moser and Luers, 2008). In this case, knowing the impacts, avoiding climate change dangers and taking responsibility in the long term (Paavola and Adger, 2006).

The key to the transition from awareness to action is knowledge, mainly having said knowledge available and accessible (Easterling, Hurd, and Smith, 2004). Knowledge itself is dynamic and knowledge about climate change continues to build and accumulate as more observations are made, models are created and validated, monitoring is completed, and mistakes are made; an idea that is fundamental to learning over time and adapting (Keeney and McDaniels, 2001; Easterling, Hurd, and Smith, 2004; Tompkins, 2005).

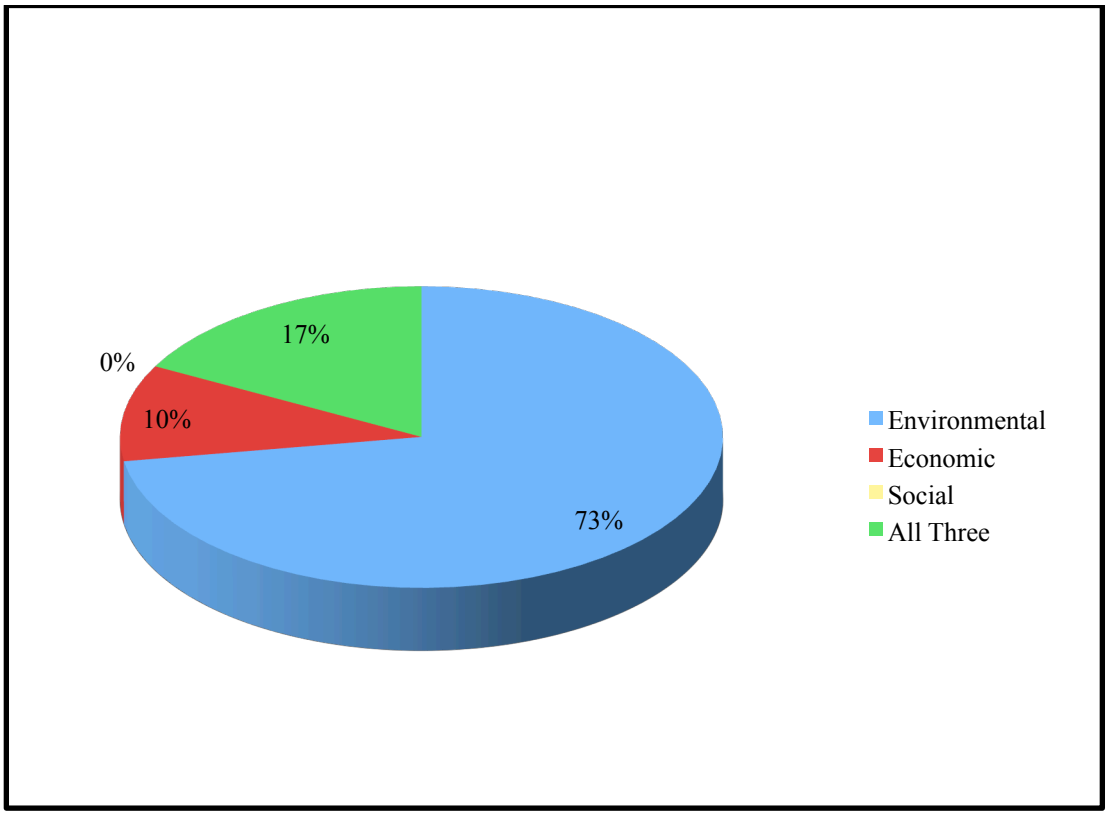


FIGURE 1: Focus of sustainability scenario literature
Source: Created for this document with data from Web of Science database search.

CHAPTER 3: RESEARCH QUESTIONS

The previous chapter provided an overview of the sustainability science discipline, along with ancillary climate change complications, focusing on sea level rise. The contribution of this research is to build upon the basis of understanding for sustainability, namely social sustainability, and bridge the gap between sustainability and climate change science. This research is composed of three main questions in order to explore the interplay between analyzing sustainability perceptions, defining sustainability for a community, and linking that understanding to complications from sea level rise.

3.1 Planning for Sustainability

This objective intends to review comprehensive planning documents from numerous Maryland counties on the Delmarva Peninsula to analyze the communities' values and attitudes surrounding sustainability and sea level rise. Since planning documents must legally include substantial public participation, a review of such documents should shed light upon the different community perceptions as evident in county visions, land use plans, and associated policy statements. Specific themes to be addressed include:

- Do all Maryland counties on the Delmarva Peninsula have similar priorities for a sustainable future?
- Is sustainability considered in the counties' comprehensive plans?
- Are the three pillars of sustainability equally addressed in comprehensive plans?

- Does each plan address intergenerational, social, geographic, procedural and/or inter-species equity?
- Are communities preparing for sea level rise impacts?
- Do comprehensive plans address sea level rise as a complication of sustainability?

3.2 Defining Sustainability

Insight gathered from comprehensive plan analysis will feed into a survey of residents for one of the Maryland Delmarva counties, Wicomico County, to elicit more specific information on sustainability perspectives. Survey results will be analyzed to determine whether the community is generally concerned with sustainability and/or sea level rise, as well as differences between resident perspectives. The survey will also include perceptions on flooding risk and how the county government is handling these issues. The answer(s) to this question will address the following:

- Have current residents experienced flooding and/or evidence of sea level rise?
- Are residents concerned about the sustainability of their community?
- Do residents value environmental, economic, and social sustainability?
- Are residents skeptical of climate change science?
- Do residents feel sea level rise is important to consider for sustainability?
- Do residents feel their county government is competent in sustainability planning?
- Do certain segments of the population feel differently than others, based on location, race, income, age?

3.3 Measuring a Fuzzy Concept

In what ways might sea level rise complicate sustainability for Wicomico County? Since the focus of my study is not to determine a holistic metric for sustainability, with

regard to sea level rise, but to draw attention to potential issues surrounding sea level rise and sustainability for Wicomico County, this question will primarily be focused on scenario formation. Once sea level rise scenarios are modeled, different indicators, based upon community values obtained from the previous objectives, will be analyzed with respect to different levels of sea level rise. The following themes will be addressed through this question:

- How will sea level rise affect the current landscape of a specific county?
- How will sea level rise affect sustainability for Wicomico County?
- Will sea level rise cause any equity concerns?

CHAPTER 4: RESEARCH DESIGN

When researching sustainability and sea level rise, the majority of literature focuses on quantitative measures, while public education, participation, and consensus building are all essential for planning (El-Sabh, Demer, and Lafontaine, 1998; Innes and Booher, 1999; Conroy and Berke, 2004; Duxbury and Dickinson, 2007). Research into sustainability sheds light on many such conflicts, which are inherent in any field where three priorities are to be balanced; the best way to approach such tasks is to use a community-based planning process (Conroy and Berke, 2004). It is this planning process that is most important in sustainability science, not some achievable goal that can be quantified (Haughton, 1999). That being said, research has focused on statistical and quantifiable GIS-based measures of demographic patterns, which is necessary, but leaves a hole for qualitative research (Holifield, 2001). For this reason, the following methodology focuses primarily on qualitative research methods.

4.1 Data and Study Area

The study area chosen for this research is Wicomico County, Maryland. The following sections describe why the study area, a county, is at the appropriate scale for this research, as well as why Wicomico County is chosen.

4.1.1 Global to Local

Each country has its own prescribed government system that is unique to the jurisdiction. The United States, in particular, is a country that has many different

physiographic regions, from mountains to coasts to the plains. Likewise, there are wealthy and poor regions and regions with high minority populations. These different regions all have different decision-making policies and criteria. For this reason, even though regional planning may be necessary, sustainability review is suggested at the local scale.

The Intergovernmental Panel on Climate Change (IPCC) has done a remarkable job of taking research and synthesizing the known facts into a global report. This report was the first publicly acknowledged report on global climate change that discussed the anthropogenic, or human-driven, effects of greenhouse gas emissions on the natural climate change cycle. The IPCC will often re-assess the situation in order to account for updates, more observed changes, and improvements in their technology and modeling, and then publishes the updated assessment. The reports are a combination of three working groups that discuss causes of climate change, possible impacts, adaptation to and mitigation for climate change all while taking into account three scenarios, one aggressive, one middle-of-the-road, and one low-pressure (IPCC, 2007).

While this report is invaluable to those researching climate change, the results are on a global scale, discussing global trends and some super-regional trends, such as the North Atlantic, Africa, etc. This information is the best starting point, detailing global temperature changes and the likely effects of such changes on coastal areas, mountains, and the Northern Hemisphere, among other large regions. However, in order to adapt to climate change, and sea level rise in particular, much more detailed information on a localized scale is needed.

The PEW Center on Global Climate Change has taken the IPCC report one step closer to this goal with a series of publications detailing changes in the United States. These reports allow for a more detailed look at changes that are predicted, as well as changes that have already occurred in the United States. The publications from the Center also distinguish different effects and impacts for different regions of the United States. Still, these reports draw attention to broad changes that are likely to occur, such as migration of species to the north as temperature increases, as well as the increased vulnerability of coastal areas.

More specifically, the Maryland state government has also begun to prepare for climate change and is a leader in climate change planning for the nation. Maryland has established a "Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change, Phase 1: Sea Level Rise and Coastal Storms," as well as a "Phase 2: Building Societal, Economic, and Ecological Resilience" (Climate Change Maryland, 2013). In addition, the State also published a "Plan to Reduce Greenhouse Gas Reduction" in July of 2013 (Climate Change Maryland, 2013). With the State of Maryland putting emphasis on climate change and sea level rise, the State has produced a framework for its localities, allowing them to follow the lead and look at their own possible impacts and plan for a sustainable future.

While the focus on climate change and sustainability is seen at the international, national, and state levels, it is imperative to start at the local level. Humans and their environment function intimately at this local level, allowing for the most difference per change (Graymore, et al., 2008). This is also the level where citizens have the most relevant responsibility (Warner, 2002). Perhaps the largest benefit is that locally relevant

qualitative data can shed light on community perceptions, local actors, and will allow for an understanding of the community, from the community (Head, 2011; Hanssen, et al., 2012).

4.1.2 Wicomico County, Maryland

Wicomico County is located on Maryland's Lower Eastern Shore, bordering the Nanticoke River on its western edge, where the river meets the Chesapeake Bay, on the east by the Pocomoke River, and on the south by Wicomico River and Wicomico Creek, as seen in Figure 2. The northern boundary of the County is its border with Delaware. The County has a natural beauty indicative of the Chesapeake Bay, which creates a unique natural environment as the nation's largest estuary teeming with an abundance of aquatic species, such as crabs, oysters, and fish. This estuary is the center of the culture of the entire Chesapeake Bay region, including Wicomico County.

More generally, Maryland is the fourth vulnerable state in the nation to sea level rise, with 6.1 percent of the state's land area vulnerable to inundation, Figure 3 (MCCC, 2008). Historically, the state has experienced an average rate of 3 – 4 mm/year of sea level rise, having risen about a foot in the last century (MCCC, 2008). This past rate of rise has already caused thirteen of the Chesapeake Bay islands to disappear, with the last island, Smith Island, at risk of disappearing before 2100 (MCCC-ARWG, 2008). However, due to the gentle slope of the region, all areas in the Chesapeake Bay region are highly susceptible to sea level rise, as a one-foot rise in sea level covers a significantly larger area of land and increases the flood level also by one foot (MCCC-ARWG, 2008; Worcester, 2008).

Maryland's risk for sea level rise is high also due to the amount of land

subsidence occurring in the state, or the gradual sinking of land mass. Specifically, Wicomico County averages 0.66ft/century of land subsidence (MCCC-ARWG, 2008). According to these numbers, land subsidence is responsible for half the amount of relative sea level rise, or the amount of sea water levels rising plus the amount of land sinking. Along with the gentle sloping topography of the area, land subsidence significantly influences sea level rise and could cause a rise upwards of three (3) feet by the year 2100 (MCCC, 2008; MCCC-ARWG, 2008).

Sea level rise may be troublesome enough, but the climate change effect further exacerbates other coastal issues already being experienced on Maryland's coastline. One of the largest issues is coastal erosion, with 31 percent of Maryland's coastlines already facing the problem (MCCC-ARWG, 2008). Coastal flooding poses another threat likely to worsen with a potential 10-15 percent projected increase in precipitation due to more frequent and/or intense storm activity (MCCC, 2008; MCCC-ARWG, 2008; Worcester, 2008). The coast is already exposed to a number of hurricane, tropical storm, and nor'easter events, causing flood and storm surge threats, such as Hurricane Isabel in 2003, requiring around $100 million dollars in aid money to the state of Maryland, among five other larger storms since the 1950s (National Climatic Data Center, 2011). It is estimated that Wicomico County could see anywhere from 9 to 11 feet of storm surge given a category 3 hurricane event, a probable maximum storm event given the history of the county (USACE, 2006).

Other possible concerns include raised water tables and the possible acceleration of saltwater intrusion (MCCC, 2008; MCCC-ARWG, 2008; Worcester, 2008). With the increase in sea level rise, the water table will rise higher and higher, pushing the

saltwater/freshwater interface further upstream (Worcester, 2008). This not only affects the amount of salinity in the water, further impacting the Chesapeake Bay's unique aquatic populations, but also allows saltwater to reach aquifers used for drinking water (Worcester, 2008).

Taking these sensitive environmental characteristics into account, the Social Vulnerability Index (SoVI), first presented by Dr. Susan Cutter, et al. (2003), links the environmental risks to socioeconomic indicators that may reduce a community's ability to adapt to hazard events. This index is run for the entire nation, county by county (Cutter, et al., 2003). Wicomico County has a score of -1.89643, indicating a slightly negative vulnerability, a decrease in vulnerability. Ranked against other counties in the nation, Wicomico ranks in the medium-low social vulnerability quantile; however, ranked against other counties in the state, Wicomico ranks in the medium-high quantile, most likely due to its location in a hazard-prone area (University of South Carolina, 2011).

Wicomico County may have a reduced vulnerability rate nationally because it lies at a crossroads of two major transportation routes, US 13 and US 50, creating a center for economic and regional activity on the Eastern Shore. Within the County lies the City of Salisbury, which boasts a large state university, Salisbury University, as well as a large medical complex, Peninsula Regional Medical Center. Salisbury, together with the City of Fruitland to its south and the Town of Delmar to its north, creates the Metro Core region of the County, effectively cutting the county into Western County, the Metro Core, and the Eastern County. The County also is home to the Towns of Hebron, Mardela

Springs, Pittsville, Sharptown, and Willards. Figure 4 illustrates the transportation network, local jurisdiction boundaries and intra-county regions.

Table 1 shows that the population of Wicomico County has grown steadily since 1970 from 54,236 people to 98,733 people in 2010, an increase of 44,497 people or 82 percent (Census, 2010). The Maryland Department of Planning (MDP) further projects the population to increase another 26 percent to 124,900 people by 2040 (2011). This amount of growth increases the number of people potentially affected by sea level rise, as well as indicates an opportunity to affect where growth happens, striving to keep the increased population out of vulnerable areas.

Additional demographic information for Wicomico County show that the gender split of the population is relatively equal with 48 percent male and 52 percent female population (Census 2010). The county is multicultural, however, a majority of the population is white (59%), with a smaller black or African American population at 24 percent, an Asian population at three (3) percent, and a Hispanic or Latino population at five (5) percent (Census, 2010).

While the population's rate of increase has slowed, so has the increase in households in Wicomico. The most recent Census data shows that there has been a pretty significant increase in households since 1970, 111 percent, but the rate of increase has slowed from 33 percent to 13 percent (2010), while the average household size has also decreased from 3.08 persons per household in 1970 to 2.47 persons per household in 2010, Table 2.

Table 3 shows that Wicomico County has about four (4) percent of its population living in group quarters, with the remaining 96 percent of the population in 41,192

housing units (Census, 2010). Of that total, 56 percent are owner-occupied units, with 34 percent renter-occupied units and the remaining 10 percent of units being vacant.

With the amount of growth in the county, it is essential to obtain a comprehensive understanding of the threats of sea level rise to the County, as well as how those residents view the threats. In doing so, opinions and perceptions of sea level rise will be able to influence the County's adaptive capacity and increase the awareness of associated impacts, ultimately improving sustainability.

4.2 Research Question 1 Methodology

The first research question asks what the community attitudes and values surrounding sustainability are. In order to answer this question, comprehensive planning documents from Maryland counties on the Delmarva Peninsula are analyzed using content analysis. There are 14 counties that make up the Delmarva Peninsula, three being in Delaware, two in Virginia, and the remaining nine in Maryland. To be sure that the analysis is as objective as possible, only those counties in Maryland were included, as different states may require different formats, information, etc., to be part of their comprehensive planning documents. Additionally, Caroline County was removed from the study due to its location inland, as it is not adjacent to the Chesapeake Bay or Atlantic Ocean.

4.2.1 Step One: Comprehensive Plan

Planning for sustainability, in any region, needs to include a long-term and holistic approach, including different dimensions and a balance of the three pillars (Wheeler, 2000). Instead of developing a new sustainability plan, one can use the comprehensive plan document required by most states of their counties, as these plans

become the cornerstone for change toward a sustainable future (Neuman, 1998; Conroy and Berke, 2004). The comprehensive plan is an agent for public engagement and integrates diverse values into goals and policies for the future (Berke and Goschalk, 2009).

Comprehensive plans can help bridge theory and practice, essential for sustainability planning (Berke and Conroy, 2000). Therefore, evaluating these plans will offer a learning experience that will shed light on how to improve the plans (Berke and Godschalk, 2009). For the purposes of this research, comprehensive planning documents from eight Maryland counties on the Delmarva Peninsula are reviewed for sustainability and/or sea level rise content. Five of the eight counties have a comprehensive plan adopted since 2000, with Dorchester County dated 1996, Somerset County dated 1996, and with Wicomico County dated 1998, however a draft updated plan created in 2010 for Wicomico County is waiting for adoption. The most recent plans for each county will be evaluated, with Wicomico County being its 2010 draft plan.

4.2.2 Step Two: Content Analysis

Content analysis is a technique used in corporate social and environmental responsibility research and more recently in planning research (Berke and Conroy, 2000; Warner, 2002; Conroy and Berke, 2004; Jose and Lee, 2007; Berke and Godschalk, 2009; Finn and McCormick, 2011). This analysis allows for quantifying qualitative information by evaluating the content of documents, messages, or interviews for specific characteristics (Jose and Lee, 2007; Berke and Godschalk, 2009).

This research objective takes the comprehensive plans designated as per the criteria listed in the last section and will analyze all concrete references to environmental,

economic, or social sustainability, as well as sea level rise. These analyses will rely fundamentally on research methods used by Berke and Conroy (2000) and Conroy and Berke (2004) to evaluate comprehensive planning documents. Table 4 shows a list of code words used to search the comprehensive plans for inclusion of sustainability and sea level rise.

