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Murrells Inlet Assessment 2021

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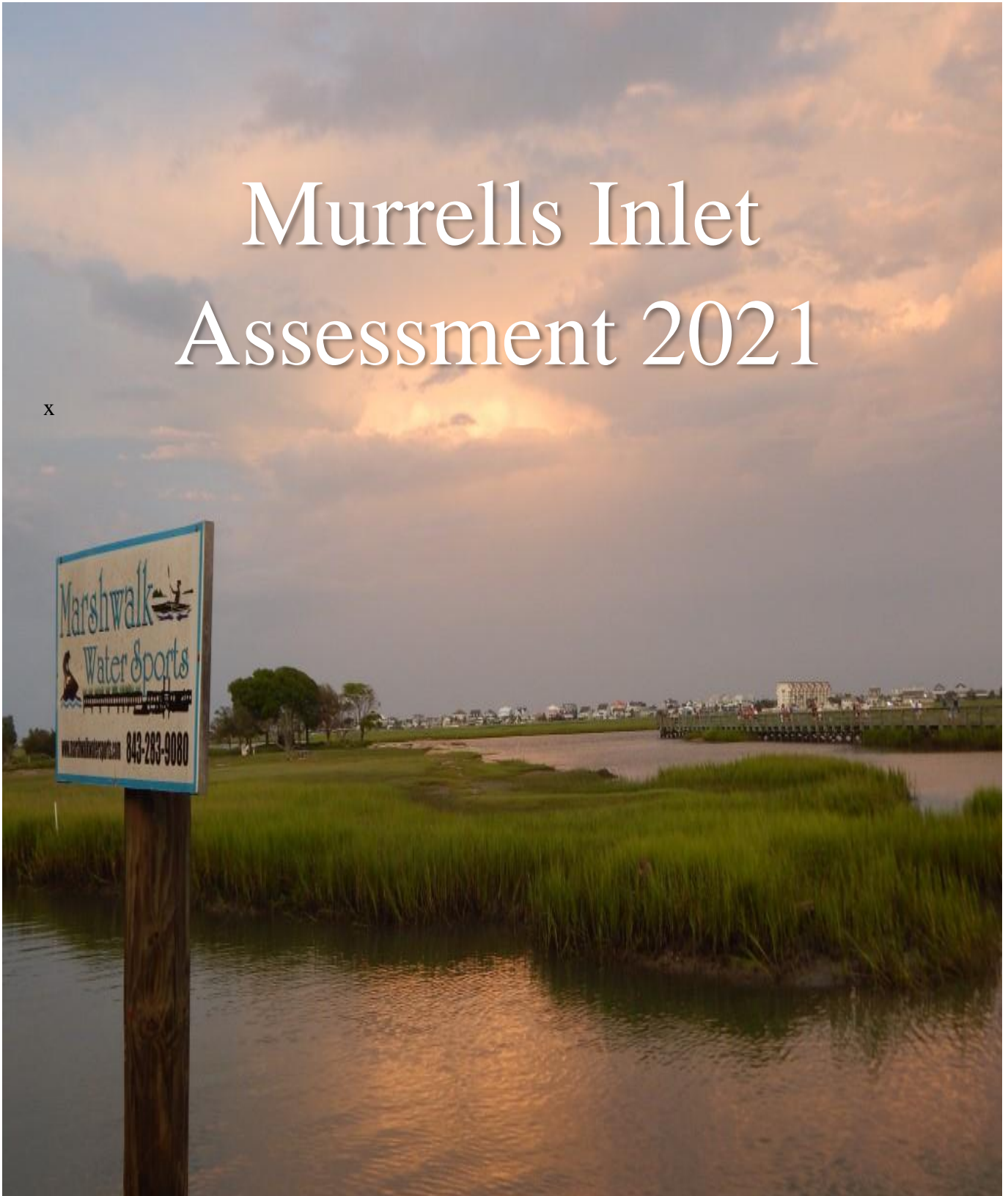
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COASTAL CAROLINA UNIVERSITY

Murrells Inlet Assessment 2021

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INTRODUCTION

Assessment Question:

How does the environment impact the quality of life in Murrells Inlet?



Inlet Princess off the coast of MI Jetties. August 2015. Photo taken by Julia Angell.

Community

The community of Murrells Inlet is built upon a balance of residents and tourists. Both groups of people typically have one thing in common, loving the water culture. In Murrells Inlet it is not unusual for the community to engage in water sports, fishing, or relaxing by the water. The culture and Environment here are what draw tourists in, and as of lately, drawing them to stay here.



Crazy Sister Marina on the Marshwalk. August 2015. Photo taken by Julia Angell.

Economy

Murrells Inlet is home to a variety of local restaurants, businesses, and shops. These businesses support the local economy and bring in tourists to enjoy the area. The Marsh Walk at Murrells Inlet is where the local economy meets nature in a blend of local food, live music, small-businesses, and the view of the marsh.



Wildlife in Murrells Inlet. August 2015. Photo taken by Julia Angell.

Nature

Murrells Inlet has an abundance of wildlife despite the urbanization that has taken place. Some of the species here can be found on protected land such as Huntington Beach State Park and Brookgreen Gardens. With a growing population, the wildlife located within Murrells Inlet have faced loss of habitat. As ecosystem health worsens due to human-coastal impacts, these species must learn to adapt and overcome the issues caused by both residents and tourists.

UNIT OF ANALYSIS AND SCALES



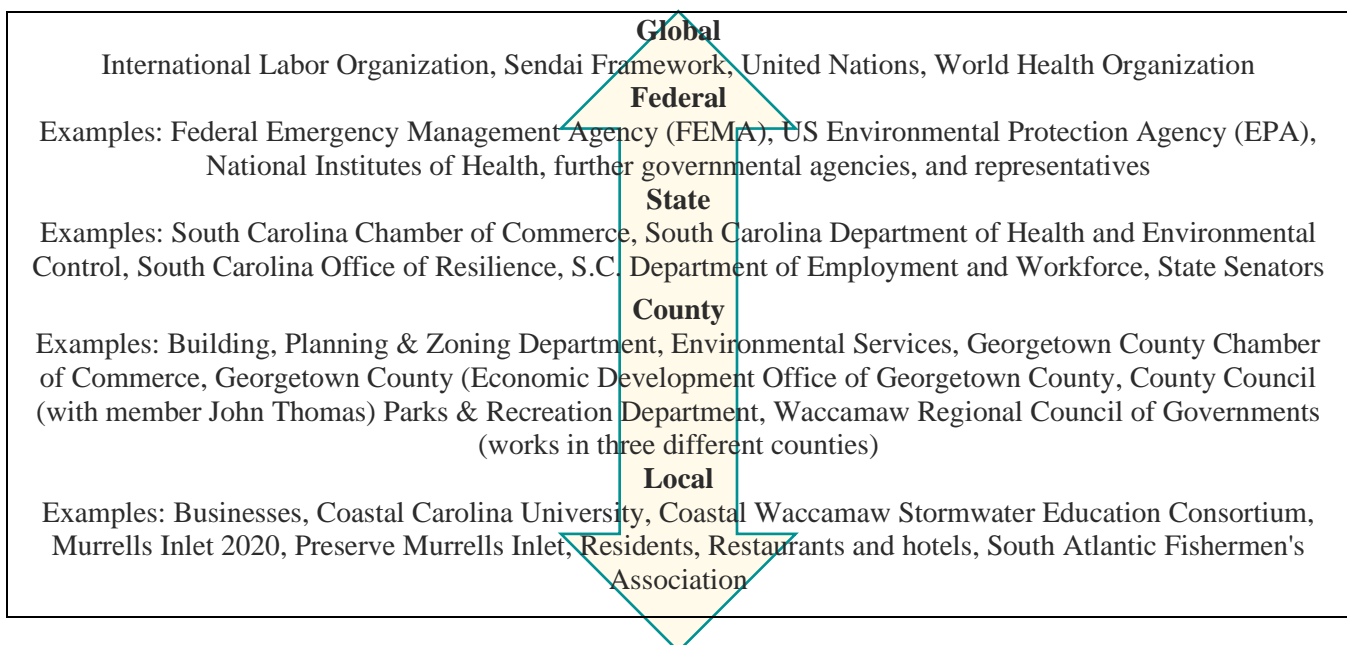
Figure 1. The orange parameter represents the unit of analysis focused on and the blue parameters are the Murrells Inlet Watershed.