Each analysis will evaluate three portions of the applicable comprehensive planning chapters; educational content, or the background information for each chapter, the policy statements, and implementation content, as per Warner (2002). Applicable chapters include the introduction, land use, transportation, housing, community and economic development chapters, along with any environmental-focused chapters such as sensitive areas or water resources. Each chapter will be analyzed first to determine if the three pillars of sustainability and sea level rise concerns are discussed (Berke and Conroy, 2000). Analysis of social sustainability will be broken out into the five subclasses of equity, as determined by Haughton (1999), namely, intergenerational, social, procedural, geographic, and interspecies. Page counts will be the units of measure, given as percentages of the whole, as we are focused on measuring if sustainability and sea level rise are concerns, not necessarily how well each county plans to contend with the issues.

Once the content analysis is complete, one should be able to discuss the overall consciousness of sustainability and sea level rise that exists in the Maryland Delmarva counties. From there, counties can be compared to determine where more attention is needed. Lastly, this analysis will allow for a comparison between Wicomico County and

the surrounding areas to determine if Wicomico County is above or below the average in sustainability and sea level rise planning.

It is important to note that with content analysis, there is attention in the literature on intercoder reliability (Jose and Lee, 2007; Berke and Godschalk, 2009). While there exists content analyses where it was not clarified if there was more than one coder or reliability between coders, there are researchers that place a high regard on having more than one coder and having a high reliability between coders, as this speaks to the validity of the data generated (Berke and Godschalk, 2009). This paper focuses on determining if sustainability and sea level rise are explicitly addressed in the comprehensive plans, thereby removing the need for an additional coder as there should be little to no misinterpretation.

4.3 Research Question 2 Methodology

The second research question in this study is focused upon public awareness and response to sea level rise. The evaluation of public perception at the county scale requires qualitative methods focusing on sea level rise and sustainability issues in Wicomico County in order to determine whether public perception supports sustainability and/or sea level rise concerns. An unsolicited attitude survey is administered to obtain data leading to an understanding of resident experiences and opinions; this will give depth to the outcome(s) of my first reseach question (Conroy and Berke, 2004). Due to the lack of widespread internet accessibility in Wicomico County, I follow the basic methodology that Myatt, Scrimshaw, and Lester (2003) used for a coastal management attitude survey, by using a self-administered, unsolicited attitude survey mailed through the US Postal Service. This survey is also posted online, via Survey Monkey, to allow

for an increase in participation. The questions range from "yes" or "no" closed questions to rating scales to several open-ended questions, see Appendix A. The questionnaire focuses on four related topics; your environment, sustainability, global climate change, and sea level rise; in order to collect a broad range of perception, along with a section asking general demographic data (Myatt, Scrimshaw, and Lester, 2003). This study also indicates how residents perceive the risk of flooding, major issues of concern, and sea level rise science and sustainability (Myatt, Scrimshaw, and Lester, 2003).

Using the parcel database for Wicomico County, which is all public information, about 800 residential addresses are selected through a random sample generator to receive a survey. A letter introducing the investigator, the research, the survey, and general consent information is mailed, as well as a consent signature page, and the survey. Each set of forms are coded for a geographic region (Western Wicomico County, Eastern Wicomico County, and the Metro Core, see Figure 4) to allow for analysis of regional differences in perception in Wicomico County. To ensure confidentiality, the identifiable information for participants are stored separately from the survey responses. While there is a code and number linking the two, the data are stored separately and securely.

In order to increase the number of participants, an incentive is used. Participants who complete the survey have their signed consent form entered into a random drawing for one of three Target gift cards, ranging from two (2) $25.00 gift cards to one (1) $50.00 gift card. The identifiable information on the consent form, and determined by the code and number on the form, is used to mail the gift card to the winners. After which, the identifiable information for participants is stored separately from all gathered

data. The principal investigator administers the drawing after the 30 day response window has lapsed, ensuring confidentiality of data.

All analysis of the data is performed soley by the investigator and no identifiable information is used in the reporting of results. Such analysis includes running and reporting basic descriptive statistics, such as basic percentages and cross-tabulations with demographic data as per Myatt, Scrimshaw, and Lester (2003). Potentially regional differences are tested for significance using a chi-squared test, with results reporting the generated p-values.

The data sources used for this research are all public information obtained from Wicomico County Department of Planning or the U.S. Census Bureau. Parcel information is obtained as geographic information system (GIS) data, modified by geographic region. The attribute data are run through a random sample generator, selecting 800 parcel identification numbers. These numbers are researched through the Maryland Real Property database to fact check physical address. Other data used include GIS files showing Wicomico County's jurisdictional boundary, the boundaries of all incorporated municipalities, zoning, land use, streets, waterways and Chesapeake Bay Protection zones, which are all considered public information.

4.4 Research Question 3 Methodology

The final research question examines the impact of sea level rise on future sustainability in Wicomico County. The research methods for this question center around scenario construction to review potential sea level rise impacts. In order to accomplish this, I need to first model sea level rise scenario data, using publically-available remote sensing data and creating the different rise scenarios in a vector information, using

ArcGis. Once this has been completed, my second step will be to run a sustainability assessment by analyzing different indicators. The selected indicators include locally-relevant and publically-available data in a GIS format. While there may be many different indicators that could potentially be reviewed, the indicators are selected based on how applicable they are to the comprehensive plan goals as well as to the survey responses.

4.4.1 Step One: Sea Level Rise Scenarios

Given all of the data obtained about relative sea level rise, the state of Maryland has come up with four sea level rise scenarios (MCCC-ARWG, 2008). In order to allow this research to be applicable at the county level, the Maryland sea level rise scenarios are modeled. The first scenario is the existing water level, which changes depending upon location. The second scenario is the year 2100 at the current rate of sea level rise, one foot per century, which is based off historic tide gage data and historic land subsidence numbers (MCCC-ARWG, 2008). The third scenario is 2100 with an accelerated rate of 1.7 feet per century, based off of projected subsidence rates as well as the IPCC Fourth Assessment sea level rise rates (MCCC-ARWG, 2008). Lastly, the fourth scenario is 2100 with the highest rate of anticipated sea level rise at 3.2 feet per century (MCCC-ARWG, 2008). These four scenarios run the estimated range of sea level rise, but with an increase in glacial melting, the highest rate scenario could easily reach four (4) feet per century (MCCC-ARWG, 2008).

In order to create vector GIS files that will allow for ease of assessment, I downloaded publically available data from ArcGIS online. The data are layer packages that show different land covers for the different IPCC sea level scenarios, created and

maintained by the National Wildlife Federation. The Maryland scenarios fall in line with the IPCC scenarios, only showing a 0.10-foot difference in the mid-range scenario; the IPCC modeling a 1.6-foot rise while Maryland models a 1.7-foot. rise. Once these layers were imported into ArcGIS, there was a simple selection of all applicable water designations; open ocean, tidal creek, estuarine open water, riverine tidal open water and inland open water; and the selected data were exported as its own feature class. This process is applied to all three modeled sea level rise change scenarios, while the current water feature class provided by Wicomico County Department of Planning provided the baseline scenario. The final sea level rise scenario files were rigid, causing each layer to not be visually smooth, so I apply a smoothing polygon function to smooth the lines and endpoints, allowing for a more organic and aesthetically pleasing shape.

These scenarios show possible conditions in the year 2100 due to relative sea level rise in Maryland. While the State developed their own measures, the scenarios approved by the State for planning purposes largely follow the IPCC suggested rates of sea level rise. Assuming that the scientists and remote sensing professionals working with IPCC were correct in their raster-based modeling, I took their information and converted the files into a vector format for use with a sustainability assessment. I believe the visualization of the sea level rise scenarios are plausible and surprising in range of sea level rise, that the information is vivid and evokes concern, and that the design is well prepared, as per Xiang and Clarke (2003). While Xiang and Clarke (2003) discuss the need for tradeoffs to be visually displayed in scenarios, ensuring there is a meaningful difference between scenarios, I believe that since the sea level rise scenarios are exploring possible natural changes and not policy changes, one cannot truly show

tradeoffs. Eventually, the sustainability assessment could lead to possible policy initiatives that can be used in scenario creation to show different opportunities and threats for the county.

4.4.2 Step Two: Sustainability Assessment

The assessment method used for this research includes some elements of a wellbeing assessment, quality of life assessment, and vulnerability assessment (Ness, 2007; Graymore, et al., 2008; Dannevig, et al., 2012). Ultimately this assessment of sustainability includes a qualitative analysis of data based upon a quantitative model of sea level rise (Dannevig, et al., 2012). This assessment will not be aggregated into one composite score, as the purpose of this research is to determine how sea level rise affects Wicomico County's sustainability and any associated equity concerns. Similar to wellbeing and quality of life assessments, indicators will be locally relevant (Graymore, et al., 2008). Since this research is based upon an evaluation of data based upon the sea level rise scenarios, this methodology most reflects that of vulnerability assessment, though analyzing resiliency will not be a focus of this assessment (Ness, et al., 2007).

4.4.2.1 Indicators

Determining indicators is perhaps the most problematic step in any assessment. There is no established number of indicators for any set study, nor is there a base set of indicators used in assessments, for any type (Tanguay, et al., 2010). While many see that this lack of consistency across assessment types to be an issue, this paper reflects that as each community defines sustainability for its own citizenry, then the assessment of sustainability should likewise be unique, allowing the assessment to be locally relevant (Tanguay, et al., 2010).

Assessment tools have been used in conjunction with scenarios in past research, therefore, it is appropriate to use the sea level rise scenarios to feed into an assessment on sustainability (Ness, et al., 2007). Indicators should be simple and clear and reflect what is being assessed, in this case, the three pillars of sustainability in reference to sea level rise (Ness, et al., 2007). They can also be used to show any progress in public education, indicate consensus amongst a community, and be an early warning to potential issues (Alberti, 1996; Wheeler, 2000; Warner, 2002).

To determine indicators for this sustainability assessment, data are reviewed from the results of the first two research questions. If there are any issues that concern the community in the comprehensive plan or in the survey responses, those indicators will be included in the initial list, as comprehensive planning documents in particular reflect a certain level of consensus on concerns (Alberti, 1996). In addition, indicators will be included if they reflect an aspect of environmental, economic, or social sustainability. Once a master list of indicators is compiled, they are reviewed for data availability. A final list of indicators is then compiled for the assessment.

4.4.2.2 Assessment

Once indicators are finalized, each indicator is reviewed to determine if it is affected by any of the three sea level rise scenarios. Indicators will be analyzed for overlap with the established sea level scenarios. This will allow for a determination on potential impacts from sea level rise. Potential impacts will be measured by frequency counts and overall percentages of the indicator affected. For example, a road is affected if one or more segments of the road travel through potential inundation areas. It will be obvious that if a road is affected by a 1-foot rise in sea level, it will be affected by a 3.4-

foot increase in sea level; however, the extent of any change in vulnerability will be discussed. It may then be determined that some percentage or more of the major roadways may be affected by sea level rise. Special attention will be placed upon equity indicators to determine if there are any concerns with intergenerational, social, or geographic equity for any of the three sea level rise scenarios.

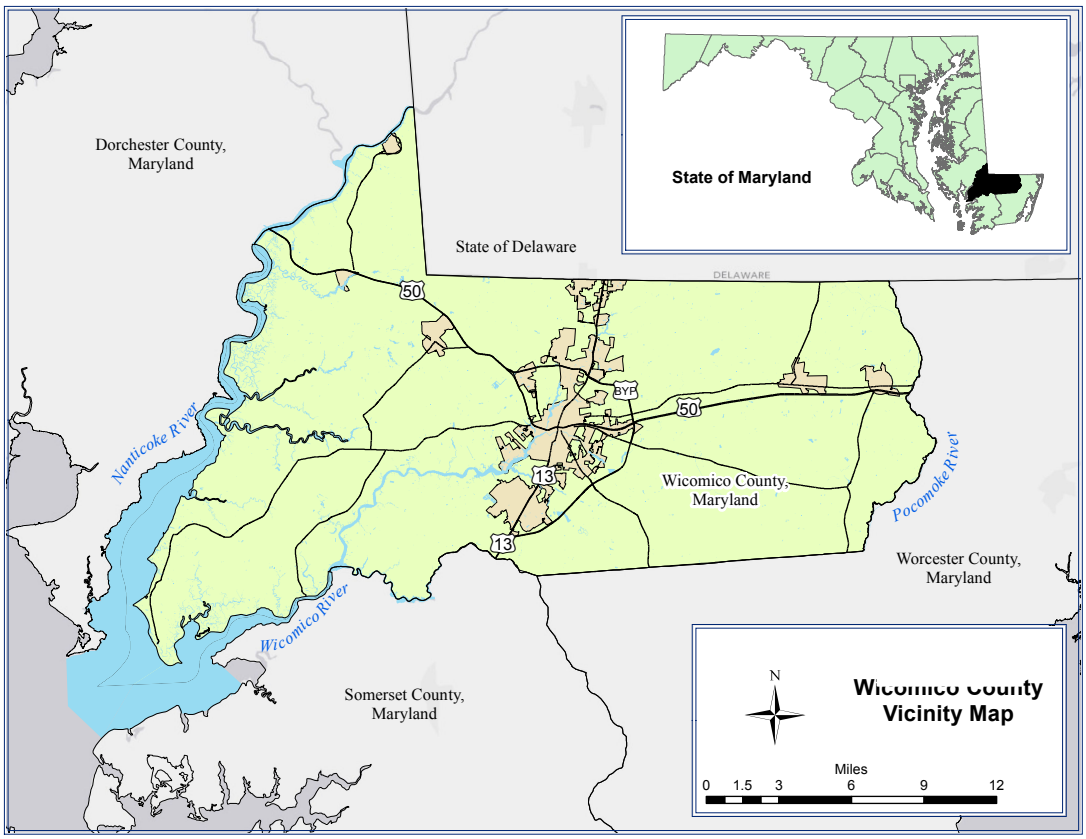
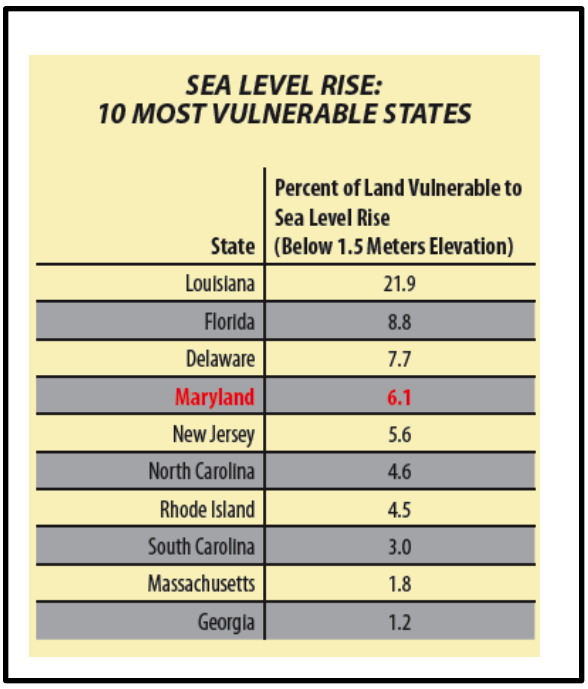


Figure 2: Wicomico County vicinity map
Source: Created for this document with data from Wicomico County GIS



SEA LEVEL RISE:
10 MOST VULNERABLE STATES

State	Percent of Land Vulnerable to Sea Level Rise (Below 1.5 Meters Elevation)
Louisiana	21.9
Florida	8.8
Delaware	7.7
Maryland	6.1
New Jersey	5.6
North Carolina	4.6
Rhode Island	4.5
South Carolina	3.0
Massachusetts	1.8
Georgia	1.2

FIGURE 3: Sea level rise vulnerability, by state
Source: Maryland Climate Change Commission

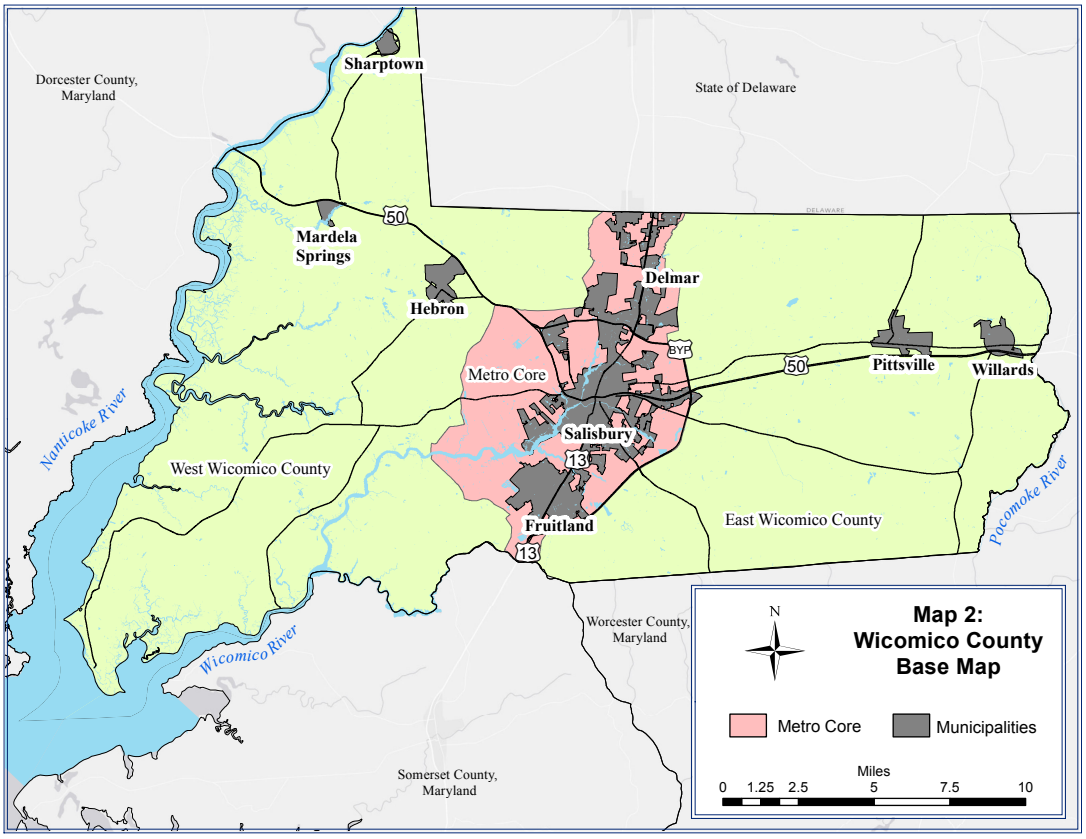


FIGURE 4: Wicomico County base map
Source: Created for this document with data from Wicomico County GIS

TABLE 1: Population growth in Wicomico County

	Census Data					MDP Projections					
	1970	1980	1990	2000	2010	2015	2020	2025	2030	2035	2040
Total Population	54,236	64,540	74,339	84,644	98,733	100,800	106,450	111,650	116,450	120,900	124,900
Population Increase	n/a	10,304	9,799	10,305	14,089	2,067	5,650	5,200	4,800	4,450	4,000
Percent Increase	n/a	19.0 %	15.2 %	13.9 %	16.6 %	2.1%	5.6%	4.9%	4.3%	3.8%	3.3%

Source: U.S. Census Bureau (2010), and the Maryland Department of Planning (2011)

TABLE 2: Household growth of Wicomico County

	Census Data				
	1970	1980	1990	2000	2010
Total Households	17,170	22,876	27,772	32,218	36,262*
Increase in Households	n/a	5,706	4,896	4,446	4,044
Percent Increase	n/a	33%	21%	16%	13%
Average Household Size	3.08	2.72	2.56	2.53	2.47

Source: U.S. Census Bureau (2010), and the American Community Survey five year estimate (2005-2009)

TABLE 3: Household tenure of Wicomico County

	Number	Percentage
In group quarters	4,403	4%
Total number of Housing Units	41,192	100%
Occupied Housing Units	37220	90%
Owner-Occupied Housing Units	23,317	57%
Renter-Occupied Housing Units	13903	34%
Vacant Housing Units	3,972	10%

Source: U.S. Census Bureau (2010) and the American Community Survey five year estimate (2005-2009)

TABLE 4: Code words use for content analysis

Issue	Code Word(s)
General Sustainability	sustain
Environmental Sustainability	environment
Economic Sustainability	economic (viable and future used as context clues)
Social Sustainability	equity
Intergenerational Equity	generation
Social Equity	social, equality
Geographic Equity	region
Procedural Equity	participation, engagement
Interspecies Equity	species
Sea Level Rise	sea level rise

Source: Created for this document by authors

CHAPTER 5: RESULTS

5.1 Research Question 1

This research question centers on what attitudes and values community members have with regard to sustainability. In order to ascertain how communities on Maryland's Eastern Shore perceive sustainability concerns, comprehensive planning documents were analyzed. The results are discussed below.

5.1.1 Sustainability Concerns

With sustainability being so difficult to define, there are numerous ways to address concerns. This calls for analysis of many different types of sustainability content, covering all three pillars. Below is a discussion of how sustainability was addressed in the various comprehensive planning documents reviewed.

5.1.1.1 Sustainability Inclusion

To determine whether a comprehensive plan included sustainability, the term "sustain" is sought in each document. Page numbers allow a determination as to how pervasive sustainability, as a theme, is included in the comprehensive planning documents. It is encouraging that all counties surveyed include a theme of sustainability somewhere in their comprehensive plans, seen in Figure 5. Five of the counties mention sustainability on less than 50 percent of its document's pages, with the lowest being Dorchester County with mentions in 13 percent of their plan. The last four counties all have sustainability mentioned on over 50 percent of their document's pages, the largest

being Queen Anne's County, with 82 percent inclusion. If, however, all counts of environmental, economic, and social sustainability were tallied along with general sustainability, these inclusion numbers could increase. These measures were kept separate due to the possibility of double counting one page for sustainability, environmental sustainability, and/or an inclusion of any other type of sustainability.

Sustainability as a theme shows that the Maryland Counties on Delmarva are looking to the future, starting to prepare their counties for many changes. With the varying degrees of inclusion, it is important to look at each plan in reference to when the plans were adopted to determine if including sustainability is increasing or decreasing in the overall region. Document adoption year may, in fact, indicate the difference in sustainability inclusion, as Dorchester's plan was completed in 1996 and Queen Anne's plan was adopted in 2010. While the data do follow the trend that the inclusion of sustainability increases with a more recent adoption of the comprehensive plan, Talbot County has an inclusion rate of 58 percent, while having the third oldest plan of those reviewed, 2005. Figure 6 shows this pattern of increasing levels of sustainability terminology in more recently adopted comprehensive plans.

5.1.1.2 Balance of the Three Pillars

While the literature shows that much attention is placed upon environmental sustainability, the content analysis performed shows that in six of the eight plans reviewed, social sustainability has the largest percentage of applicability, as seen in Figure 7. There are two plans that favor environmental sustainability and one plan that favors economic. Cecil County has the plan that is most equally balanced, with the span from the lowest addressed pillar, social, being 28 percent and the highest pillar,

economic, being 40 percent, a difference of only 12 percent. Wicomico County shows a 14 percent difference between its highest pillar, social, and its lowest pillar, environment; while Somerset County exhibits a 13 percent difference from environmental, at its lowest, to social, at its highest. Kent County has a 17 percent difference from economic, at its lowest inclusion rate, to social, at its highest. From there, percentages jumped from a 21 percent different in Queen Anne's County to a 41 percent difference in Worcester County.

Environmental sustainability is the second highest-ranking subset of sustainability in the study, Figure 7. The term 'environment' was sought throughout the document and context clues were used to determine what type of environment was mentioned. For instance, in an economic development chapter, there might have been mention of the business environment, which would void that count. In addition, if "environment" was found in the document, but the discussion was not discussing sustainability, the mention was also removed from the count.

Economic sustainability was by far the most difficult subset of sustainability to measure, in terms of mentions in the comprehensive plans. The term "economic" is used as a key word to highlight any possible discussion of economic sustainability. Each plan includes an economic development chapter and, as such, a large number of mentions for "economic" are references to the chapter in the plan, or even references to the Department of Economic Development, or other similarly titled department within the local government. In addition, a lot of discussion over the economy do not involve sustainability, such as increasing tourism, increasing tax base, business revenues, etc. Discussion of economy, in terms of sustainability, does, however, include mentions of

new viable economic ventures, capitalizing on environmentally and/or socially acceptable ventures (i.e. greenways, parks, ecotourism), and improving economic development while renovating existing structures.

Social sustainability has a high inclusion rate due in part because of the nature of a comprehensive plan, Figure 7. While each plan does take into account social needs associated with housing, which is common to the comprehensive planning documents, each specific type of social equity described in this paper allows for an increased awareness of inclusion in the plans. For instance, the introductory chapters for all plans include a description of the public involvement required in planning practices, allowing for researchers to directly tie the comprehensive plan to procedural equity. In addition, the plans reference future generations throughout the plan, which is inherent in a planning document for future development. If, however, environmental and economic sustainability were also broken into subsets with specific key words, there might be a different result, as there were five key words searched for social sustainability, while only one key word was used for each environmental and economic sustainability.

5.1.2 Social Sustainability Concerns

Social sustainability is known for being the one pillar of sustainability least researched, sometimes even forgotten. However, this content analysis contradicts those findings and shows that the vast majority of sustainability concern falls into a social category, Figure 7. This may be due to the fact that traditionally, researchers focus on just the present social equity issues as social sustainability. However, once intergenerational, social, geographic, procedural and interspecies equity are all

considered, it seems that comprehensive plans discuss social sustainability fairly well, Figure 8.

The results of these content analyses show that six out of eight plans discuss geographic equity more prominently than any other type, Figure 8. For counties on the Eastern Shore of Maryland, this would be typical, as the counties do come together to form a larger region. Mentions of geographic equity were sought using the term "region," where mentions were only counted if it was referencing the larger Delmarva region, and not a region within their county boundary. These discussions include regional job training, where a community college in one county served to train employees for another county or a region-wide need, such as the Peninsula Regional Medical Center. In addition, some counties specifically mention their responsibility to the larger region in terms of services provided, training opportunities, environmental quality, etc. While inclusion of geographic equity is higher than others, it is important to note that the plans discuss the larger Delmarva region and even the state, but do not draw a direct line between their growth and the nation or the globe.

Surprisingly, one of the next highest included equity discussions centers on interspecies equity, seen in Figure 8. While this terminology is relatively new to sustainability and planning discourse, the regulations surrounding endangered species protection and habitats of special concern can be linked to improving equity for non-human species. The State of Maryland has regulated habitat protection, sensitive areas, and endangered species protection and these concerns are included in every comprehensive plan reviewed. Further research into what qualifies as interspecies equity

and how those concerns are translated into planning policy are needed to further explain its importance in sustainability planning.

Procedural equity is mentioned fairly often in many plans, Figure 8. As discussed previously, it is required that all comprehensive planning include public involvement on some level, mostly with the visioning, document review, and public comment periods. Because of this, all plans mention public participation and involvement in their corresponding introductions. In addition, anytime there is mention of producing another supplemental plan to look into economic development techniques, land use changes, etc., there is mention of public involvement. The plans do not, however, include the number, race, age, location, etc., of those participants.

Figure 8 shows that social and intergenerational equity are the two subsets of social sustainability least mentioned in the comprehensive plans. Social equity is mainly discussed in housing chapters, discussing the need for affordable housing. In addition, there are mentions peppered throughout some plans stating that any possible solution to issues should be socially acceptable. While there are also mentions implying the need to make decisions for the future, there is not a focus on ensuring long-term viability, mainly only focusing on shorter-termed policy applicable to the 20 year horizon of the plan. It is important to note that each plan should be updated every six (6) years in Maryland, so there may not be a huge focus on future generations written into the plan, as it is known that plans will evolve with growing needs.

5.1.3 Sea Level Rise Concerns

The content concerning sea level rise shows a vastly different picture in comprehensive plans, as Figure 5 illustrates. Four plans have no mention of sea level rise

at all in their comprehensive plans, one of those counties being Dorchester with the largest Chesapeake Bay shoreline in the State of Maryland. The remaining counties include sea level rise in less than five percent of their respective plans; Worcester County, waterfront on the Atlantic Ocean, has the largest inclusion at four percent, seen in Figure 5.

It is interesting that the inclusion of sea level rise is not higher given that the Delmarva region is at risk for sea level rise and has already witnessed some loss of land due to changing shorelines. There are two possible explanations for the low percentage of sea level rise discussion in the plans. First, three counties on Delmarva have stand alone planning documents related to sea level rise; Dorchester County, Somerset County and Worcester County. While the Worcester Comprehensive Plan refers to this document, the Dorchester and Somerset Comprehensive Plans do not refer to the technical documents, due to the fact that their plans were last updated in 1996, prior to the technical documents, both dated 2008.

Secondly, there has not been an established link between sustainability and sea level rise, as sustainability inclusion is higher than sea level rise inclusion. In addition, sea level rise mentions were not directly related to sustainability issues identified in the plans. Without this link, plans that are focused on sustainability planning may not necessarily include sea level rise strategies within their plans. The State of Maryland has prepared reports and considers sea level rise a risk worth preparing for, however, many counties may not feel strongly about the issue. It is clear in their comprehensive plans that sea level rise is not at the same level of inclusion as sustainability and therefore, the two issues are not being discussed jointly.

5.1.4 Wicomico County

Wicomico County discusses sustainability throughout 74 percent of their comprehensive plan draft, the second highest amongst Maryland Eastern Shore counties, Figure 5. The detailed split showed that economic and environmental sustainability are fairly even at 29 and 28 percent coverage, respectively, while social sustainability receives 43 percent of the coverage, Figure 7. This higher percentage of social sustainability discussion is consistent across the reviewed counties, as six out of eight counties all receive the highest counts for social sustainability.

The breakdown of social sustainability shows the vast majority of discussion on geographic equity, Figure 8. This is consistent with the trend throughout the reviewed counties. Wicomico County's comprehensive plan focuses a great deal on the role the county has on the Eastern Shore of Maryland as an economic center for the region, also as a home to a state university, Salisbury University, and a large medical complex, Peninsula Regional Medical Center. There is also a large discussion on regional issues in the Transportation Chapter due to the fact that the two major transportation routes for the Delmarva Peninsula, US 50 and US 13, intersect in Wicomico County, Figure 4.

A distant second is intergenerational equity due to the focus on the viable future generations experience in Wicomico County, as seen in Figure 8. This discussion is lacking in all the other comprehensive plans, but Wicomico County deals with future generations at a much higher level than any other county reviewed. While there is general mention of providing for future generations, there is distinctive mention about linking the course of study at local colleges and universities to future county employment, as well as providing future housing and recreational opportunities. The

plan also discusses ensuring potable water for future residents and other quality assurance measures for services in the county.

As for sea level rise, Wicomico County has the second highest count for inclusion at 3 percent, or discussion on seven (7) of 206 total pages in the planning document, Figure 5. While this does seem low, it is important to note that sea level rise is discussed in its own section, five pages, as part of the Sensitive Areas Chapter. In addition, sea level rise is mentioned in the Introduction as a concern and in the Plan Implementation Chapter in reference to securing funding for a sea level rise study.

5.1.5 Summary of Results

A summary of the major findings for the first research question is provided below.

- Three of eight counties include sustainability in more than 50 percent of their comprehensive plans, Figure 5.
- There is a trend that the more recent the comprehensive plan adoption, the higher the mention of sustainability within the plan, Figure 6.
- The three pillars of sustainability are not discussed evenly in the comprehensive plans, with the majority of discussion centered on social sustainability issues, Figure 7.
- The largest subset of social sustainability covered by Maryland Eastern Shore counties is Geographic Equity, Figure 8.
- Sea level rise is discussed in five percent or less of the comprehensive plans reviewed, with half of the plans not discussing sea level rise at all, Figure 5.
- There is no established link between sustainability and sea level rise found in the reviewed comprehensive plans.

5.2 Research Question 2

An unsolicited, self-administered attitude survey was conducted for residents of Wicomico County. The survey serves as a way to measure resident perceptions about sustainability and sea level rise. Below is a discussion of each portion of the survey, as well as different cross-referenced information to help determine whether Wicomico County residents are concerned with sustainability and/or sea level rise.

5.2.1 Respondent Background

The majority of 66 participants are older than 45 years of age (66%), with 45 percent of those individuals being over 65 years of age, as seen in Table 5. There is a low response rate for those below 25 years of age with three (3) percent. Thirty-one (31) percent of respondents are aged 25 through 44 years of age. A large majority of respondents consider themselves Caucasian (88%), with a small African-American response (9%) and three percent not wishing to answer. Sixty-two (62) percent of residents have lived in Wicomico County for more than 10 years, with 15 percent of those living in the County more than 30 years. The majority of these residents own their home (94%). Just under half of the respondents have a bachelor's degree or higher (47%), with 44 percent having graduated from high school. Six (6) percent of responders have not graduated from high school. The results show that 31 percent of respondents are retired, with 22 percent having a business/professional occupation and 13 percent working in the medical field. These results confirm that Wicomico County has a large aging population.

5.2.2 Part 1 of Survey: Your Environment

Table 6 illustrates that of the participants of this survey, 13 percent said they live in a flood zone, while 62 percent said they did not. Most interestingly, 22 percent of respondents said they do not know if they currently live in a flood zone. Additionally, only nine (9) percent of respondents said they currently have flood insurance, a number that is far less than those that said they live in a flood zone. The majority of respondents said they are not required by law to have flood insurance (75%), but at the same time, 25 percent of respondents are not sure if flood insurance was required on their property. Sixty-seven (67) percent of those that have flood insurance said that having the insurance gives them peace-of-mind in relation to potentially major flooding events. The vast majority of respondents had properties that were elevated at least five (5) feet above standard sea level (78%).

Only a small percentage of respondents live on waterfront property, 16 percent, and only 13 percent have experienced flooding within the last five years. Just less than half of the waterfront property owners have hard shoreline protection (40%), such as a bulkhead. Of those that have experienced flooding, one respondent had to evacuate their home, while the other respondents had a small amount of water during heavy rain events that flooded their yard only. One respondent further stated that during hurricanes, water can encroach above his bulkhead by up to 30 feet, Table 6.

When asked about saltwater intrusion, most residents said they were less worried about the issue, Table 6. Only six (6) percent of respondents were “extremely worried,” while 16 percent were moderately worried. An overwhelming 56 percent of respondents were not worried at all about possible saltwater intrusion.

5.2.3 Part 2 of Survey: Sustainability

Just over half the survey respondents stated that they have a clear concept or idea of what "sustainability" means, as seen in Table 7. While 34 percent of respondents did not answer what is meant by the term "sustainability," respondents that did answer include a reference to future generations (38%), resource balance (29%), and resource maintenance or keeping the use of resources stable (24%). Ten (10) percent of respondents included human responsibility, the concept of using renewable resources only, and resiliency among their definitions. Only five (5) percent of respondents include additional terms such as using less, adapting to changing conditions, keeping up with demands, and using carbon. Additionally, five (5) percent of respondents reference the community, economic conditions, and environmental integrity as part of their definitions.

The majority of respondents said that economic development, positive social conditions and environmental quality are all important, Table 7. Economic development results show that respondents feel it is moderately important (37%), with another 26 percent stating it is extremely important. Environmental quality is high on the list with 36 percent stating it is extremely important, 25 percent stating it is highly important, and another 18 percent, stating it is moderately important, for a total of 79 percent agreement. Positive social conditions also resulted in high agreement with a 36 percent response of extremely important, 21 percent highly important, and 21 percent moderately important.

A large percentage of respondents stated they are making efforts to ensure a sustainable lifestyle (72%). Twenty-eight (28) percent stated they are not striving toward sustainability, while 13 percent declined an answer. Respondents also stated that they

feel Wicomico County is extremely or highly sustainable (46 percent), while an additional 39 percent said the County is moderately sustainable, Table 7.

5.2.4 Part 3 of Survey: Global Climate Change

When asked about global climate change, results did not represent one viewpoint over another as indicated in Table 8. Thirty-eight (38) percent of participants stated that they are moderately worried about climate change, with 19 percent stating they are highly or extremely worried and 44 percent stating they are less worried or not worried at all. Results about whether participants trusted the science behind climate change followed the same bell curve with 34 percent moderately trusting the science, with 28 percent trusting the science and 38 percent skeptical.

5.2.5 Part 4 of Survey: Sea Level Rise

Survey respondents showed differing opinions on sea level rise, as Table 9 illustrates. Thirty-four (34) percent of participants are moderately concerned about sea level rise, with 21 percent highly or extremely concerned and 44 percent skeptical. However, 44 percent of participants stated they are moderately concerned about an increase in flooding from coastal storms, with 26 percent highly or extremely concerned and only 31 percent not concerned. Interestingly, 56 percent of respondents said they have noticed or experienced increasing sea levels.

Respondents are fairly split when asked if they felt the County government was taking adequate protective measures concerning sea level rise with 47 percent stating the government was not adequately preparing and 41 percent stating the government was adequately preparing; 13 percent of participants did not answer this question, Table 9.

That being said, the majority of respondents do not feel sea level rise will affect Wicomico County significantly (69%).

Given the results from the previous questions, it is a surprise to find that 88 percent of respondents have not taken, nor plan to take, actions to mitigate potential sea level rise and associated flooding. When asked if they knew whether their property would be affected by sea level rise, 63 percent responded that they are not sure.