UNIT OF ANALYSIS:

We completed our research based on boundary lines outlined in the figure above. We examined from the South end of Murrells Inlet, where the tip meets the ocean connecting it to Huntington Beach State Park. The boundary then travels up to Sunnyside Avenue to the right of Highway 17 and upwards going east towards the beach connecting to Waccamaw Drive.

SCALES:

The community of Murrells Inlet is impacted by diverse levels of scales in all regions; this refers to the natural, social, and economic aspects of the area. On a local level, organizations and businesses influence the local economy. Georgetown County and the state level both influence policy. The federal government plays an influential role in policy and funds.



The organizations and people listed here merely constitute an overview rather than a complete list of the diverse actors in Murrells Inlet.

METHODOLOGY

TOOLS

A variety of tools were used to assess aspects of Georgetown County and, more specifically, the Murrells Inlet area. The list below is the main tools that helped focus the study but is *not* conclusive of everything used.

- National Oceanic and Atmospheric Administration, Sea-Level Rise Viewer
- National Fish and Wildlife Foundation, Coastal Resilience Evaluation and Siting Tools
- South Carolina Department of Health and Environmental Control, Environmental Maps (ArcGIS)
- Headwaters Economic Tools
- Climate Resilience Toolkit
- US Census Data and Dashboards
- Official Reports and statistics published by Georgetown County
- Newspaper articles and information published by private and/or tourist institutions and organizations

*All tools and methods were utilized from August 2021 through October 2021.

*Interviews and phone calls were conducted in November 2021.

*Photographs throughout the report were taken from August 2015-November 2021.

*AirQ Software will provide data linking air pollution with specific health effects, helping to drive policy responses. New monitoring stations are planned for urban areas.

METHODS

To achieve a representative picture of all aspects of sustainability relating to Murrells Inlet, extensive research was conducted by all group members. To triangulate data and resolve possible questions arising from the data several interviews and personal observations were conducted. Additionally, phone calls with several offices of the State Senate in Columbia clarified open questions, for example, the revenue and fiscal affairs office and research department.

Prior to this final report, four preliminary reports on specific subtopics were written:

- September 9, 2021: Overview of the Social, Economic, and Environmental Connections and Challenges in Murrells Inlet
- September 30, 2021: Problem Statement, Unit of Analysis and Empirical Evidence
- October 19, 2021: Disaster Risk Reduction

FRAMEWORK

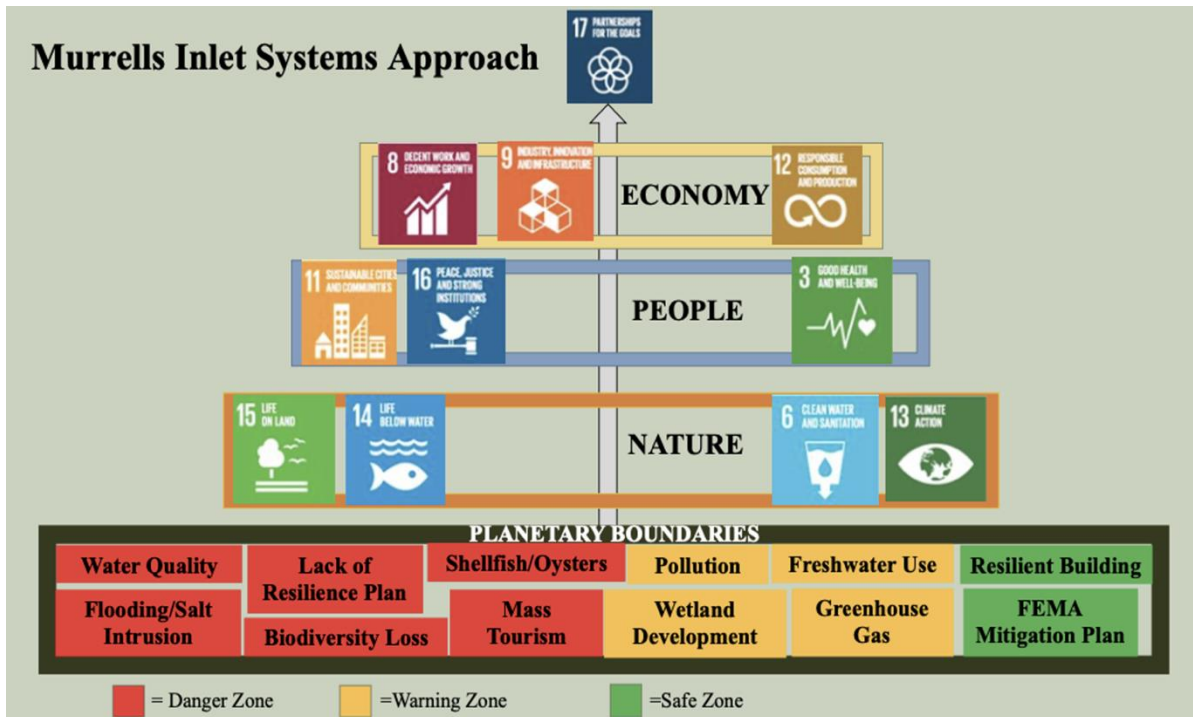


Figure 2. The Murrells Inlet Systems Approach. Designed to show how our group connected SDGs to nature, people, and the economy of Murrells Inlet. Planetary boundaries relate to topics touched upon throughout the report.

Through our research and study, we have connected our findings in the Murrells Inlet community to several of the Sustainable Development Goals (SDGs) and organized the focused area into a pyramid framework. At the basis of our framework lies nature, as quality of life and business success relies on a location of environmental health. After nature lies people, this refers to tourists, residents, and recently moved residents. The economy refers to local businesses, job opportunities, and economic growth. With a healthy relationship between each of these levels, the community can have the potential to meet criteria for a sustainable future.

Planetary Boundaries: Each of the areas highlighted represent an issue or occurrence in the community. Red marks areas that, through our research, we have deemed danger zones that need attention. Yellow marks warning zones that are experiencing a decline in health or are causing negative effects on the community. Green marks positive attributes that the community has already adopted.

Nature: For the natural framework of Murrells Inlet, we completed and connected our research to the following four SDGs: Life on Land (#15), Life Below Water (#14), Clean Water and Sanitation (#6), and Climate Action (#13). Each of these goals tie into and impact the natural atmosphere and ecosystems of the area.

People: The people aspect of our framework relates to the community of Murrells Inlet, balancing residents, and tourism. We connected our research to the following three SDGs: Sustainable Cities and Communities (#11), Peace, Justice, and Strong Institutions (#16), and Good Health and Well-Being (#3).

Economy: Economy sits at the top of our framework pyramid and relates to the local economy and business that tourism brings into the community, and the impact of locals on the community. We connected our research to the following three SDGs: Decent Work and Economic Growth (#8); Industry, Innovation, and Infrastructure (#9); and Responsible Consumption and Production (#12).