5.2.6 Regional Response

Discussing geographic equity for the purposes of this research concerns regions within Wicomico County and does not include extrapolation to larger geographies. Wicomico County has been split into three regions based on risk from sea level rise. The first region comprises most of eastern Wicomico County, which has a lower risk of sea level rise due to it not being waterfront, see Figure 4. Region 2 encompasses what is called the Metro Core region of Wicomico County, which is the center portion of the County surrounding the incorporated areas of Fruitland, Salisbury and Delmar. This region has moderate risk due to the presence of the Wicomico River traveling through the center of Salisbury. The last region, Region 3, comprises the western portion of Wicomico County, which is adjacent to the junction of the Wicomico River and the Chesapeake Bay. Much of this region is waterfront and low lying, exhibiting a higher sea level rise risk.

Respondents are relatively equally distributed across the three regions, with 38 percent representing Region 1, 28 percent representing Region 2, and 34 percent representing Region 3. Most notably, Region 3 participants state that they do not have a clear concept of sustainability, while the majority of respondents in Regions 1 and 2 state

that they do have a clear concept of sustainability, as seen in Table 10. This is concerning due to the higher level of sea level rise risk for Region 3 complicating sustainability and shows regional significance with a p-value of 0.018. Other findings show that Region 1, with the least sea level rise risk, reports that they do not feel sea level rise would significantly affect Wicomico County (80% of Region 1 respondents), while the other Regions show an even split on the question. Furthermore, Region 3 shows that a majority of respondents trust that Wicomico County is highly sustainability, a five (5) on a 1-5 scale, while Regions 1 and 2 both show that they feel Wicomico County is somewhat sustainable, at a three (3) out of five (5). Overwhelmingly, respondents stated that they have not, nor plan to mitigate for sea level rise personally, with 100 percent of respondents from Region 1, 75 percent from Region 2, and 90 percent from Region 3. These last three findings show no significance with respect to regional differences with p-values of 0.302, 0.108, and 0.21, respectively. All three regions follow the same trends for all other questions.

5.2.7 Demographic Response

The survey responses show that the vast majority of those that participated in the survey are over the age of 45 (66 percent) and have lived in Wicomico County for over 20 years (61 percent), Table 5. In particular, 88 percent of respondents report that they consider themselves Caucasian, while only nine (9) percent report African-American; three (3) percent chose not to answer. There is the potential for an inequity situation, in particularly race/ethnicity, with regards to procedures if planning practices show similar participation.

In fact, the only demographic profile that shows any difference between respondents was how age affected participant view of the three pillars of sustainability and whether they had a clear concept of sustainability, as seen in Table 11. The age group of 45-64 year olds respond that they believe positive social conditions are extremely important to sustainability, while the under 25, 25-44, and 65+ age groups all responded that positive social conditions are only somewhat important to sustainability, showing significance with a p-value of 0.056. Results are similar for economic and environmental importance to sustainability, though these cross tabulations show no statistical significance with p-values of 0.301 and 0.720, respectively. When asked about whether respondents had a clear concept of sustainability, the majority of the age groups 25-44 and 45-64 respond yes, while the majority of under 25 and 65+ respond no, though the p-value of 0.292 illustrates that this is not statistically different.

Race, number of years in residence, and housing ownership variables all show an overwhelming majority of respondents in one category over another, i.e. Caucasian v. African-American, Home owners (94%) v. renters (6%); therefore, these variables could not provide meaningful cross-tabulation results. In the future, obtaining a higher number of survey respondents might shed light on these cross references.

5.2.8 Summary of Results

A summary of the major findings for the second research question is provided below.

- There are 66 survey responses, with only two from the online survey.
- The majority of respondents are over the age of 45, 66%, Table 5.
- The majority of respondents are Caucasian (88%), with less than 10% African American participation, Table 5.

- While 13% of respondents live in a flood zone, only 9% have flood insurance; 25% are unsure if flood insurance was required for their property, Table 6.
- Over half of respondents have a clear concept of sustainability (66%), with the majority of these being between 25 and 64 years of age, Table 7.
- Major themes in sustainability definitions include the future generation (38%), resource balance (29%), and/or resource maintenance (24%), Table 7.
- The majority of residents feel that the environmental and positive social interactions are extremely important to sustainability, while they feel economic development was only somewhat important to sustainability, Table 7.
- Respondents state that they are making efforts to become more sustainable (72%), while they also state that they feel Wicomico County is sustainable in its current state (85%), Table 7.
- While 54% of participants are concerned about sea level rise, 70% are concerned with sea level rise-related flooding, Table 9.
- The majority of residents have no plans for mitigating sea level rise on their own (88%), while 69% state that sea level rise will not significantly affect Wicomico County, Table 9.
- Region 3, the region most susceptible to sea level rise impacts, has the least clarity of the regions on the term “sustainability,” significant with a p-value of 0.01, but felt that Wicomico was sustainable, Table 10.
- Respondents between the ages of 25 and 64 thought that positive social conditions were important to fostering sustainability, shown as significant with a p-value of 0.05, Table 22.

5.3 Research Question 3

While sustainability is shown to be a concern for residents of Wicomico County, sea level rise is less of a concern. However, an analysis of Wicomico County's vulnerability to sea level rise shows how sea level rise affects sustainability at the county scale.

5.3.1 Sea Level Rise Scenarios

Once the sea level rise scenarios from the National Wildlife Federation were transformed into an ArcGIS vector format, they were overlaid with the Wicomico County Base Map. Generally, Region 1, the easternmost portion of Wicomico County, shows no direct risk from sea level rise. The majority of water, collected in ponds, in smaller streams, etc., does not have a direct pathway to the Wicomico or Nanticoke Rivers, nor the Chesapeake Bay. Therefore, while sea level rise is a complicating factor for Wicomico County's sustainability, the areas east of Salisbury should not experience direct impacts, as seen in Figure 9.

Region 2, also known as the Metro Core, exhibits moderate risk to sea level rise, Figure 9. This is mainly due to the fact that the Wicomico River, which splits off the Nanticoke River at the intersection with the Chesapeake Bay, travels just north of Fruitland and into the center of the City of Salisbury. More specifically, the Wicomico River travels right through downtown Salisbury, where a river walk exists to take advantage of the natural feature. The riverbanks are supported by bulkheads or other stabilization, which may reduce the risk to rising sea levels; however, with an increased river level due to sea level rise, flooding hazards increase.

Lastly, Figure 9 illustrates a different situation for Region 3. With tidal influence from the Chesapeake Bay, the Nanticoke River and Wicomico Rivers will also be affected by sea level rise, causing a lot of the marsh areas on its banks to be potentially inundated. The two highest risk areas within Region 3 are along the northern portion of the Nanticoke River and the southwestern portion of Wicomico County, where the Wicomico River splits off of the Nanticoke River; these areas have a large amount of low lying areas. However, potential risks exist along the banks of both rivers and further inland along smaller tributaries.

5.3.2 Indicator Outcomes

After reviewing the Wicomico County Comprehensive Plan, functioning as a public participation-based document, many priorities and/or objectives are continually mentioned as important for sustaining Wicomico County and growing the communities in the future. The County wishes to expand and diversify its current economic base. Transportation is also mentioned frequently throughout the Comprehensive Plan, in reference to its importance to the Delmarva Region, as well as its relevance to the economy. Wicomico County also places emphasis on maintaining the Metro Core region as a center for finance, education, government, and medical services in the tri-state area. Due to these statements, indicators for economic sustainability include the number of buildings, the roads, the railroads, and the number of major shopping destinations possibly affected by sea level rise. In addition, median household income is collected for census tracts located in potential inundation areas.

Environmental indicators are handled in the same manner, starting with Wicomico County's Comprehensive Plan. The Plan states that environmentally sensitive

and rural lands are to be protected, that natural features are to be conserved, that agricultural lands should be protected, and that wildlife habitats may be threatened due to sea level rise. Indicators chosen for the analysis of sea level rise impacts on environmental sustainability include greenways, Targeted Ecological Areas (TEAs), Natural Heritage Areas (NHA), Rural Legacy Areas, and Chesapeake Bay Critical Area (CBCA) lands that are potentially affected.

Social indicators were more difficult to determine. Wicomico County's Comprehensive Plan states that they value public access to open spaces, safeguarding their historic and rural heritage areas, as well as mentioning the importance of public participation throughout their plan. Wicomico scored high in social sustainability mentions in their Plan due to a high mention of geographic equity, focusing on the importance of the transportation system to the Delmarva Region, as well as by focusing on their role as an economic center for the region, both of these areas are discussed under economic indicators. In addition, a high number of references to species protection warranted a high score for social sustainability under interspecies equity, which is discussed under environmental indicators. Therefore, indicators that are discussed under social indicators are those not discussed elsewhere that are important to the County. These include parks and open spaces. Other additional indicators that are determined as socially important and, therefore, included in the analysis, are public service and safety locations (post office, libraries, emergency services, police and fire stations, hospitals, etc.), schools, and an estimated number of people that could potentially be affected by sea level rise. Additionally, information at the census tract level, poverty rate and race, are collected as well.

As with any study, not every possible indicator of sustainability is used in this study. First and foremost, indicators are chosen based upon public opinion represented in the Wicomico County Comprehensive Plan and/or mentioned by the sustainability survey participants. Secondly, while there is potential for an indicator to be used to measure sustainability, if there was no potential impact from sea level rise, it was removed from this study as irrelevant. Examples of these indicators would be carpooling numbers and mean travel time, which are indifferent to sea level rise impacts. Additionally, only results from the first and third sea level rise scenarios will be reported, as many results are the same for one (1) foot of sea level rise and 1.6 feet of sea level rise.

5.3.2.1 Economic Indicators

In terms of shopping, Wicomico County shows that no commercial strips are affected by any of the sea level rise scenarios, Figure 10. However, for all of the sea level rise scenarios, five (5) out of 12 possible major shopping destinations may potentially be affected. These shopping areas are mainly in the downtown area, but the Salisbury Mall area and another area south of Route 50 might be affected.

The transportation system had many interesting outcomes. Five (5) out of a possible 62 railroad segments are highlighted as possibly being affect in all of the sea level rise scenarios, Figure 11. In addition, 21 out of 644 road segments would potentially be affected in the first sea level rise scenario. This number increases to 26 segments for the third sea level rise scenario, Figure 12, Table 12.

There are less than one percent of buildings in Wicomico County at potential risk from sea level rise, Figure 13. The first sea level rise scenario may potentially affect 144

out of 76,571 buildings in the County. The third sea level rise scenario could affect up to 325 of these buildings.

Out of a possible 19 census tracts that exist within Wicomico County, 12 may be potentially affected by all scenarios of sea level rise, Figure 14. The possibly affected census tracts show a range in median household income from $28,841 in Census Tract 3, to $82,890 in Census Tract 103, Table 13. One third of the tracts fall under $40,000 household median income.

5.3.2.2 Environmental Indicators

Environmental indicators reviewed were the number of greenways, area of Targeted Ecological Areas, area of Rural Legacy Areas, Natural Heritage Areas, and area of Chesapeake Bay Critical Area potentially affected by sea level rise. There are seven (7) existing, 11 potential and 10 water trail greenways that may potentially be affected by sea level rise at a one-foot rise (first sea level rise scenario); 28 out of a possible 44 greenways, Figure 15. When looking at a one-meter rise (third sea level rise scenario), the number increases by two existing greenways. About 10,000 acres of Targeted Ecological Areas are in the risk area for the first sea level rise scenario, rising to around 22,000 acres for the third sea level rise scenario, Figure 16. These areas include green infrastructure areas, rare species habitat, aquatic life, and water quality protection areas. Rural Legacy Areas, land conserved through a state program, show the same 14,945.6 acres of potential risk to all of the sea level rise scenarios, Figure 17. Wicomico County's one Natural Heritage Area, an area characterized as having a natural significance to the state, is located along the Nanticoke River; therefore, parts of the area are within all three sea level rise scenarios, Figure 18. Lastly, the Chesapeake Bay

Critical Area (CBCA), typically water adjacent areas, show 99.5 percent of Salisbury's CBCA is within the sea level rise scenarios, 1,046.1 acres, while 93.5 percent of Wicomico's CBCA is included in the first sea level rise scenario and 96.3 percent is included in the third sea level rise scenario, 19,890.7 acres and 20,498.7 acres respectively, Figure 19.

5.3.2.3 Social Indicators

Fortunately, there are no public service or public safety services located within any of the sea level rise scenarios. Additionally, there are no schools located within the scenarios. However, 39 out of 113 parks are within all of the sea level rise scenarios, Figure 20. These are mainly waterfront parks. In addition, there are roughly 100 people that could be affected in the first sea level rise scenario and 281 people in the third sea level rise scenario. These population counts are extrapolated by determining which buildings in the inundation areas are primary structures and then multiplying the number of structures by the 2010 average household size (2.47).

Out of the 12 possibly affected census tracts in Wicomico County, all but two have a white population making up more than 50 percent of the total population, with Census Tract 1 having a 51 percent Black population and Census Tract 5 being 49 percent White and 39 percent Black. American Indian, Asian, Pacific Islander/Hawaiian, other, and two or more races all had 10 percent or less of the total population of each tract. The Hispanic population is under 10 percent in the majority of tracts and under 25 percent in all the tracts; Census Tract 1 has a 12 percent Hispanic population, Census Tract 3 has an 11 percent Hispanic population, and Census Tract 5 has a 16 percent Hispanic population.

Four of the 12 census tracts also show a poverty rate of more than 25 percent; Census Tract 1 with 26 percent, Census Tract 3 with 37 percent, Census Tract 4 with 30 percent, and Census Tract 105.02 with 33 percent. These tracts are all located within the City of Salisbury, and correlate with the tracts showing lower median household incomes.

5.3.3 Summary of Results

A summary of the major findings for the third objective is provided below.

- Region 1 shows a lower risk of direct sea level rise impacts, Region 2 shows a moderate risk of direct sea level rise impacts, and Region 3 shows a high risk of direct sea level rise impacts, Figure 9.
- Five (5) out of 12 major shopping destinations show to be potentially affected by sea level rise, Figure 10.
- Five (5) out of 62 segments of railroad track show to be potentially affected by sea level rise, Figure 11.
- Twenty-one (21) out of 644 roadway segments show to be potentially affected by sea level rise at the 1-foot level and 26 segments at the 1-meter level, Figure 12.
- One hundred and forty-four (144) out of 76,571 buildings show to be potentially affected by sea level rise at the 1-foot level and 144 at the 1-meter level, both less than one percent, Figure 13.
- Median household income for potentially affected census tracts range from $28,841 to $82,890, with the majority of tracts showing below $40,000, Figure 14.

- Seven (7) existing, 11 potential, and 10 waterway greenways show to be potentially affected by sea level rise at the 1-foot level, with nine (9) existing greenways at the 1-meter level, Figure 15.
- About 10,000 acres of Targeted Ecological Areas show to be potentially affected by sea level rise at the 1-foot level, roughly 22,000 at the 1-meter level, Figure 16.
- Just shy of 15,000 acres of Rural Legacy Area show to be potentially affected by sea level rise, Figure 17.
- The one Natural Heritage Area in Wicomico County shows to be potentially affected by sea level rise, Figure 18.
- About 99 percent of Salisbury's Chesapeake Bay Critical Area (CBCA) shows to be potentially affected by sea level rise, with 94 percent of Wicomico County's CBCA affected at the 1-foot level and 96 percent at the 1-meter level, Figure 19.
- Thirty-nine (39) out of 113 parks show to be potentially affected by sea level rise, Figure 20.
- Roughly 100 people show to be potentially affected by sea level rise at the 1-foot level, about 280 at the 1-meter level.
- Ten (10) of 12 census tracts potentially affected by sea level rise are more than 50 percent white, with one census tract showing 49 percent white and 39 percent black and another census tract showing 51 percent black.
- Four (4) of 12 census tracts potentially affected by sea level rise show a poverty rate of over 25 percent.

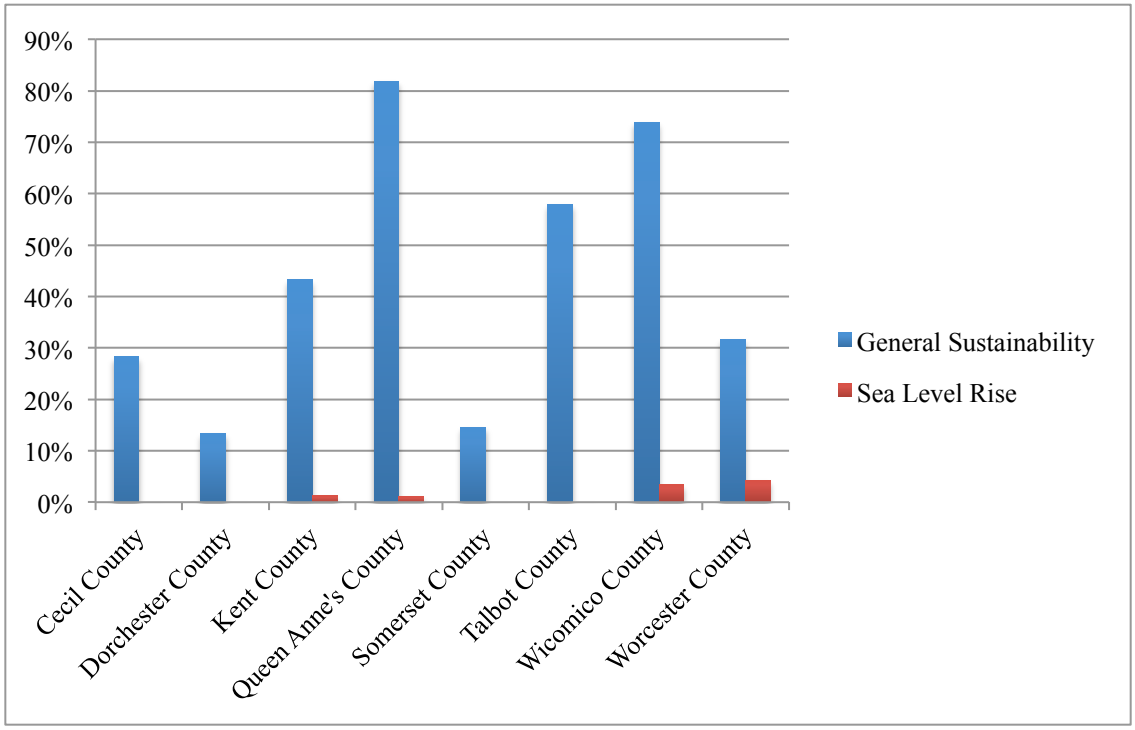


FIGURE 5: Inclusion of sustainability and sea level rise in comprehensive plans
Source: Content Analysis created for this document with data from Comprehensive Plans for Maryland's Eastern Shore Counties

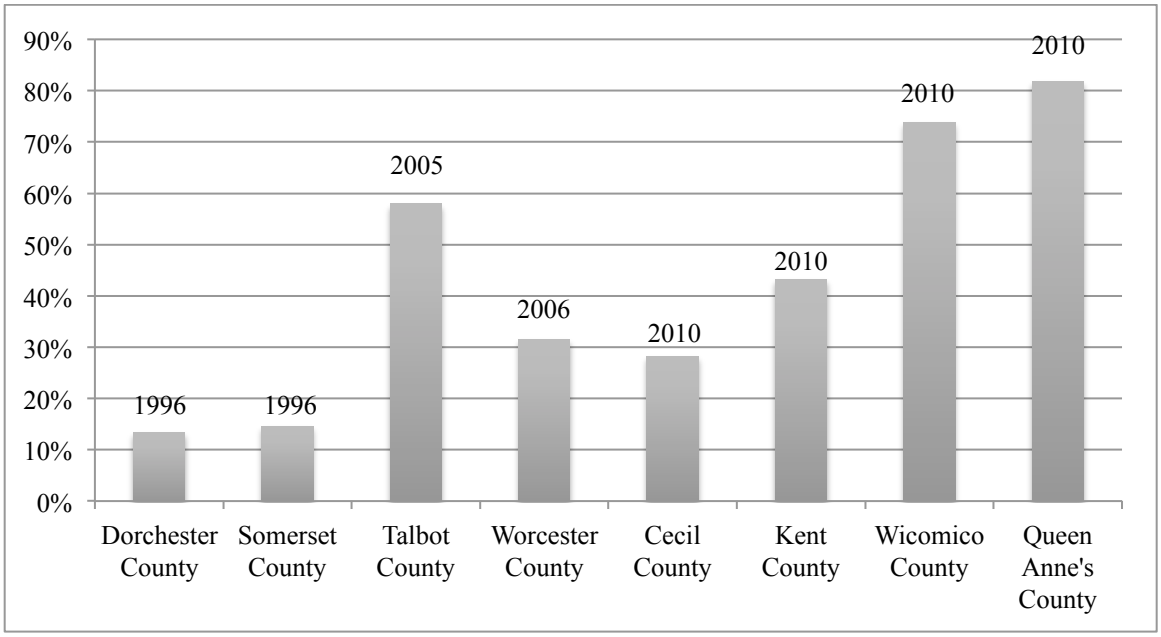


FIGURE 6: Sustainability inclusion by date
Source: Content Analysis created for this document with data from Comprehensive Plans for Maryland's Eastern Shore Counties

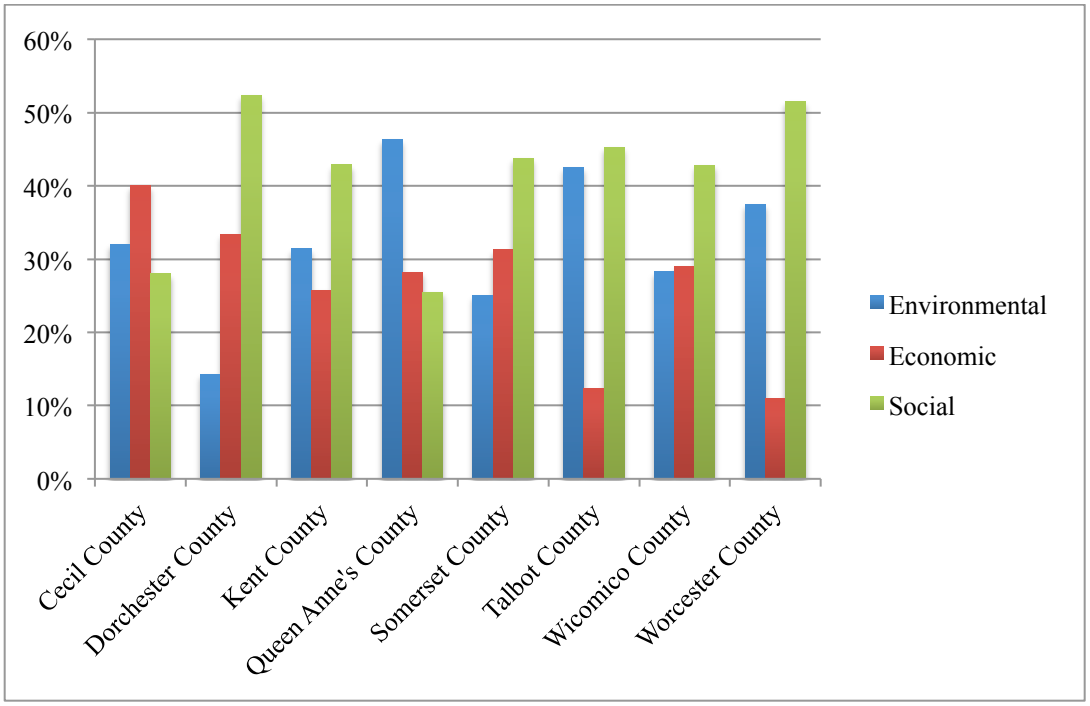


FIGURE 7: Sustainability inclusion by pillar
Source: Content Analysis created for this document with data from Comprehensive Plans for Maryland's Eastern Shore Counties

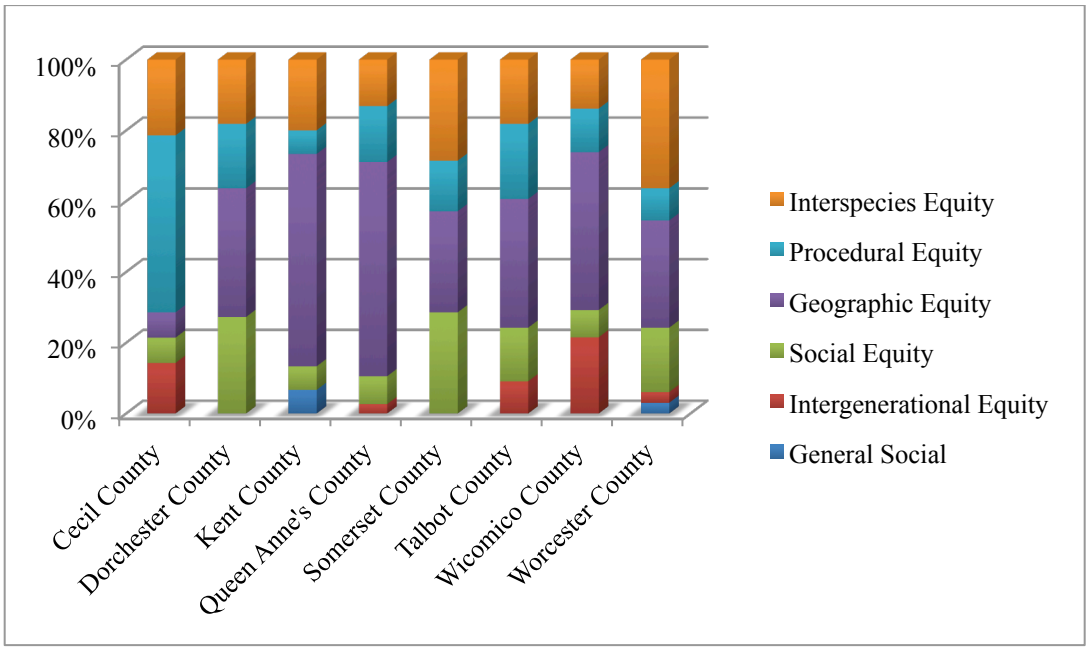


FIGURE 8: Social sustainability inclusion by sub-type
Source: Content Analysis created for this document with data from Comprehensive Plans for Maryland's Eastern Shore Counties.

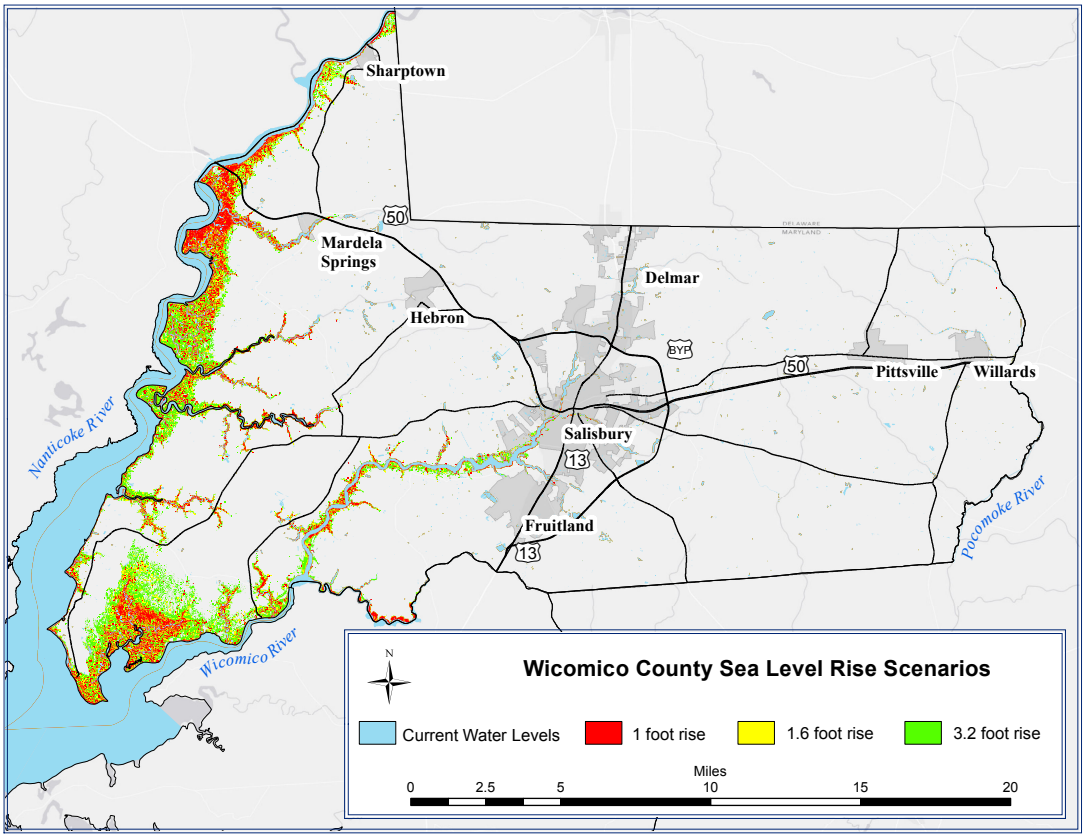


FIGURE 9: Wicomico County sea level rise scenarios
Source: Vulnerability Assessment created for this document with data from Wicomico County GIS

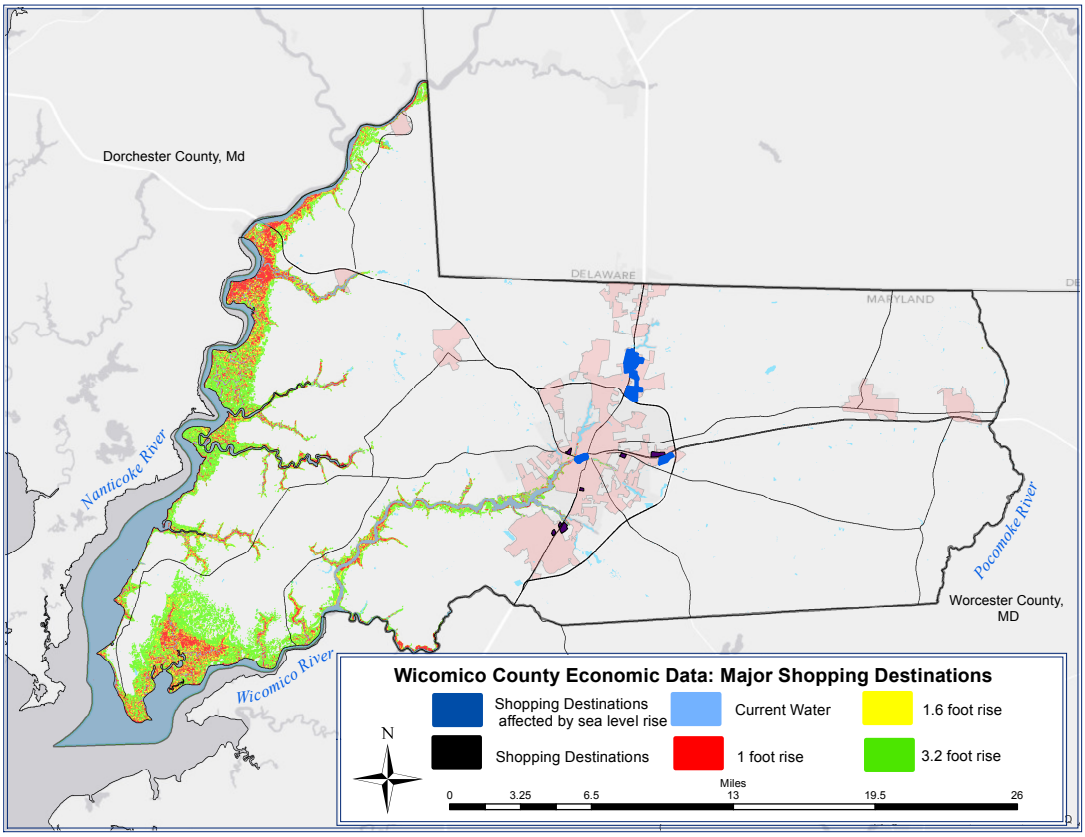


FIGURE 10: Wicomico County major shopping destinations
Source: Vulnerability Assessment created for this document with data from Wicomico County GIS

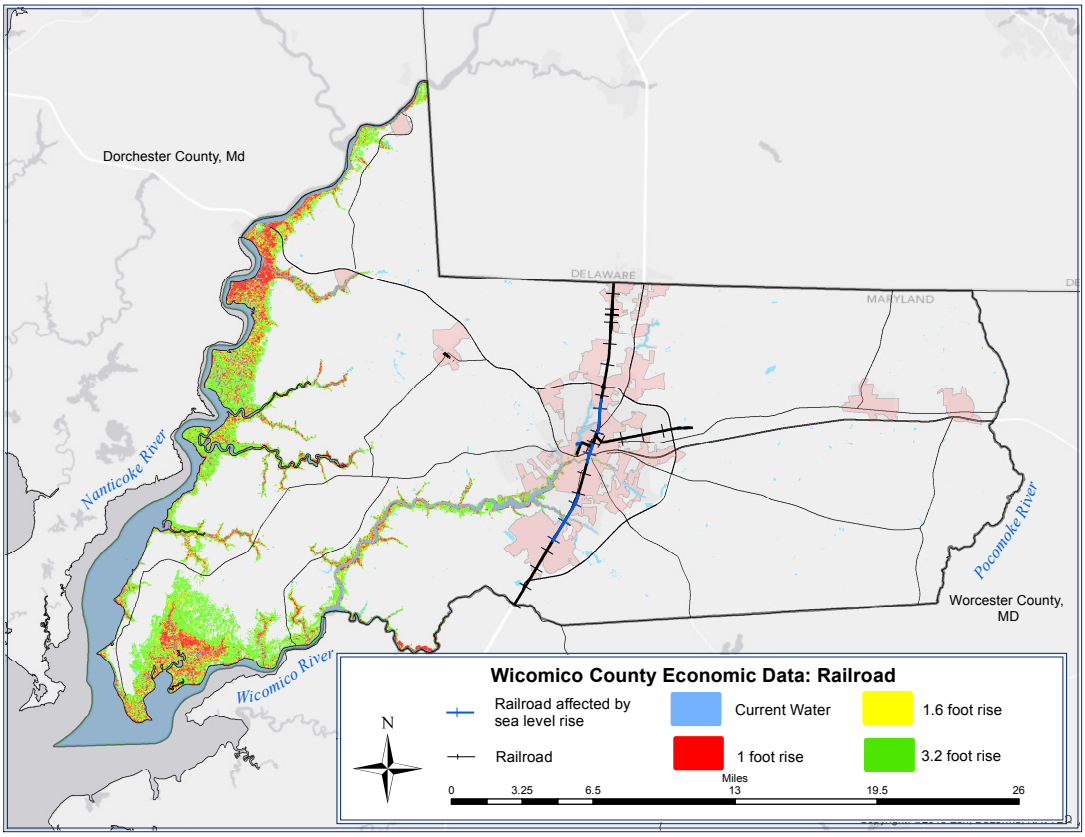


FIGURE 11: Wicomico County railroads
Source: Vulnerability Assessment created for this document with data from Wicomico County GIS

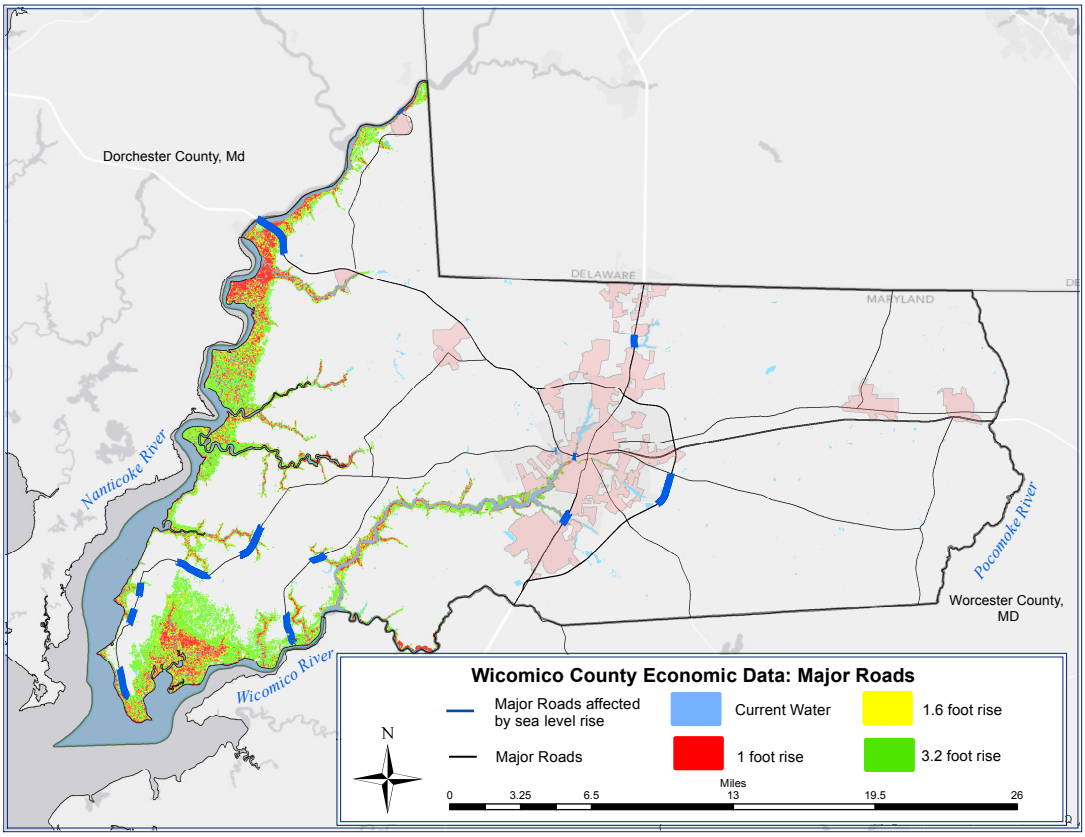


FIGURE 12: Wicomico County major roads
Source: Vulnerability Assessment created for this document with data from Wicomico County GIS