SDGs OVERVIEW

SDG	EXPLANATION	CONNECTION
#3- Good Health & Well Being	Ensure healthy lives & promote wellbeing for all, at all ages	The state of the estuary, and businesses built upon its beauty, rely on the area to be of sound health to continue to provide for the community
#6- Clean Water & Sanitation	Ensure availability & sustainable management of water sanitation for all	Polluted runoff causes wetland degradation, affects shellfish efficiency, and worsens water quality
#8- Decent Work & Economic Growth	Promote sustained, inclusive, & sustainable economic growth, and full & productive employment, & decent work for all	High concentration of businesses alongside the Marsh Walk cause pollution. New development in the areas will lead to wetland development
#9- Industry, Innovation, & Infrastructure	Build resilient infrastructure, promote inclusive & sustainable industrialization& foster innovation	Past development has led to wetland degradation
#11- Sustainable Cities & Communities	Make cities & human settlements inclusive, safe, resilient, & sustainable	Communities modeling SDG success can be used as examples
#12- Responsible Consumption & Production	Ensure sustainable consumption and production	Eutrophication of estuary from food industry businesses, pollution of single-use plastic, and run-off
#13- Climate Action	Take urgent action to combat climate changes and its impacts	Sea level rise is leading to salt intrusion and flooding. An overdevelopment of wetlands leads to the decrease of natural mitigation strategies such as filtration, carbon absorption, and biodiversity formulation
#14- Life Below Water	Conserve and sustainably use the oceans, sea, and marine resources for sustainable development	Oyster and estuary health, wetland development, and water quality
#15- Life on Land	Protect, restore, & promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat forestation, and both half and reverse land degradation and biodiversity loss	Huntington Beach State Park and Brookgreen Gardens are sanctuaries for flora and fauna, both native and exotic
#16- Peace, Justice, & Strong Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, & build effective accountable and inclusive institutions at all levels	Forming unity and inclusive spaces fosters policy formation and progress
#17- Partnerships for the Goals	Strengthen the means of implementation & revitalize the global partnership for sustainable development	Implementation of policies and laws leads to sustainable community & progress

ENSURE HEALTHY LIVES AND PROMOTE WELL-BEING FOR ALL AT ALL AGES

Target(s)	Indicator(s)
3.8 Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality, and affordable essential medicines and vaccines for all	<p>.1 Coverage of essential health services (defined as the average coverage of essential services based on tracer interventions that include reproductive, maternal, newborn and child health, infectious diseases, non-communicable diseases and service capacity and access, among the general and the most disadvantaged population)</p> <p>.2 Proportion of population with large household expenditures on health as a share of total household expenditure or income</p>
3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination	<p>.1 Mortality rate attributed to household and ambient air pollution</p> <p>.2 Mortality rate attributed to unsafe water, unsafe sanitation, and lack of hygiene (exposure to unsafe Water, Sanitation, and Hygiene for All [WASH] services)</p>



Boats near the Marshwalk, October 2021. Photo taken by Anastasia Gluth.

Murrells Inlet is known as the “seafood capital of South Carolina” and where one can also find nature and relaxation. One of the top tourist destinations offering numerous activities and luxuries for those wanting to explore the natural surroundings The Marsh is surrounded by commercial and residential properties, accessing retail stores, restaurants, and outdoor activities.

Crazy Sisters Marina located at the end of the Marsh Walk, is well known for its fishing charters, local cruises, jet skiing kayaking, eco-tours and some dolphin watching. Commercial fishing is an important part of the culture and economy of the area. A fleet of independent commercial fishing boats anchors in the Marsh behind the restaurants and fishes the waters of the Gulf Stream for local and regional customers. Deep sea tournaments launch regularly from the Marsh, and inshore fishing is also a popular activity.



The Inlet Princess off the coast of Murrells Inlet., September 2015. Photo taken by Julia Angell.

Murrells Inlet hosts two continually active public boat launch facilities accommodating freshwater and saltwater navigation. Boaters can be seen regularly navigating the waters of the Intracoastal Waterway/Waccamaw River from the public boat launch adjacent to Wacca Wache Marina, or the Marsh and Atlantic Ocean from the public boat launch adjacent to Belin United Methodist Church any time of year (Murrells Inlet, 2014). The cultural importance of the salt marsh is reflected in SC Department of Natural Resources commercial fish catch records. Ninety-eight percent of all spots documented in the state are caught in or around Murrells Inlet, 30 percent of all flounder, and 23 percent of all snappers.

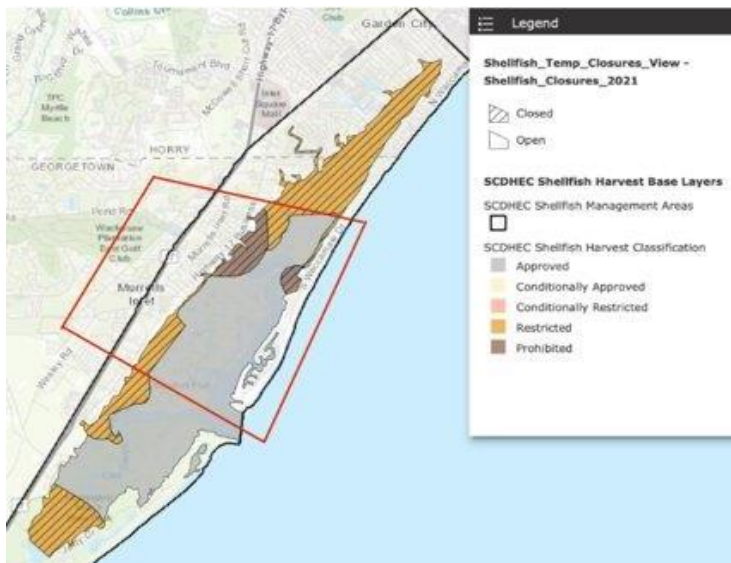
Morse Park Landing can be a hidden gem for some the marsh views are breathtaking, there are crabbing docks, a boat launch, and a memorial. The “Lost at Sea” monument is a place where sailors and fisherman who have lost their lives can be honored. The Murrells Inlet Marsh Walk for some time has been another popular tourist destination and a place where locals like to spend their evenings after a long day of work. There are numerous seafood restaurants and at several you can listen to live music as well. As you stroll along the path you will notice most if not all the restaurants offer indoor and outdoor seating. This is because when coming to the Inlet most want to enjoy the beauty of the marsh and even have the chance of spotting a dolphin or two.

ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL

Target(s)	Indicator(s)
<p>6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally</p>	<p>.1 Proportion of domestic and industrial wastewater flows safely treated</p>
<p>6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers, and lakes</p>	<p>.1 Change in the extent of water-related ecosystems over time</p>

When it comes to sanitation and clean water in Murrells Inlet, heads turn towards the toxicity that runoff water drains into our estuaries and rivers. Shellfish contamination is something that Murrells Inlet has dealt with for years. Due to high levels of toxicity many of the areas in the estuary are prohibited or restricted, though there is still a good portion that is approved for shellfish harvesting (ArcGIS, 2019). With oysters struggling to thrive due to prominent levels of polluted water, MI is losing a natural attribute to help regulate and filter water within the estuary.

A challenge that has been monitored for a century has been shellfish consumption and their toxicity levels. Most of Murrells Inlet is closed to shellfish harvesting due to contamination. Murrells Inlet falls under Shellfish Growing Area 04, where a portion of our region is restricted (area class 4-R) or prohibited (area class 4-P) for shellfish harvesting. While we have many areas that are restricted, there is a larger percentage that is approved and open for harvesting (area class 4-A) (ArcGIS, 2019).