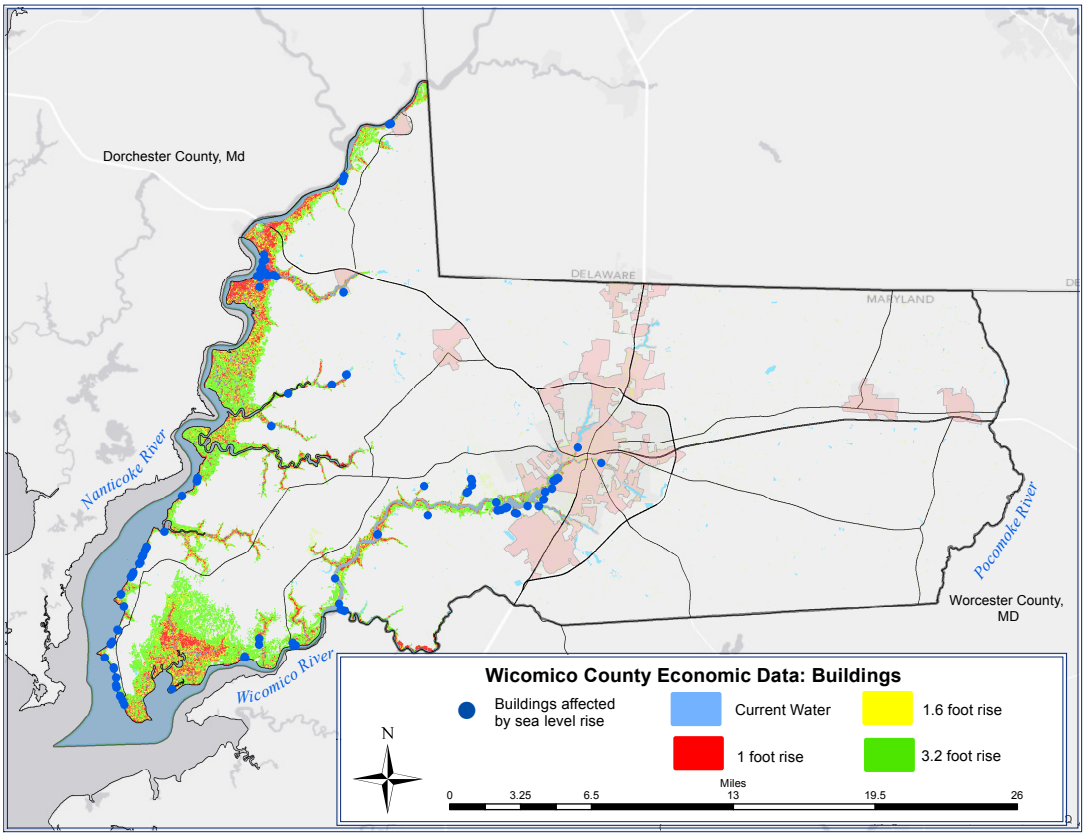


FIGURE 13: Wicomico County buildings
Source: Vulnerability Assessment created for this document with data from Wicomico County GIS

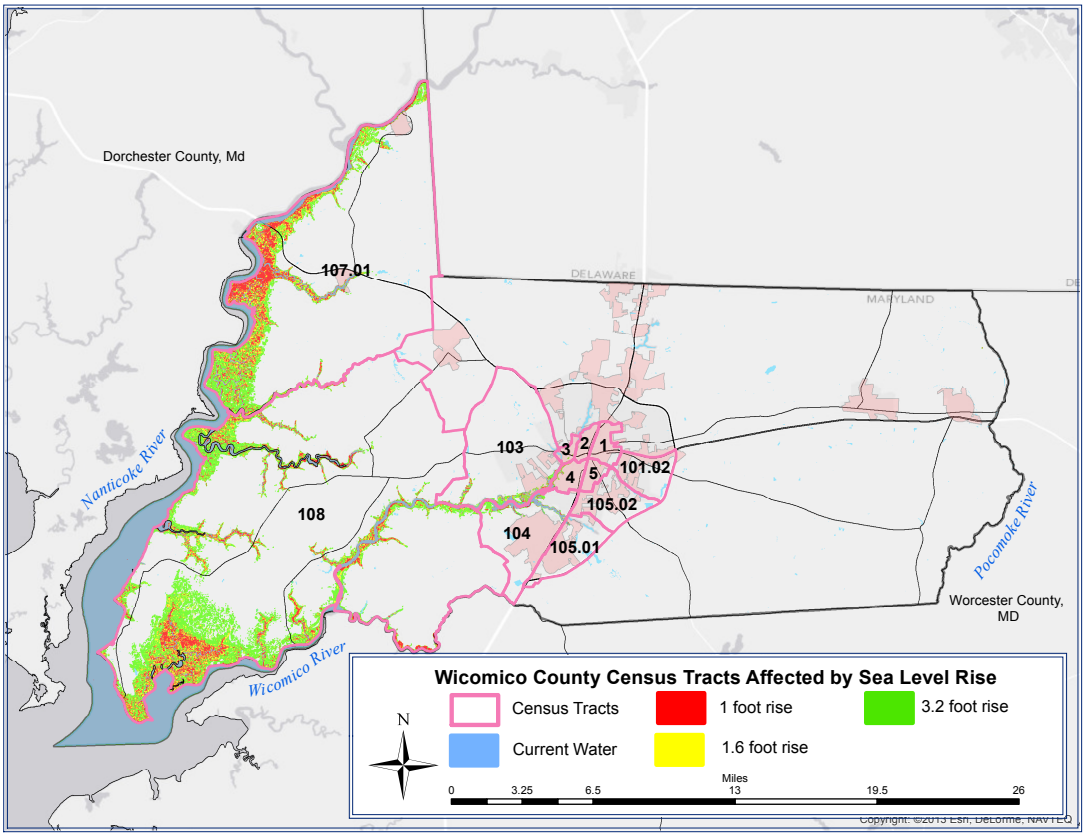


FIGURE 14: Wicomico County census tracts affected by sea level rise
Source: Vulnerability Assessment created for this document with data from Wicomico County GIS

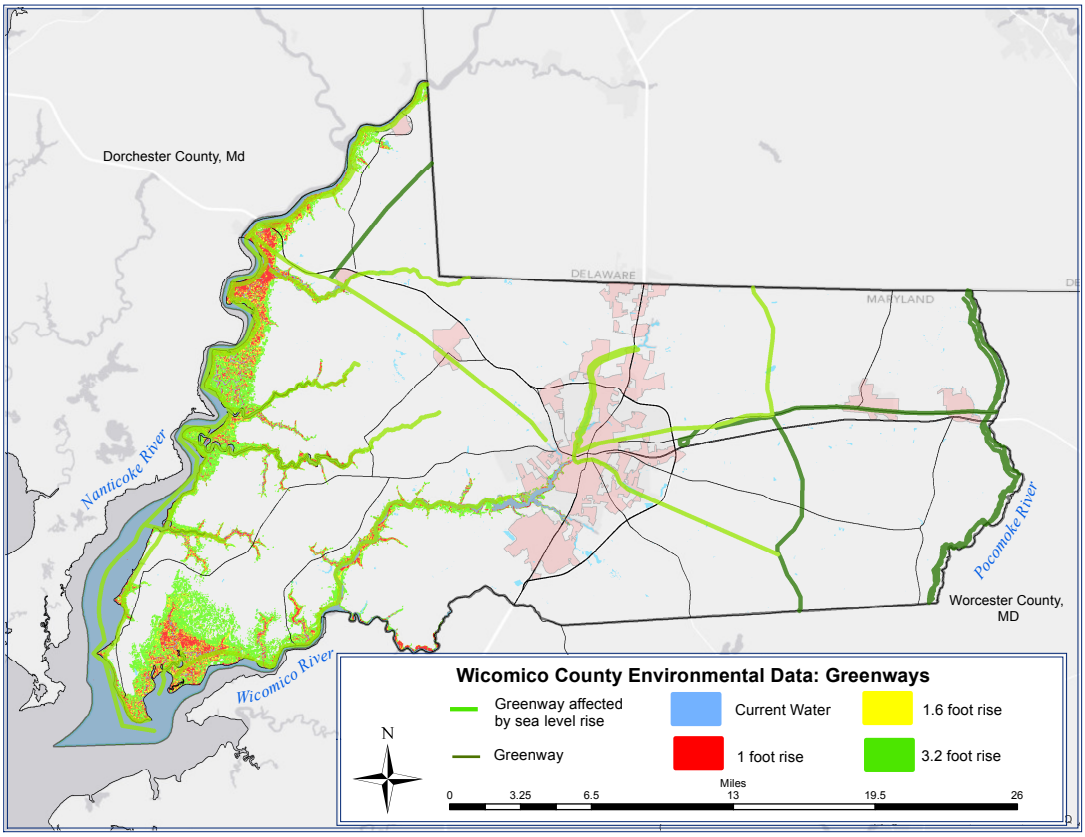


FIGURE 15: Wicomico County greenways
Source: Vulnerability Assessment created for this document with data from Wicomico County GIS

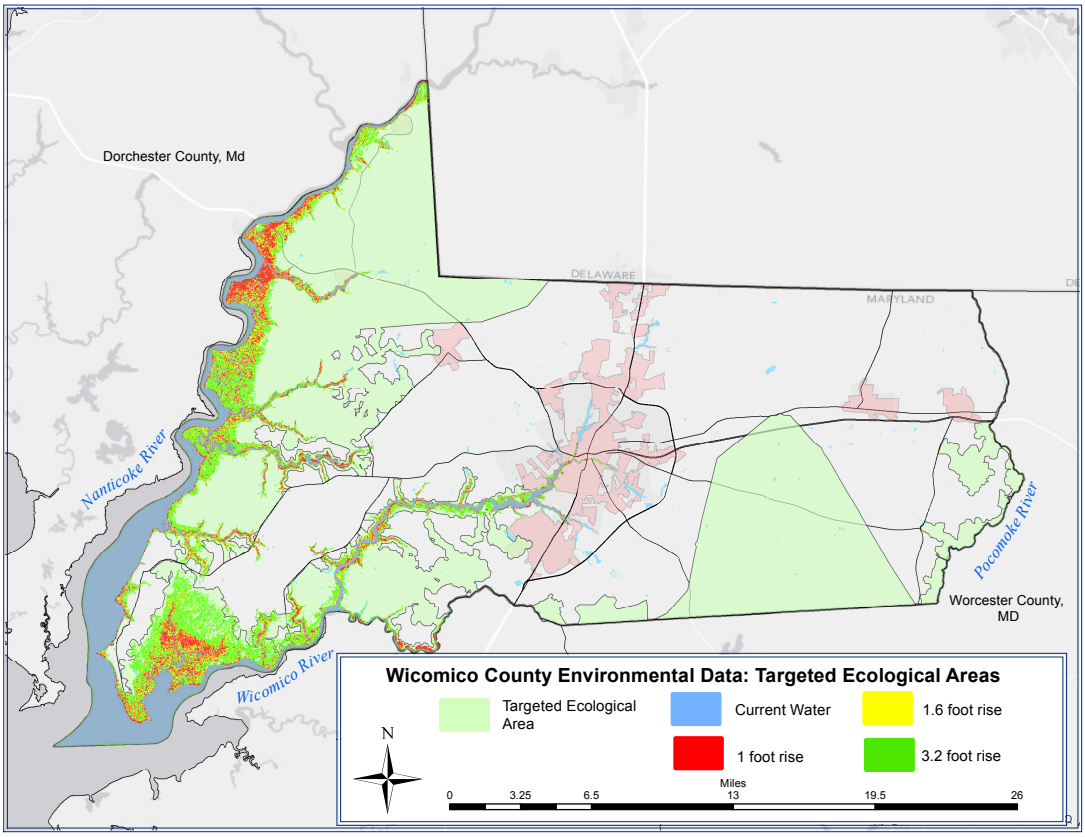


FIGURE 16: Wicomico County targeted ecological areas
Source: Vulnerability Assessment created for this document with data from Wicomico County GIS

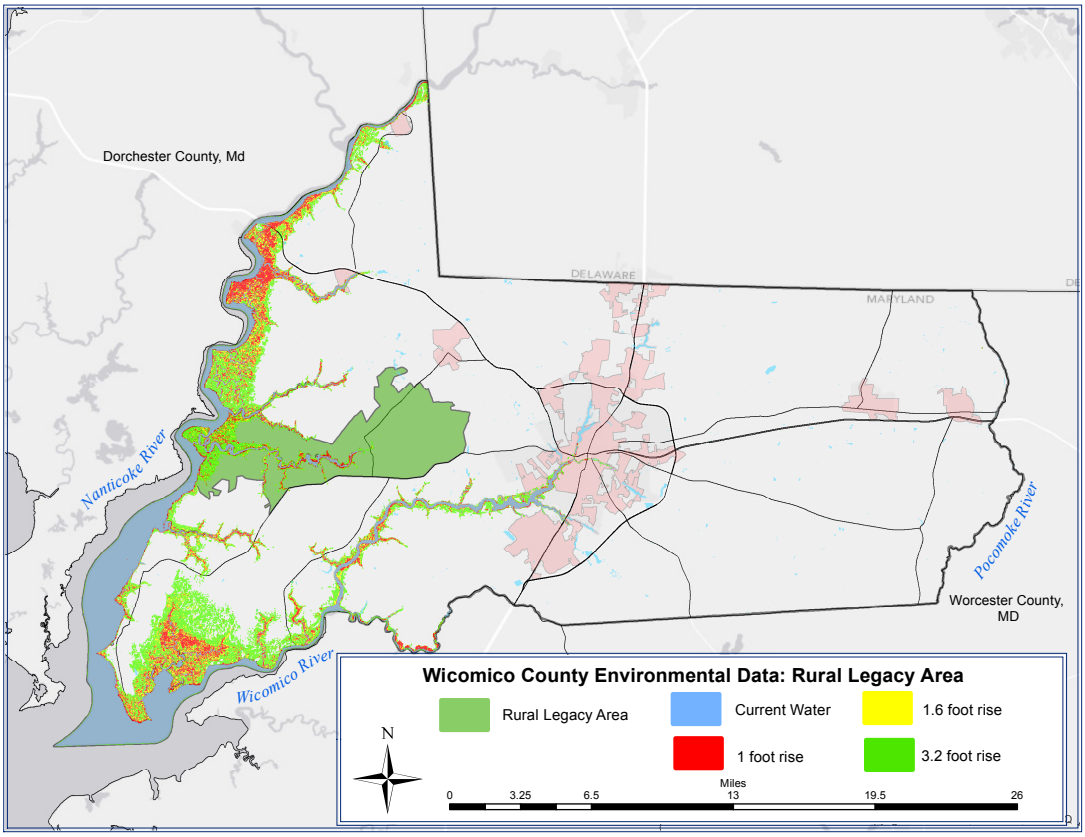


FIGURE 17: Wicomico County rural legacy area
Source: Vulnerability Assessment created for this document with data from Wicomico County GIS

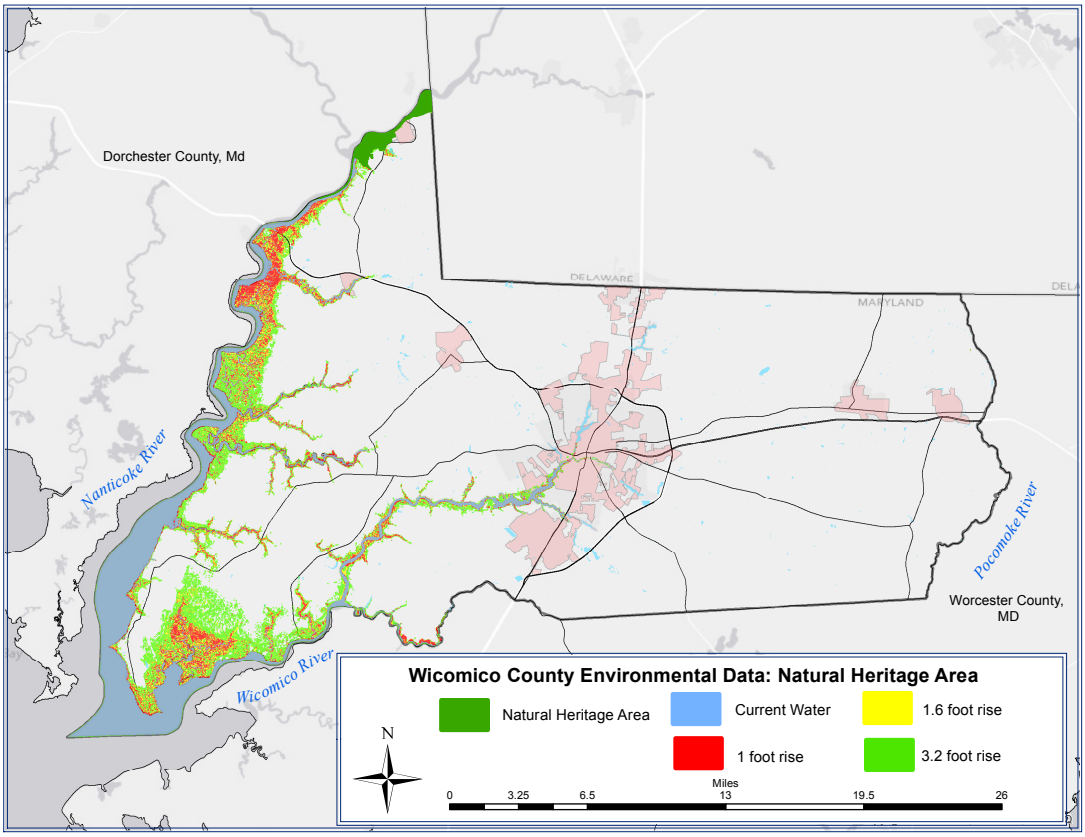


FIGURE 18: Wicomico County natural heritage area
Source: Vulnerability Assessment created for this document with data from Wicomico County GIS

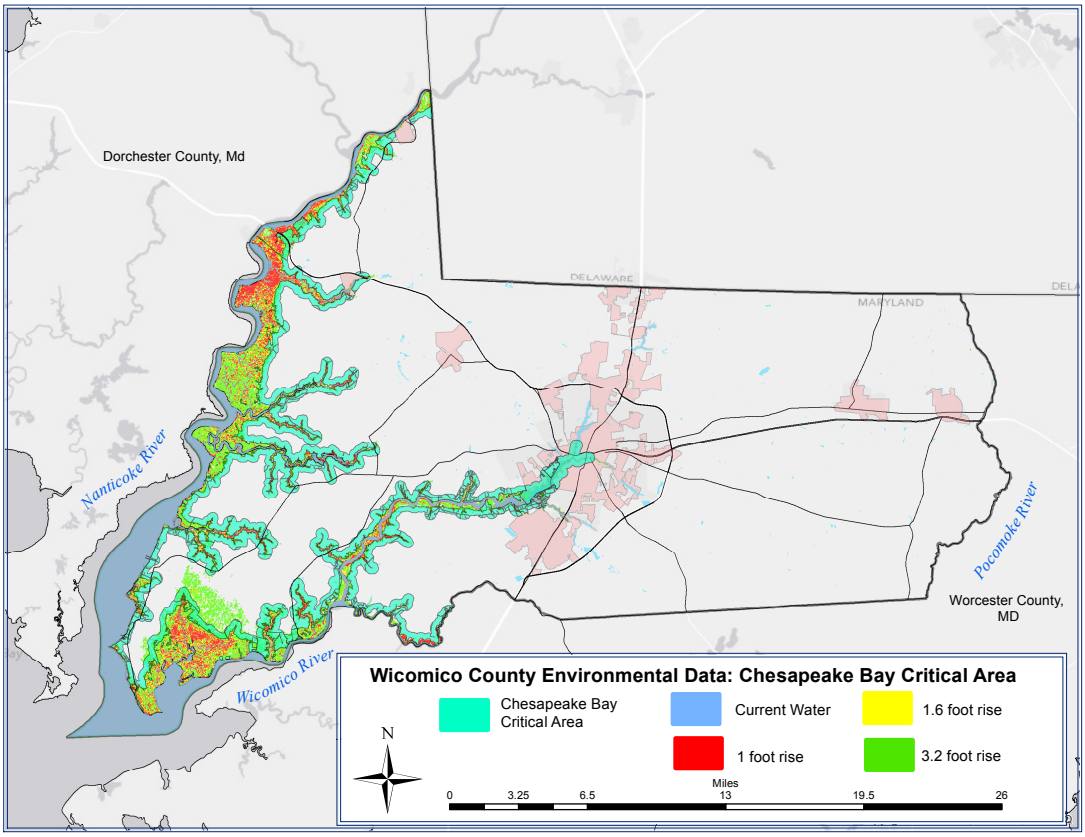


FIGURE 19: Wicomico County Chesapeake Bay critical area
Source: Vulnerability Assessment created for this document with data from Wicomico County GIS

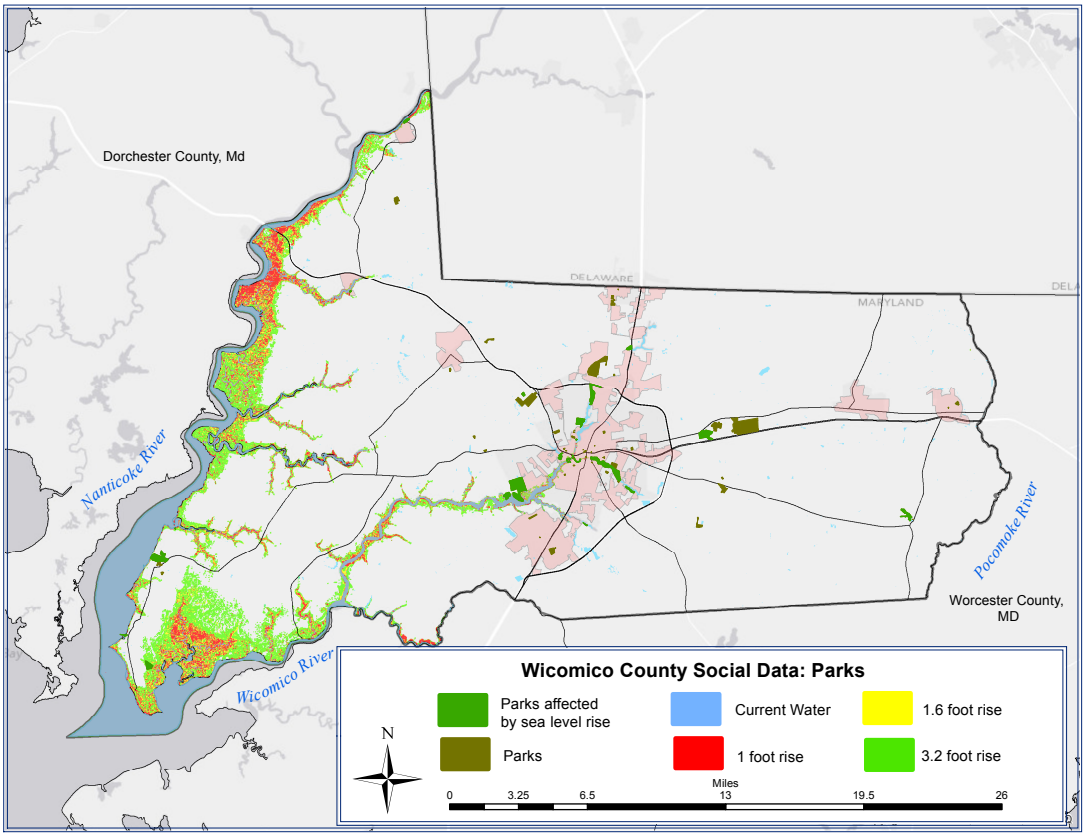


FIGURE 20: Wicomico County parks
Source: Vulnerability Assessment created for this document with data from Wicomico County GIS

TABLE 5: Survey questions and answers: Background information

Age		
	under 25	3%
	25-44	31%
	45 - 64	38%
	65+	28%
Race		
	Caucasian	88%
	African-American	9%
	I prefer not to answer	3%
Residence		
	0-10	31%
	10-*20	6%
	21-30	31%
	30+	25%
	No Answer	6%
Home Ownership		
	Rent	6%
	Own	94%
Education		
	Less than High School	6%
	High School/GED	16%
	Some College	28%
	Bachelors Degree	22%
	Graduate Degree	25%
	I Prefer not to answer	3%
Occupation		
	Retired	31%
	Teacher	9%
	Farmer	6%
	Medical	13%
	Professional/Business	22%
Income		
	<$20,000	13%
	$20-39K	19%
	$40-59K	9%
	$60-79K	13%
	$80-99k	9%
	$100-149K	13%
	$150k+	9%
	I prefer not to answer	16%

Source: Survey created for this document.

TABLE 6: Survey questions and answers: Your environment

1. Do you live in a flood zone?	
Yes	13%
No	62%
Do not know	22%
2. Do you have flood insurance?	
Yes	9%
No	91%
3. If "Yes" to Question 2, does flood insurance give you peace-of-mind in case of a major flood?	
Yes	67%
No	33%
4. Are you required by law to have flood insurance?	
Yes	0%
No	75%
Do not know	25%
5. Have you experienced flooding within the last five years?	
Yes	13%
No	88%
6. If you answered "Yes" on Question 5, how did flooding affect your property (i.e. your home, your yard only, both your home and yard, your business, etc.)?	
Yard only	
Small amount after a noreaster [sic]	
I had to evacuate my home	
4-5 times per year the river rises above my bulkhead. Yard only. Encroachment ranges from 4-5 feet up to 30-40 feet when we've had hurricanes.	
7. Do you live on waterfront property?	
Yes	16%
No	84%
8. If you answered "Yes" on Question 6, do you have hard shoreline protection (i.e. bulkhead, rip rap, sand bags, etc.)?	
Yes	40%
No	60%
9. Is your property elevated five (5) feet above sea level?	
Yes	78%
No	22%

TABLE 6: Survey questions and answers: Your environment (continued)

10. How worried are you about saltwater intrusion into public drinking water supplies?	
Extremely Worried (5)	6%
Worried (4)	0%
Moderately worried (3)	16%
not really worried (2)	22%
Not worried (1)	56%

Source: Survey created for this document.

TABLE 7: Survey questions and answers: Sustainability

1. Do you have a clear idea or concept of what is meant by "sustainability"?	
Yes	66%
No	34%
2. If you answered "Yes" on Question 1, in your own words, what is meant by "sustainability"?	
Themes	
Use less	5%
Future - continue	38%
Changing conditions- adapt	5%
Resource balance	29%
Three pillars	5%
Responsibility	10%
Resource maintenance	24%
Renewable resource	10%
Resilience	10%
Keep up	5%
Use carbon	5%
Not available	34%
3. How important is economic development to fostering sustainability in this community?	
Extremely Important (5)	26%
Important (4)	19%
Moderately Important (3)	37%
Little Important (2)	15%
Not Important (1)	4%
4. How important are positive social conditions to fostering sustainability in this community?	
Extremely Important (5)	36%
Important (4)	21%
Moderately Important (3)	21%
Little Important (2)	14%
Not Important (1)	7%

TABLE 7: Survey questions and answers: Sustainability (continued)

5. How important is environmental quality to fostering sustainability in this community?	
Extremely Important (5)	36%
Important (4)	25%
Moderately Important (3)	18%
Little Important (2)	14%
Not Important (1)	7%
6. In your opinion, how sustainable is Wicomico County?	
Sustainable (5)	25%
(4)	21%
(3)	39%
(2)	14%
Unsustainable (1)	4%
7. At the present time, are you making efforts to make your lifestyle more sustainable?	
Yes	72%
No	28%
	13%

Source: Survey created for this document.

TABLE 8: Survey questions and answers: Global climate change

1. How worried are you about global climate change?	
Extremely worried (5)	3%
Worried (4)	16%
Moderately Worried (3)	38%
Less worried (2)	31%
Not worried (1)	13%
2. Do you trust the science that has identified and studied the impacts of climate change?	
Trust (5)	3%
(4)	25%
(3)	34%
(2)	25%
Distrust (1)	13%

Source: Survey created for this document.

TABLE 9: Survey questions and answers: Sea level rise

1. How concerned are you that sea level is rising owing to climate change?	
Concerned (5)	3%
(4)	19%
(3)	34%
(2)	31%
Skeptical (1)	13%
2. How concerned are you that flooding from coastal storms will increase due to sea level rise?	
Concerned (5)	13%
(4)	13%
(3)	44%
(2)	22%
Skeptical (1)	9%
3. Have you noticed a receding or increasing shoreline?	
Yes	56%
No	38%
Not Available	6%
4. Do you feel sea level rise will significantly affect Wicomico County?	
Yes	31%
No	69%
5. Do you know if your property is potentially in a flood zone provided the sea level does rise?	
Yes	38%
No	63%
6. Do you feel that the City/County government is taking adequate measures to protect residents from sea level rise impacts?	
Yes	41%
No	47%
Not Available	13%
7. Have you planned or taken actions to mitigate sea level rise and associated flooding?	
Yes	13%
No	88%

Source: Survey created for this document.

TABLE 10: Survey questions and answers: Regional cross tabulations

Do you have a clear understanding of sustainability?		
Region	Yes	No
1	29%	7%
2	25%	4%
3	11%	25%
p-value = 0.018		

Do you feel sea level rise will significantly affect Wicomico County?		
Region	Yes	No
1	7%	31%
2	10%	17%
3	17%	17%
p-value = 0.302		

Have you/do you plan to mitigate sea level rise personally?		
Region	Yes	No
1	0%	38%
2	7%	21%
3	3%	31%
p-value = 0.210		

How sustainable is Wicomico County?					
	Unsustainable (1)	2	3	4	Sustainable (5)
Region					
1	4%	4%	24%	4%	0%
2	0%	8%	16%	4%	4%
3	0%	0%	4%	8%	20%
p-value = 0.108					

Source: Survey created for this document.

TABLE 11: Survey questions and answers: Age cross tabulations

How important is economic development to fostering sustainability in this community?						
		1	2	3	4	5
Age	under 25	0%	0%	2%	0%	0%
	25-44	2%	0%	9%	6%	2%
	45 - 64	0%	4%	2%	4%	9%
	65+	0%	4%	4%	0%	2%
p-value = 0.301						
How important are positive social conditions to fostering sustainability in this community?						
		1	2	3	4	5
Age	under 25	0%	0%	0%	4%	0%
	25-44	7%	4%	7%	14%	4%
	45 - 64	0%	0%	11%	0%	21%
	65+	0%	11%	4%	4%	11%
p-value = 0.056						
How important is environmental quality to fostering sustainability in this community?						
		1	2	3	4	5
Age	under 25	0%	0%	0%	4%	0%
	25-44	4%	7%	4%	11%	7%
	45 - 64	0%	0%	7%	7%	19%
	65+	4%	7%	4%	4%	11%
p-value = 0.720						

Source: Survey created for this document.

TABLE 12: Major roads potentially affected by sea level rise

Road Name	Number of Occurrences
Nanticoke Road	5
Ocean Gateway	1
Ocean Highway	2
Salisbury Bypass	1
Salisbury Parkway	2
Sharptown Road	1
Whitehaven Road	2

Source: Vulnerability Assessment created for this document with data from Wicomico County GIS

TABLE 13: Median household income per census tract

ID #	Census Tract	Median Hhd. Income
24045000100	1	$39,138.00
24045000200	2	$49,827.00
24045000300	3	$28,841.00
24045000400	4	$37,552.00
24045000500	5	$38,572.00
24045010102	101.02	$56,584.00
24045010300	103	$82,890.00
24045010400	104	$51,683.00
24045010501	105.01	$60,680.00
24045010502	105.02	$39,605.00
24045010701	107.01	$58,197.00
24045010800	108	$69,055.00

Source: Vulnerability Assessment created for this document with data from Wicomico County GIS

CHAPTER 6: DISCUSSIONS

Sustainability is and will continue to be an elusive concept studied by numerous professionals in a myriad of disciplines. At its core, the term means to continue on into the future. How to take this concept and apply it to any community is difficult and has created division politically. While this term elicits an emotional response from individuals, communities, states, and so forth, the geographic and planning literature determine that sustainability is the combination of economic, environmental, and social fortitude in the face of changing conditions. One of those complicating and changing conditions is climate change. In particular, sea level rise will be affecting the coasts of every continent, but those impacts will be realized differently among the different nations, states, and communities. While there are numerous studies defining sustainability, to be used generically, and many more studies detailing sea level rise impacts at different geographic scales, there has been little discussion of how sea level rise complicates the already wicked task of striving for sustainability.

The purpose of this dissertation has been to enhance the knowledge of sustainability by linking sea level rise effects and impacts to sustainability concerns through the lens of equity. This research focuses firstly on social sustainability, or equity, as this pillar of sustainability has received little attention in the literature. This research also focuses on the disconnect between sea level rise and sustainability science, as the two topics are treated as mutually exclusive in the literature. The last focus of this

research is to shed light on how analyzing sustainability at the local scale is important in order to operationalize sustainability for the community.

With these foci in mind, the research started by asking what are community values and attitudes surrounding sustainability and sea level rise on Maryland's Eastern Shore. By analyzing sustainability for a larger geographic region, the context for sustainability planning was set to allow for a focused case study of one county, Wicomico County. Secondly, this research asked whether Wicomico County is concerned with sustainability and/or sea level rise and if the issues are linked. Allowing community members to add input as to what sustainability means for their community and discussing sea level rise concerns allows the community to be at the center of sustainability. Lastly, this research asked what complications sea level rise brought to Wicomico County's sustainability. By providing a base level vulnerability analysis, based upon indicators matching community attitudes and values, issues that link sustainability and sea level rise can be exposed. The remainder of this chapter will be organized to allow for in-depth discussions for each research question posed above.

6.1 Research Question 1: Community Values and Attitudes

The starting point in this research is to determine the overall attitude surrounding sustainability planning for the Delmarva Region of the United States. Only three (3) of eight (8) plans included sustainability in over 50 percent of its comprehensive planning document; however, the data show that with more current updates to the comprehensive plans, the more sustainability is included in the plan's language, Figures 5 and 6. It would be reasonable to deduce, then, that the counties in Delmarva are increasingly

aware of sustainability concerns for their region and will continue to improve upon their plans, adding necessary language to help guide sustainable futures.

When breaking down sustainability, it was determined that the three pillars of sustainability, environmental, economic, and social sustainability, are not handled in an equal manner, Figure 7. There is a heavy bias in the planning documents toward social sustainability. This bias is largely due to the fact that comprehensively planning for the future inherently includes discussion on social equity issues. For instance, while there is no literature surrounding inter-species equity in geography or planning, it scored very well in the content analysis due to the State of Maryland requirements for endangered species and habitat protection, Figure 8. In addition, numerous plans mention their responsibility to the Delmarva Region, whether it be in transportation, services provided, educational opportunities, natural open spaces, or the inclusion of their county in scenic byways and reserves, allowing for higher than anticipated scores for geographic equity.

While the sustainability scores show that not every subset of social sustainability is handled with the same attention, nor are the three pillars handled with the same attention, I believe that the plans do show a balance in sustainability that reflects the priorities of each county. For instance, Wicomico County's Comprehensive Plan mentions of social sustainability broke down to 45 percent geographic equity, mainly focusing on the importance of the County as a hub for shopping, education, and transportation, which is a high priority for Wicomico County, Figures 7 and 8. However, Cecil County showed a higher inclusion of procedural equity (50%), with only seven (7) percent mention of geographic equity, reflecting that Cecil County does not have the

same function for Delmarva in terms of the economy, but can instead focus on internal procedural issues.

Similarly, Queen Anne's County shows that 46 percent of its sustainability mentions referred to environmental sustainability issues, Figure 7. The County also handles a lot of traffic from the Chesapeake Bay Bridge and boat traffic all over its inlets. The increase in this traffic has helped to boost development and creates a priority for environmental protection amidst the development pressures. Therefore, the County focuses more on those environmental issues and protecting its natural beauty as necessary.

Worcester County, the eastern most county in Maryland bordering the Atlantic Ocean, scores highest for social sustainability at 52 percent and lowest for economic sustainability at 11 percent, Figure 7. Worcester County is home to Ocean City, Maryland, one of the largest tourist destinations in Maryland. Economic development is not necessarily an issue for this county; however, there is a small year-round population that has different needs from the seasonal residents, offering up more priority for social sustainability issues. In addition, there is a 38 percent inclusion of environmental sustainability, which is largely important because their economy is based upon its location and environmental amenities.