Garden City Connector Marsh, September 2021. Photo taken by Julia Angell

In the 1970's Murrells Inlet's water quality had an elevated level of fecal bacteria, which was the initial reason shellfish harvesting faced closure. Murrells Inlet was then added to the Clean Water Act's Federal List of Impaired Waters in the 80's and was further approved by SC DHEC in 2005. Today there are still best management practices being performed to better the water quality (Watershed-based plan - Coastal Carolina University, 2020). Fecal pollution appears to be deposited into Murrells Inlet from urban areas through stormwater runoff. Other possibilities of contamination could be due to boats or manufacturing sewage collection systems (Kelsey, et al., 2003).

Figure 3. Shellfish Closures in Murrells Inlet. Legend shows which areas are approved, prohibited, and restricted. The red box indicates our focus area of Murrells Inlet (SCDHEC, 2021).



PROMOTE SUSTAINED, INCLUSIVE AND SUSTAINABLE ECONOMIC GROWTH, FULL AND PRODUCTIVE EMPLOYMENT AND DECENT WORK FOR ALL

Target(s)	Indicator(s)
8.1 Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 cent per gross domestic product growth per annum in the least developed countries	.1 Annual growth rate of real GDP per capita
8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labor-intensive sectors	.1 Annual growth rate of real GDP per employed person
8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small-, and medium-sized enterprises, including through access to financial services	.1 Proportion of informal employment in non-agriculture employment
8.9 By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products	.1 Tourism direct GDP as a proportion of total GDP and in growth rate

Economic development and growth (Target 8.1) functions as a critical component of Georgetown County's Comprehensive Plan (Richardson, 2012). Economic aspects influence Murrells Inlet across different spheres of life, and directly tie to the natural environment (Tourism Works, 2021). An estimated 4.9 million tourists generated \$1.2 billion (about \$4 per person in the US) of revenue (CCU Center for Economic and Community Development, 2013). The economic value of the marsh is difficult to estimate. Many numbers, such as revenues of small businesses, are not public for reasons of privacy and because of incomplete Census data or specifically dedicated state research (Roberts, 2021). The CCU Center for Economic and Community Development (2013) estimated it around \$720 million, which includes restaurant sales, real estate, boating, channel navigability, and tourist attractions. In 2012, the total accommodation and food services sales 2012 amounted to \$49,974,000 (US Census Bureau, 2020), 39 percent of which was generated by restaurants on the marsh. The local accommodation and hospitality tax is estimated to amount to \$4.8 million from July 2021 to June 2022, underlining the relevance of tourism for the local economy and public revenue (Georgetown County Council, 2021). With a per capita income of \$37,007, Murrells Inlet even superseded the US average of \$34,103, and the South Carolina average by even \$5,000 more (US Census Bureau, 2020).

A balanced geographic distribution of new industry locations and the area's economic growth will be necessary to achieve less concentration on the Marsh Walk as the sole economic driver (Goldfinch, 2021). A focus on small businesses is important for Murrells Inlet, since 557 out of a total of 944 organizations, businesses and establishments had less than 5 employees in 2019. Out of the 944 businesses in total, 106 were in the construction sector, 138 in retail trade, and 78 active in real estate and rental (US Census Bureau, 2021). At 5.9%, the unemployment rate in 2019 was 1% higher than in 2011. Sales and related occupations take up 21% of the total workforce in Murrells Inlet (Deloitte Ltd, Datawheel LLC, 2019).

The relevance that is given to tourism in Murrells Inlet (Target 8.9) is exemplified by the construction of the 435-foot long Jetty View Walk in 2013. It was funded through a partnership between Georgetown County and Murrells Inlet 2020, totaling \$189,135. Both the Jetty View Walk and the Marsh Walk aim at increasing the tourist attractiveness of Murrells Inlet. In April and July 2021, the county invested \$144,458 in reparations of the Marsh Walk (Georgetown County, 2021a). Moreover, the significance of Murrells Inlet as a tourist hub is mirrored in the Murrells Inlet Revitalization Fund. The Fund has been specifically established "for the revitalization of Murrells Inlet. Funding is used to repair, replace, and otherwise improve the Marsh Walk and beach walkovers as needed" (Georgetown County, 2021b, p.180).

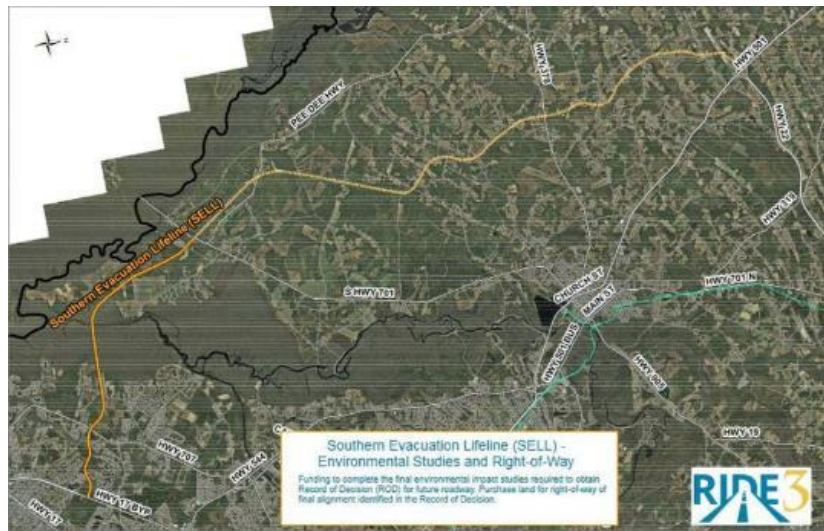
Analyzing the Georgetown County budget (July 2021-June 2022), clear tendencies become apparent. Even though certain expenditures in the 9.04% culture and recreation function flow towards tourism and cannot clearly be separated from budget allocations toward economic development, economic development is planned to only receive 1.28% (Georgetown County Council, 2021). This is an indication for a lack of focus on SDG 8.

Overall, while Murrells Inlet's economic growth over the last years has enabled a strong current position, a stronger emphasis on sustainable and eco-friendly tourism (target 8.9) is necessary to decouple economic growth from environmental degradation. Targets 8.2 and 8.3. comprise higher levels of economic productivity, a focus on high-value added sectors and policies for business-oriented growth. All these are supported by the state government. The aim is to create higher-paying jobs in the area and enhance the business environment, especially for small businesses.

Target(s)	Indicator(s)
<p>9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all</p>	<p>.1 Proportion of the rural population who live within 2 km of an all-season road .2 Passenger and freight volumes, by mode of transport</p>
<p>9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities</p>	<p>.1 CO2 emission per unit of value added</p>

Murrells Inlet and Garden City Beach have attracted many retirees in the recent decade, a trend that should continue as more of the baby boomer generation prepare for retirement. Within Murrells Inlet, there have been increases in residential real estate valuations of properties on the marsh by at least \$194 million. The impact on the area is evidenced by the recent expansion of the Georgetown Hospital System with the addition in 2002 of the new Waccamaw Community Hospital located in Murrells Inlet. The four-story, 236,000 square feet (about twice the area of a Manhattan city block), the 167-bed facility was designed to accommodate the growth of the region and is already in the middle of another expansion. (Deloitte Ltd, Datawheel LLC, 2019).

Population growth is another factor. Overpopulation of the area led to overdevelopment, too many boats, much more disturbance to wildlife, and it is quite frankly slowly pushing away the nature of the area. “There are a few of us left that remember its history... There are some things that have gotten better; the amenities, the Marsh Walk, all that is great. Interesting, great good and a great nightlife, but at the end of the day, it’s created in an environment that has fostered the growth of the Inlet, and that’s a terrible thing.” (Interview Stephen Goldfinch) Murrells Inlet is falling out of touch with nature, which is what attracts most of the tourism and is also the identity of the town.



Southern Evacuation Lifeline, October 2021. Article by Samantha Kummerer.