Sea level rise was mentioned in comprehensive planning documents in less than five (5) percent of the four documents addressing the issue, with four (4) plans not mentioning it at all (Cecil, Dorchester, Somerset and Talbot Counties), Figure 5. With little mention of this phenomenon, there cannot be a direct link drawn between sea level rise and sustainability concerns. The results shed light on the fact that while awareness on

sustainability increases, the same cannot be said for sea level rise, which constitutes a sustainability issue. There exists a disconnection between sustainability and sea level rise that should be addressed comprehensively at the local planning level to ensure that residents, elected officials, and the like, can all come together to tackle issues being as informed as possible about future complications.

Therefore, we can conclude that while the communities value the inclusion of sustainability concerns into their comprehensive plans, they may not share that same value for sea level rise concerns. Each county has made its own priorities, based upon public participation and its own unique characteristics. It stands to reason, then, that each county will address sustainability in different manners and pay more attention to one pillar over another, including different priorities within each pillar. This research supports the theory, as even the three counties that include sustainability more substantially in their plans, Queen Anne's County, Talbot County, and Wicomico County, do not share the same focus in addressing sustainability. It is fair, however, to state that all counties could improve upon their inclusion of sea level rise issues.

6.2 Research Question 2: Wicomico County, Sustainability, and Sea Level Rise

In order to determine whether Wicomico County residents, in particular, are concerned about sustainability or sea level rise, a survey was used to gather individual perceptions. The results of the survey show that residents do care about sustainability, defining the term as planning for the future generation and maintaining and balancing our resources, Table 7. The residents felt that positive social interactions and environmental quality are extremely important to sustainability, with economic development being only somewhat important to sustainability, Table 7. However, while residents stated that they

were making their lifestyles more sustainable (72%), they also had no plans for mitigating sea level rise on their properties (88%), highlighting the disconnect between sustainability and sea level rise concerns, Tables 7 and 9.

One possible connection between sustainability and sea level rise concerns can be potential flooding events. Seventy (70) percent of Wicomico County respondents state that they were concerned with sea level rise-related flooding, while only 54 percent were concerned with sea level rise in general. Since flooding is likely to increase due to sea level rise, and will likely be the first experienced impact of sea level rise, this response is not surprising. However, of the Wicomico County survey participants, 13 percent stated they lived in a flood zone, while only nine (9) percent said they had federal flood insurance. In addition, 25 percent stated that they were unsure if flood insurance was required on their property.

These results show that people are concerned about an increase in flooding and that residents may not be aware of flooding issues. The fact that there are less respondents that had flood insurance than lived in a flood zone is a red flag highlighting a problem in flood and flood insurance knowledge and information. Adding the other respondents that were unsure about their flood insurance requirements further emphasizes this issue. The confusion may stem from a lack of information during the home buying process or because of changing flood zones. However, this survey highlighted an issue that should be addressed sooner than later through planning outreach and education, especially with the added complication of sea level rise on current flood levels.

While these results show that residents are more concerned about sustainability than sea level rise, the demographic makeup of the survey respondents highlight potential

social sustainability issues as well. No information on the demographic makeup of those that attended the comprehensive planning meetings was obtained, however, Wicomico County survey respondents provided basic demographic feedback, where about 90 percent of respondents are white. There is less than 10 percent representation of the black community. This result highlights the potential for biased results due to race, however, without further information concerning the planning document creation, this assumption cannot be confirmed. However, it is fair to say that social and procedural issues should be investigated further to determine if there is racial bias in outcomes of sustainability and sea level rise awareness research.

6.3 Research Question 3: Wicomico County's Vulnerability to Sea Level Rise

Perception of sustainability and sea level rise risk shows little concern over sea level rise in general and does not directly link it with sustainability. This is quite interesting as the vulnerability analysis of Wicomico County, in reference to sea level rise, shows impacts to environmental, social, and economic indicators. For instance, seven (7) existing greenways are in the one-foot sea level rise inundation zone, increasing to nine (9) with a one-meter rise, while roughly 10,000 acres of Targeted Ecological Areas, roughly 15,000 acres of Rural Legacy Areas, and the one Natural Heritage Area are all within the one-foot inundation zone, Figures 15, 16, 17, and 18. While the vast majority of Chesapeake Bay Critical Area for Salisbury and Wicomico (99% and 93%, respectively) is in the one-foot inundation zone, that is to be expected as the critical areas are designated as significant to the health of the Chesapeake Bay and its tributaries, Figure 19. However, these critical areas will be re-drawn if significant sea level rise inundates the existing areas. Likewise for the other indicators, as new boundaries will

have to be drawn where necessary, limiting available land for farming and/or development.

Social indicators such as poverty rates, racial composition, open spaces for social gatherings, and the number of people possibly affected were calculated. There is the potential for roughly 100 people to be at risk for a one foot rise in sea level and about 280 people at risk for a one meter rise in sea level, both numbers are less than one percent of the total population of the County. It is also important to note that 10 of the 12 census tracts that may exhibit sea level rise impacts are more than 50 percent white, with only one (1) census tract having a majority of black residents. However, four (4) of the 12 census tracts have a poverty rate of more than 25 percent. This may not constitute a racial minority issue, but having one third of possibly affected census tracts rating poverty levels higher than 25 percent would constitute a social issue and present an opportunity for outreach.

As per the economic indicators, five (5) of 12 major shopping destinations are within the sea level rise inundation zone of one-foot, along with 21 road segments, five (5) railroad segments, and 144 buildings, Figures 10, 11, 12, and13. When sea level rise is based on the highest level of rise, a one-meter inundation zone increases the road segments to 26 and the number of buildings to 325. While these numbers are not necessarily significant in and of themselves, it is important to understand that if transportation systems are a high priority for Wicomico County, having any road or rail segment(s) possibly affected by sea level rise constitutes an issue that needs further attention. Add in the possible economic impact of flooding in businesses and buildings,

causing loss of revenues and possible repair costs, and the costs for potential remediation increases.

However, perhaps one of the largest impacts, with road segments potentially inundated on both of the major road systems, Salisbury Parkway/Ocean Gateway/US 50 and Salisbury Blvd./Ocean Highway/US 13, there is a chance that evacuation routing will be disturbed. Currently, US 50 and US 13 are the two major transportation routes for evacuating residents out of the Delmarva Region. Having any interruption in the roadways could be potential for traffic congestion and slow evacuation time, potentially having harmful effects for not just Wicomico County residents, but any resident who needs to pass through the area, i.e. residents of Worcester County. More research into elevation of the roadway in areas of possible inundation is needed to ensure any bridgework is elevated above sea level and associated flood levels.

These results show that while the citizenry of Wicomico County is concerned about sustainability, but not necessarily sea level rise, sea level rise has the potentially to affect sustainability negatively. Potential routing issues trump the list, however, there is the potential for social equity issues associated with low-income residents in areas with increased vulnerability, particularly in the City of Salisbury. These issues should highlight the need for comprehensive planning at the local level to ensure that residents, elected officials, and the like, can all come together to tackle these vulnerability issues.

Together the whole of this research is merging a comprehensive planning document, resident perceptions and real scenarios to account for sustainability and sea level rise concerns. There exists a disconnect between what is known about sustainability and sea level rise in public perception, opening up future iterations of the comprehensive

plan for more inclusion of sea level rise specifically as a sustainability issue. The scenarios show that the largest potential impacts from sea level rise are related to the transportation industry, which can affect the local economy, but also affect possible evacuation routes, should the two major roadways be impassable. While a lot of natural areas are in an inundated zone, these land uses are the most appropriate as increased development in the inundation zones would only increase the amount of people and property likely affected. Socially, however, the research shows that while there is a good understanding of species equity and geographic equity, general social and procedural equity could be improved in Wicomico County, starting with public education on potential flooding and the flood insurance program, as well as outreach into minority and poverty areas.

CHAPTER 7: CONCLUSIONS

The purpose of this research is to provide a broad approach to analyze sustainability perception and the inclusion of sea level rise as a sustainability issue within a coastal community. Sustainability research has focused on environmental issues or economic issues, to a lesser degree, and has not discussed social sustainability or how that relates to real world concerns. This research contributes to the sustainability literature by addressing social sustainability and sea level rise issues comprehensively. By analyzing comprehensive plan documents for the inclusion of social sustainability, equity issues become a key factor in the research. Social sustainability is further emphasized through a survey, requesting public opinion about sustainability and sea level rise. And finally, while vulnerability analyses can focus on indicators that are economic or environmental in nature, these indicators can also shed light on possible social sustainability issues, such as poverty regions being at risk for sea level rise. This research offers an example of how to analyze social sustainability, in conjunction with, and without compromising, the other pillars, which are also addressed.

Through the content analysis and survey, this research offers support for the earlier assumption that there is a disconnect between sea level rise and sustainability. Natural hazards researchers have been studying climate change for decades and planners have been studying sustainability planning for the same period of time, but seldom do the paths cross. This disconnect is evident not just in the literature, but in public perceptions that show sustainability is accepted by residents and included into comprehensive

planning documents. There is still a healthy skepticism regarding climate change and sea level rise, as evidenced by the survey results, that further emphasize this point. However, the vulnerability assessment highlights areas of concern where sea level rise could negatively affect Wicomico County's sustainability. Stressing this disconnect and the associated potential impacts will allow for researchers to recognize and work together to bridge this gap.

This research focuses on one county to highlight the importance of scale. While sustainability should be studied at every level, it is difficult to operationalize sustainability at a large level, where the new policies and performance measures are representative of the whole. For example, while all of the counties on Maryland's Eastern Shore discuss sustainability, it is noted that many counties focus on one pillar of sustainability over another, or even focusing down to one aspect of social sustainability over others. Each of these counties recognizes that they are part of a larger region, but they all have individual priorities that need to be addressed. For this reason, studying sustainability planning, with hopes for implementation, needs to be handled at the local level so as not to disregard a significant factor for one county, in order to discuss issues for the whole.

These outcomes fill some gaps in the literature related to social sustainability, climate change and sustainability planning, and scale. However, this research also offers offers ample opportunity for future research into specific issues. The vulnerability analysis uncovers areas that need further examination, such as how evacuation routing may be affected by sea level rise and how poverty areas should prepare for climate change. The survey exposes the confusion concerning flood zones and flood insurance,

likely due to changing flood zone boundaries. In addition, the content analysis for comprehensive plans reveals that inter-species equity, a subcategory of social sustainability that has received little to no attention in the literature, has been addressed quite well in comprehensive plans for Maryland's Eastern Shore counties.

Perhaps one of the most important findings is how the local regions are taking the lead in sustainability planning. While the sustainability literature focuses on generating a definition of sustainability that planners can operationalize, planners in these communities have taken it upon themselves to include sustainability as a concern for future growth. Instead of procuring a definition prior to action, the counties are establishing priorities and working toward a more sustainable future, without regulation from the State of Maryland, from the bottom-up.

It is important to note that political climate is a significant limiting factor on this research. While this research may to be applied to various coastal communities internationally, the political atmosphere will determine how this methodology is ultimately applied. The United States has a democratic government, which allows for community outreach and participation in planning endeavors. Participation is highly valued in the US planning field. That being said, there was a low response rate for the self-administered attitude survey. This low response rate could be due to a lack of connection between the purpose of this research and outcomes likely to affect the residents; perhaps if this research was carried out in conjunction with the local government, participation would have increased. This research was kept separate from the local government to ensure that outcomes were not biased toward the local government agenda. However, because this exercise was kept separate from official

planning carried out by the local government, perhaps the residents did not take this exercise seriously.

In addition, the research received its own political perceptions applied. Wicomico County is known as a relatively conservative area, skeptical of liberal science, as evidenced by survey participants stating they only moderately trusted or did not trust climate change science. In particular one survey participant stated on their survey that "Liberal [scientists] waste too much public money chasing their own agendas. Enjoy all of the "free" grants those of us that work/produce for a living pay for."

Finally, this research focused upon one coastal community to analyze perceptions in their comprehensive planning documents and resident's opinions, comparing those with a vulnerability assessment based on sea level rise scenarios. Future work would broaden the geographic scope and compare similar local entities internationally, allowing for a better understanding of the spatial relationship in perceptions of sustainability and sea level rise.

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APPENDIX A: WICOMIOC COUNTY SEA LEVEL RISE & SUSTAINABILITY SURVEY

Date

Dear Wicomico County Resident:

The attached survey is part of a research study being conducted by Robyn M. B. Stuber as part of her doctoral research at the University of North Carolina at Charlotte (UNC Charlotte). This research project, entitled "Planning at Sea Level: An Analysis of Perception," seeks to understand how public perception shapes concepts of sustainability in reference to sea level rise.

If you are a resident of Wicomico County who is over the age of 18, you are eligible to participate in this study. You were selected at random to participate in this survey. This survey should take from 10 to 30 minutes to complete.

Please read through this letter and sign the consent signature and then complete the survey. If you wish to be involved in any future research, please provide us with your preferred contact information and sign the additional form. Place the forms and the survey into the pre-paid return envelope and post by **June 8th, 2012**. Once this is complete, your participation in the study has ended, unless otherwise noted.

You participation will benefit the research and will allow for researchers and policy-makers to understand the community values and opinions about sea level rise and sustainability. As compensation for your time, the signed consent form will be entered into a random drawing for one $25.00 Target gift card. The winner will be randomly selected and notified by mail.

All information about your participation, including your identity, is completely **confidential**. The survey will be coded based upon geographic region (East, West, Metro Core), and contain no other identifiable information. The consent form will have the same code as the survey and require your name and signature. This form will be filed separate from the survey response and will be saved on a secured storage device. The information will only be used to notify the gift card recipients. If you would like to participate in future research, the information given to the investigator will be linked to your survey, but filed separately and on a secured storage device to ensure confidentiality. There are no foreseeable risks associated with participating in this study, aside from a possible breach of confidentiality; however, the measures described above should prevent such an occurrence.

Thank you for your time and consideration for the research survey attached. If you have any questions or concerns, please contact the principal investigator, Ms. Robyn M B Stuber, at rbyers12@uncc.edu.

Sincerely,

Robyn M. B. Stuber,
Principal Investigator

CONSENT SIGNATURE FORM

You are a volunteer. The decision to participate in this study is completely up to you. If you decide to be in the study, you may stop at any time. You will not be treated any differently if you decide not to participate in the study or if you stop once you have started.

UNC Charlotte wants to make sure that you are treated in a fair and respectful manner. Contact the university's Research Compliance Office (704-687-3309) if you have questions about how you are treated as a study participant. If you have any questions about the project, please contact Ms. Robyn M. B. Stuber (rbyers12@uncc.edu).

This form was approved for use on January 4th, 2012 for a period of one year.

"I have read the information in this consent form. I have had the chance to ask questions about this study, and those questions have been answered to my satisfaction. I am at least 18 years of age. I agree to participate in this research project. I understand that I will receive a copy of this form after it has been signed by me and the principal investigator of this research study."

_____

Participant's name (PRINT)

_____

Participant's signature & date

_____

Investigator's signature & date

Wicomico County
Sea Level Rise and Sustainability Survey
December, 2011

Part 1 – Your Environment
Please circle your answer for each question, unless otherwise stated.

1. Do you live in a flood zone?

   Yes No Don't Know

2. Do you have flood insurance?

   Yes No

3. If "Yes" to Question 2, does flood insurance give you peace-of-mind in case of a major flood?

   Yes No

4. Are you required by law to have flood insurance?

   Yes No Don't Know

5. Have you experienced flooding within the last five years?

   Yes No

6. If you answered "Yes" on Question 5, how did flooding affect your property (i.e. your home, your yard only, both your home and yard, your business, etc.)?

   _____
   _____
   _____

7. Do you live on waterfront property?

   Yes No

8. If you answered "Yes" on Question 6, do you have hard shoreline protection (i.e. bulkhead, rip rap, sand bags, etc.)?

   Yes No

9. Is your property elevated five (5) feet above sea level?

   Yes No

10. How worried are you about saltwater intrusion into public drinking water supplies?

Not worried		**Moderately worried**		**Extremely worried**
1	**2**	**3**	**4**	**5**

Part 2 – Sustainability

The term "sustainability" is widely used in the popular media and news. Its meaning can vary between users. Please circle your answer for each question, unless otherwise stated.

1. Do you have a clear idea or concept of what is meant by "sustainability"?

   Yes No

2. If you answered "Yes" on Question 1, in your own words, what is meant by "sustainability"?

   _____

   _____

   _____

3. How important is economic development to fostering sustainability in this community?

Not important		**Moderately Important**		**Extremely important**
1	**2**	**3**	**4**	**5**

4. How important are positive social conditions to fostering sustainability in this community?

Not important		**Moderately Important**		**Extremely important**
1	**2**	**3**	**4**	**5**

5. How important is environmental quality to fostering sustainability in this community?

Not important		**Moderately Important**		**Extremely important**
1	**2**	**3**	**4**	**5**

6. In your opinion, how sustainable is Wicomico County?

Unsustainable				**Sustainable**
1	**2**	**3**	**4**	**5**

7. At the present time, are you making efforts to make your lifestyle more sustainable?

Yes No

Part 3 – Global Climate Change
Please circle your answer for each question.

1. How worried are you about global climate change?

Not worried		**Moderately worried**		**Extremely worried**
1	**2**	**3**	**4**	**5**

2. Do you trust the science that has identified and studied the impacts of climate change?

Distrust				**Trust**
1	**2**	**3**	**4**	**5**

Part 4 – Sea Level Rise
Please circle your answer for each question, unless otherwise stated.

1. How concerned are you that sea level is rising owing to climate change?

Not concerned/Skeptical		**Moderately concerned**		**Extremely concerned**
1	**2**	**3**	**4**	**5**

2. How concerned are you that flooding from coastal storms will increase due to sea level rise?

Not Concerned/Skeptical		**Moderately concerned**		**Extremely concerned**
1	**2**	**3**	**4**	**5**

3. Have you noticed a receding or increasing shoreline?

Yes No

4. Do you feel sea level rise will significantly affect Wicomico County?

Yes No

5. Do you know if your property is potentially in a flood zone provided the sea level does rise?

Yes No

6. Do you feel that the City/County government is taking adequate measures to protect residents from sea level rise impacts?

   Yes No

7. Have you planned or taken actions to mitigate sea level rise and associated flooding?

   Yes No

Part 5 – Background Information
Please circle your answer for each question, unless otherwise stated.

1. Age: _____
2. Occupation: _____
3. How long have you lived in Wicomico County? _____ months, _____ years
4. How long have you resided in your current home? _____ months, _____ years
5. Do you rent or own your home?

   Rent Own

6. How would you classify your racial/ethnic background?

   Caucasian African-American Hispanic

   Asian Multi-racial Other

   I prefer not to answer

7. What is the highest grade of school or year of college in which you received credit?

   0-11 years of school High School/GED Some College

   Bachelors Degree Graduate degree I prefer not to answer

8. What is your total household gross income?

   Less than $20,000 $20,000 - $39,999 $40,000-$59,999

   $60,000-$79,999 $80,000-$99,999 $100,000-$149,999

   $150,000+ I prefer not to answer