Southern Evacuation Lifeline (SELL)

A bridge across the river out of Murrells Inlet, a project that has been on the agenda for the last 20 plus years. There are some environmental concerns with the project, so it seems the two parties are once again in a stalemate. The entire project is a 28-mile-long highway that would be mainly constructed to help residents evacuate. The main concern with the project is that the road would be very close to wildlife preserves, including the Waccamaw National Wildlife Refuge, the Waccamaw River, and Winyah Bay. This is precisely why the Coastal Conservation League had opposed the project for so long. The proximity of the road would cause great disturbances to the local wildlife that is supposed to be protected around those areas. (Coastal Conservation League 2021) “It is virtually impossible to go from Murrells Inlet to Myrtle Beach in the summertime, but the bridge would greatly improve the quality of life.” (Goldfinch, 2021) It would give the ability to the people that live and work in Murrells Inlet to live in less densely populated areas and still commute to work, as affordable housing is becoming an issue. (Goldfinch, 2021) The two sides need to come together to find a long-term solution that would benefit the people and the nature, because working harmony is the only solution.

Using the Multi-Resolution Land Characteristics Consortium (MRLC) maps were created to show how land coverage has changed from 2001 to 2019. The National Land Cover Database (NLCD) provided the data to create the figures below.

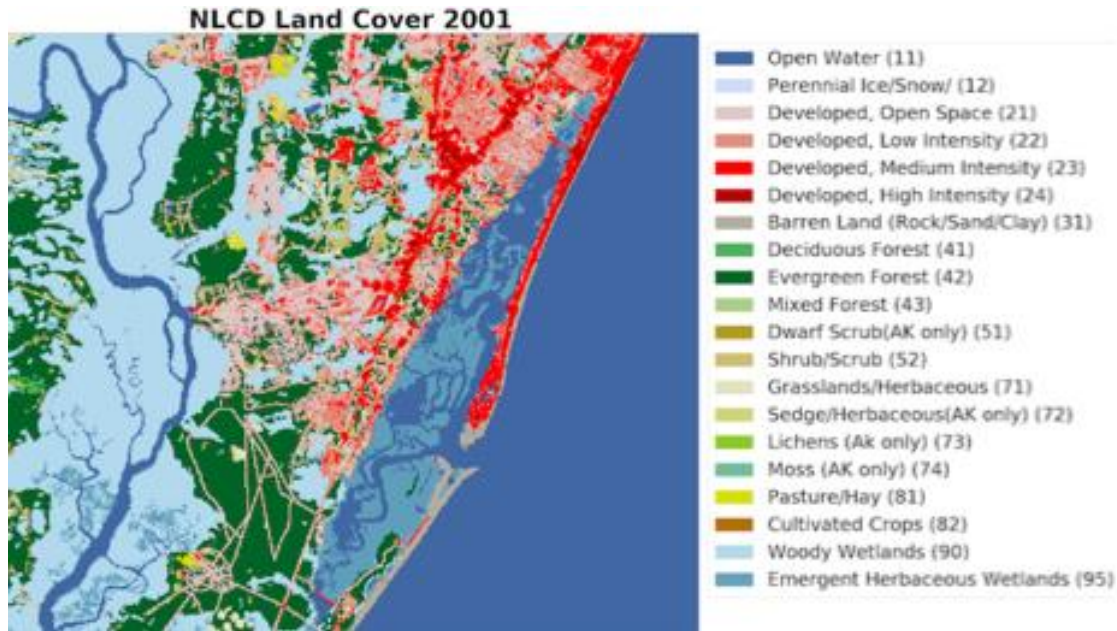


Figure 4. Murrells Inlet: Even Closer NLCD Land Cover 2001 (Golland, 2021).

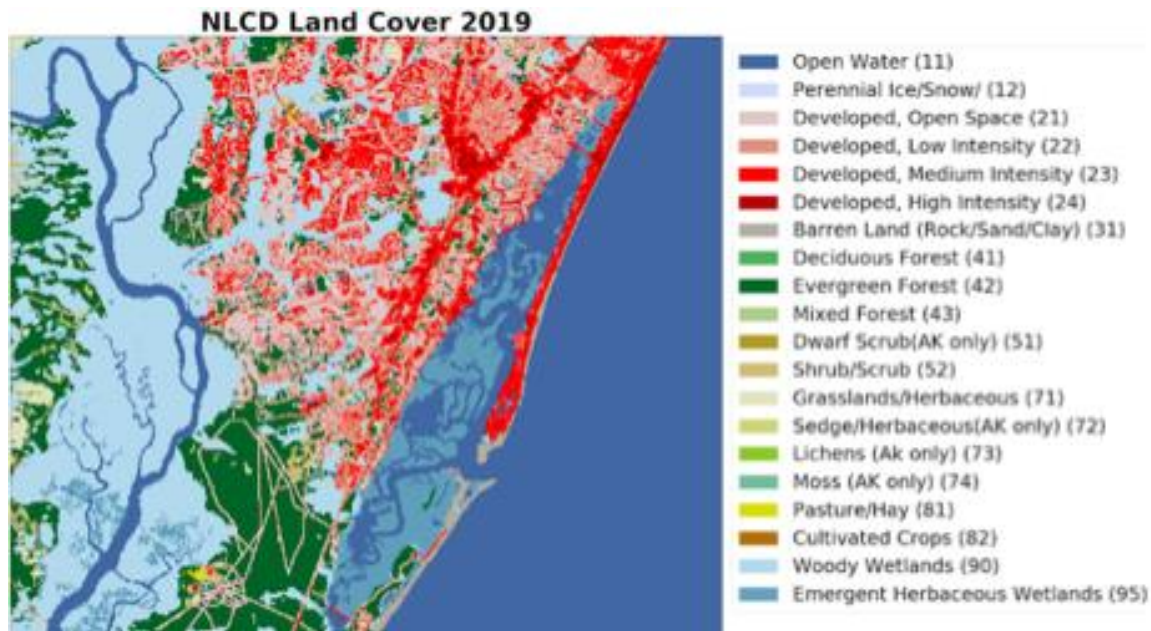


Figure 5. Murrells Inlet: Even Closer NLCD Land Cover 2019 (Golland, 2021).

When looking at and comparing the two figures above a clear change can be noticed. **Figure 5.** Shows an increase in development drastically different to **Figure 4.** Regardless of the development intensity a majority of the deciduous, evergreen, and mixed forest have no turned red when looking at the key on the right and the figures.

Impervious Land Coverage

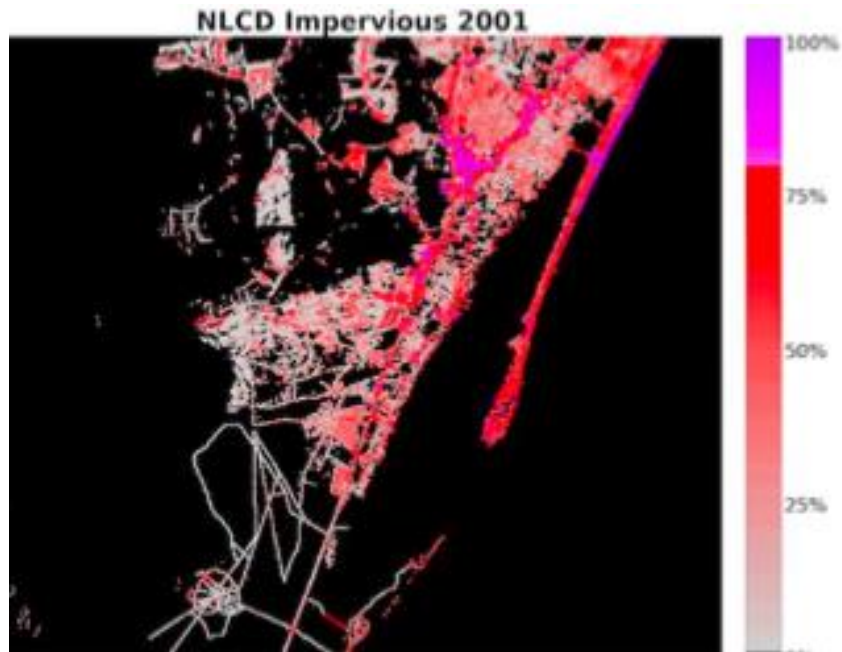


Figure 6. Murrells Inlet: Even Closer NLDC Impervious by percentage 2001.

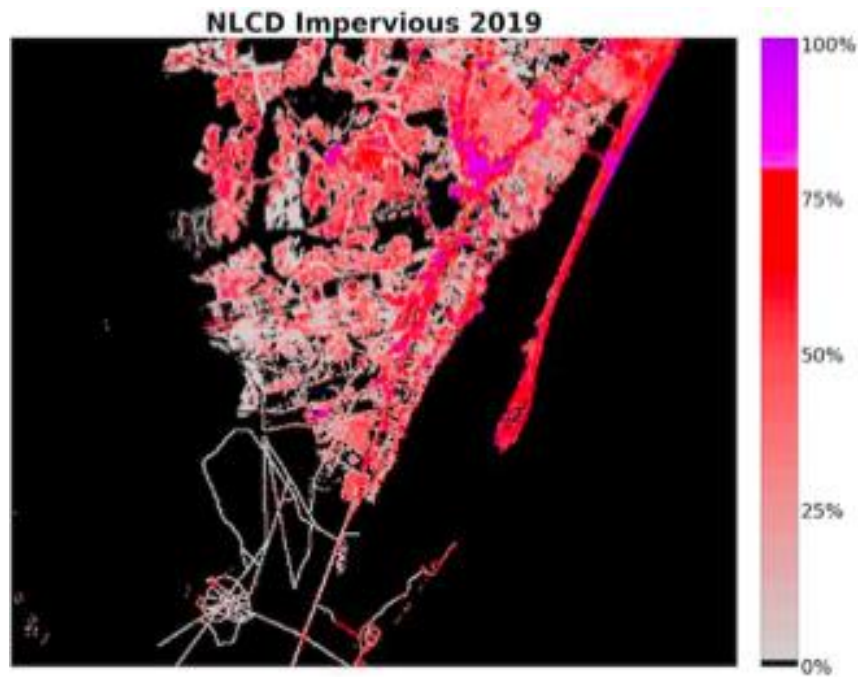


Figure 7. Murrells Inlet: Even Closer NLDC Impervious by percentage 2019.

Shown above in both **Figure 6**. And **Figure 7**. Urban Imperviousness is represented to show surface development by percentage. When comparing the two figures the amount of coverage has changed in developed areas around Murrells Inlet. In 2001 the developed areas were not as abundant, looking at 2019 the developed areas have increased because of all the red and purple areas that have spread across. These figures clearly show how much development has occurred overtime.

Target(s)	Indicators(s)
<p>11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated, and sustainable human settlement planning and management in all countries</p>	<p>.1 Ratio of land consumption rate to population growth rate .2 Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically</p>
<p>11.5 By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations</p>	<p>.1 Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population .2 Direct economic loss in relation to global GDP, damage to critical infrastructure and number of disruptions to basic services, attributed to disasters</p>

Best Practice Example: Grimma (Germany)

Targets 11.3 and 11.5 include sustainable city planning as well as the reduction of economic, natural, and other losses from natural disasters. For this section, a best practice example from a German community with similar characteristics is introduced as an additional resource for Murrells Inlet. This helps to inspire a foundation for discussions on concrete action plans in the home community (NOAA, 2021a).

Grimma is a town in eastern Germany, more specifically in the state of Saxony (Municipality of Grimma, 2021). It was chosen as a best practice example in relation to Murrells Inlet for its many similarities and relatable disaster risks concerning flooding. First, it is comparable by size and median income. With a population of 28,127 (2020), it is a medium-sized town and part of Leipzig County (State Statistical Office of Saxony, 2020). Additionally, with ruins of a historic monastery, a castle, several museums, and its proximity to Leipzig and the lake district Neuseenland as well as a hiking and biking areas, tourism plays a significant role in the local economy. Grimma's urban culture and old town are closely related to the town's river, the Mulde.

The shore silhouette is formative for the self-image of the city, just like the Inlet is for Murrells Inlet (Municipality of Grimma, 2021).

However, and most importantly for the comparison with Murrells Inlet, Grimma's location in the widened valley of the Mulde river, where several streams unite, puts the town in a constant and substantial risk of flooding (Technical University of Dresden, 2011). And just like Murrells Inlet, Grimma has very recently experienced heavy floods. In the so-called HQ 100 century flood in Germany in August 2002 (a flood that statistically appears every 100 years), the Mulde rose to its highest level ever measured, flooding Grimma's old town up to 3.50 m high (Technical University of Dresden, 2006). Almost 700 houses as well as all bridges were damaged or destroyed, one person died (Technical University of Dresden, 2011).



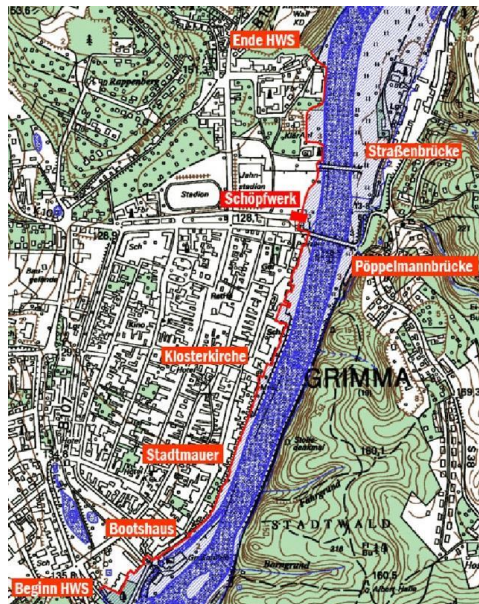
Best Practice Example: Grimma (Germany)

The most concrete and extensive measure in the resilience concept mentioned on page 15. was the construction of a 1.3 mile long and due to the permeable subsoil also up to 46 ft deep flood protection enclosure/wall, one of the largest flood protection projects in the State of Saxony to date (State chancellery Saxony, 2019). To find a suitable construction variant, the city of Grimma was recreated on a scale of 1:50 (187 by 82 ft), the largest physical model ever studied for flood protection in Saxony, and the model was flooded. To ensure that the natural groundwater flow can be maintained from the inland to the basin, a groundwater communication system was built, including wells, drainage strings, outlet pipes and pumps (State Dam Administration of the Free State of Saxony, 2019). The construction has 78 unique closure elements that take 1.5 hours to close, the largest gate is 7 by 13 ft. Every year, the construction is rehearsed for an emergency and checked (Schulte, 2021). It was constructed from 2007 to 2019. The goal was to integrate flood protection into the landscape with as little disturbance as possible, considering the opinions of residents, organizations, and businesses (State Dam Administration of the Free State of Saxony, 2006).

Additionally, Grimma installed 6 warning sirens which were credited as one reason for no reported injuries in the 2013 flood. The sirens will continue to function for up to seven days after power is cut and give clear information and instructions, not just a warning sound. A camera showing the exact water level of the Mulde is online 24 hours. All residents have been asked to leave their contact information with the town hall, who reach out in case of danger, and post on social media. In case of a risk situation, the local TV station Muldetal-TV immediately stops its regular transmission and continuously updates residents. Furthermore, a height determination of a house's front door threshold at residential or commercial buildings can be requested in the city. That way, each person can easily determine at which level of the trough there is an immediate danger of water penetration for the building (Municipality of Grimma, 2020).



Flood Protection Wall Grimma (Municipality of Grimma, 2021)



Flood Protection Wall (red line) Grimma (Municipality of Grimma, 2021).

A total of around \$65 million was invested in flood protection in Grimma, financed by the European Regional Development Fund, funds from the State of Saxony and the federal government (State Dam Administration Free State of Saxony, 2019). And even though, unfortunately, the wall's construction had not been finished when the flood of 2013 hit the city, all other measures proved to be efficient. With prior experiences, the city was cleaned within only five days, the evacuation happened far quicker, and no one was injured (Schulte, 2021). In some cases, however, the only possible solution was the relocation of business premises as well as residential homes, for example a historically important paper production company that had been located on the river shore for almost 200 years (Municipality of Grimma, 2021).

Although Murrells Inlet faces different circumstances and conditions in many ways and will require quite different solutions, the case of Grimma is meant to serve as an inspiration and example of how the process and collaboration towards SDG 11 can unfold in a concrete example, as Murrells Inlet still lacks an adequate resilience plan. In Germany, Grimma is considered a role model for the establishment of a resilience plan after a natural disaster (Municipality of Grimma, 2021).

Best Practice Example USA: Virginia Eastern Shore

The example of Grimma exemplified a process towards a resilience plan that Murrells Inlet could use as an impulse. To additionally show a concrete example for possible next steps in Murrells Inlet, the example of the Virginia Eastern Shore will now be presented briefly.

The areas encompassed a narrow peninsula which separates the Atlantic Ocean from Chesapeake Bay. It is home to 60 miles of undeveloped barrier islands with hundreds of plant and animal species, especially raptors, songbirds, and shorebirds. Like in Murrells Inlet, natural beauty defines the local culture, as well as the economy, as it is a significant tourist attraction in the area and an important economic engine for the region (The Nature Conservancy, 2021a).

Simultaneously, however, people in the region heavily depend on nature, and have experienced many problems due to rising sea levels and extreme weather events, such as storms. The shoreline is one of the US's more vulnerable coastal regions.

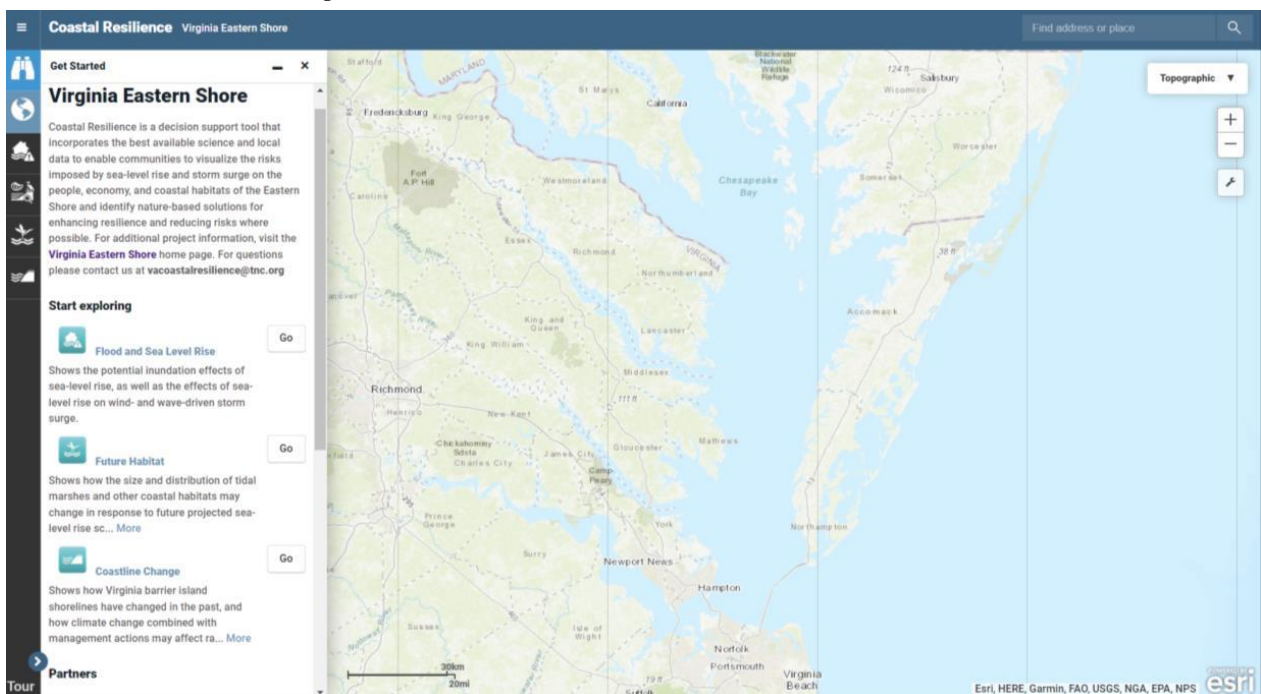
With projections of a mean sea level rise of between 4.5 to 7 feet by 2100, sea levels are rising at three to four times the global average. However, most of the formerly implemented measures were reactive rather than proactive. Unreliable and incomplete data and information sources made it difficult for communities and public authorities to



Virginia Eastern Shore Mapping and Decision Tool, Screenshot (The Nature Conservancy, 2021a).

To eliminate this first barrier, the Nature Conservancy and a consortium of partners including the Accomack-Northampton Planning Commission, University of Virginia, and NASA-Wallops Flight Facility, have developed the Virginia Eastern Shore Mapping and Decision Support Tool. It provides local governments with many relevant data points as well as projections, for example Flooding and Sea Level Rise or future habitat predictions (The Nature Conservancy, 2021a).

Taking into consideration the lack of adequate and complete data of natural hazards and threats in Murrells Inlet, a similar research project seems a great option. The Nature Conservancy even does provide data for Horry and Georgetown County already, as well as Myrtle Beach, but no specific research on Murrells Inlet is available yet.



Oyster castles, one concrete example of a measure on the Eastern Virginia Shores are these establishments (The Nature Conservancy, 2021c).

Target(s)	Indicator(s)
12.3 By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses	.1 (a) Food loss index and (b) food waste index
12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling, and reuse	.1 National recycling rate, tons of material recycled
12.7 Promote public procurement practices that are sustainable, in accordance with national policies and priorities	.1 Degree of sustainable public procurement policies and action plan implementation

Responsible consumption and production have many complex layers which relate to many important aspects in Murrells Inlet, such as tourism, water quality, wildlife, and economy.

The restaurants and other buildings indirectly affect the estuary, even if they might not realize it. Eutrophication can come from not just runoff, but also food waste. This is extremely dangerous as it can make the water uninhabitable for sea life to live in. Our food, which is often treated with pesticides or insecticides (fruits and veggies), and hormones and antibiotics (meat) has shown to cause elevated toxicity in marine life. The obvious solution is to decrease food waste, especially fishery waste thrown into the seas. However, that might not be viable in every case. An estimated 52% of seabirds are dependent on scraps from fisheries (Yusuf, 2021). This is to show that even something small such as throwing excess fish remains back in the ocean can have an unnatural impact on the wildlife of the area.

Murrells Inlet has a Staffed Horry County Convenience Center for Recycling on McDowell Shortcut Road. The Georgetown County Recycling Center is on Wesley Road. Since Murrells Inlet does not have a local government, actions such as beach clean-ups are often conducted by volunteers (Murrells Inlet 2020, 2021). Fines have decreased over the years and even at that, the fines rarely get enforced. Providers of sustainable and ecotourism, such as kayak tours or bird watching adventures, have been growing in the Inlet over the past decades (Murrells Inlet, 2014). However, an analysis of main events and activities taking place on the Marsh Walk in 2021 reveals a focus on mass events that intend to draw as many visitors to the Inlet as possible, even though smaller events focusing on the



Oyster beds at The Marshwalk, October 2021. Photo taken by Anastasia Gluth

environment or art are also relevant. Reviewing major events hosted throughout the year can help to understand focal points in the Inlet’s tourism activities. Bigger events with loud music led to more consumption of To-Go containers and more pollution into the estuary. This leads to wildlife consumption, suffocation, or entanglement due to plastic debris. In addition to wildlife consumption of plastic, this leads to toxins and carcinogens being absorbed into the ecosystem and traveling down the food chain to human consumption.

One problem for SDG 12 in Murrells Inlet is the lack of available data to measure targets. For example, target 12.5 (by 2030, reduce waste generation through prevention, reduction, recycling, and reusing) is difficult to quantify for Murrells Inlet. No studies on waste generation, especially on the Marsh Walk, are available publicly. One indicator, suggested by the UN, could be a recycling rate, or businesses’ obligation to measure their data as well.



TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS

Target(s)	Indicator(s)
13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries	.1 Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population .2 Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030
13.2 Integrate climate change measures into national policies, strategies, and planning	.1 Number of countries with nationally determined contributions, long-term strategies, national adaptation plans and adaptation communications, as reported to the secretary of the United Nations Framework Convention on Climate Change

The Natural environment interacts with everything from living to non-living, and numerous benefits are formed. The solution to these benefits starts with having a better understanding about the nature of the problem and what may be causing significant impacts on the natural ecosystems.

Adapting natural systems to help respond to future climate change impacts will require renewed focus on agricultural, natural resources, and ecosystem management techniques. Understanding and incorporating biodiversity and ecosystem services into all aspects of planning is essential to ensure that plans, polices, and guidelines that support conservation and development practices are in harmony with the natural environment. An interdisciplinary approach is necessary due to the scale and complexity of the issues. Planners will need to consult with experts and practitioners in ecosystem management, agriculture, forestry, and public health to develop effective plans to guide development that is in harmony with nature and that will help combat climate change (American Planning Association, 2021, 17). The marshes and mangroves that replace inundated forests and farmland are considered among the most valuable ecosystems in the world because they improve water quality, reduce coastal erosion, protect against flooding, sequester carbon, and support marine fisheries. Coastal sustainability in the face of sea level rise involves rapidly moving ecosystem boundaries and complex trade-offs between the direct and indirect values of different land uses (Feagin, 2010).

Barriers are supposed to separate an area like a marsh/estuary and the human population/businesses or another land region to not only protect the natural environment but making sure one ecosystem does not blend into the next like a salt marsh mixing with a freshwater marsh. When there are barrier removals whether it be accidental or intentional the breach can cause significant impacts that may drown the wetland, an example being saltwater intrusions which create ghost forest.

The creation of ghost forests and the wholesale reorganization of ecosystems begins with more subtle changes that can be anticipated with a deeper understanding of the ecological processes that link sea level rise and land conversion. In the initial stages of groundwater salinization, live trees may exhibit reduced sap flow and annual growth, although reduced growth is not always observed. During the next phase of ghost forest formation, forest distress becomes more visible. Young trees die conspicuously and tree recruitment ceases. Because recruitment ceases prior to the death of mature trees, the tree age distributions skew towards older trees at lower elevations and relict trees stand as ghost forests in-waiting. Salt-tolerant species establish in the understory as adult trees die, aided by increased light penetration and seed delivery from storm wrack deposits. Shrubs often dominate the transition from forest to tidal wetland (Kirwin, 2019, 452). Dead trees underlined by wetland vegetation are a striking final indicator of uplands that have been displaced by sea level rise and saltwater intrusion.



Brookgreen Gardens, January 2021. Photo taken by Julia Angell.

Long-time residents have observed many distinct landscape changes over the years. As an example, prior to the construction of the jetties in the late 1970s there were two entrances into the main creek of Murrells Inlet (Douglass, 1985). Locals also have noticed many changes on a much shorter timescale. Several tidal creeks have become shallower in recent years, caused by sedimentation deposited by tributary creeks and from shoreline erosion. Army Corps of Engineers studies also indicate that the tidal exchange and sediment pathway exchange between the Murrells Inlet estuary and the Atlantic Ocean has been altered because of the construction of the jetties (US ACE 2002) (Waccamaw Regional, 2014).

Tree Canopy Scales



Figure 6. Murrells Inlet: Change in Tree Canopy 2011. (Golland, 2021).

When looking at **Figure 8**, you can see deep shades of green throughout the tree canopy coverage from that year. Then we look at **Figure 9**, there is a gradient change in color, the green is lighter showing a change in coverage over a 5-year period. This is more than likely due to several factors; salt intrusion, flooding, and deforestation to create new roads and buildings etc.

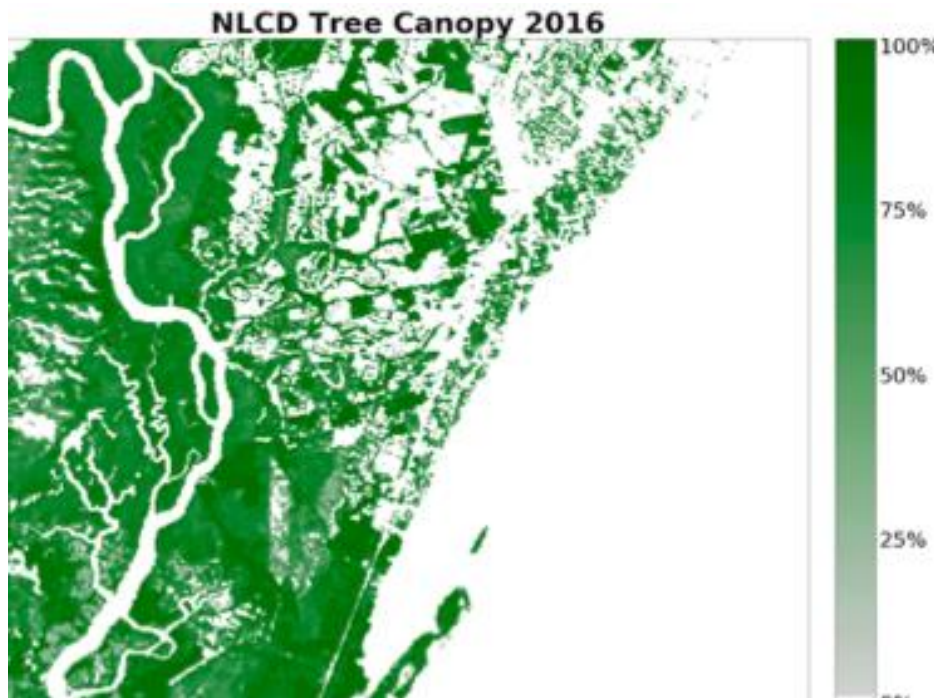


Figure 9. Murrells Inlet: Change in Tree Canopy 2016. (Golland, 2021).

Even though it may not look like there are huge differences there are changes in coverage when looking at the formation and shift of white space to green space.



CONSERVE AND SUSTAINABLY USE THE OCEANS, SEA AND MARINE RESOURCES FOR SUSTAINABLE DEVELOPMENT

Target(s)	Indicator(s)
14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution	.1 (a) Index of coastal eutrophication; and (b) plastic debris density
14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	.1 Number of countries using ecosystem-based approaches to managing marine areas
14.3 Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels	.1 Average marine acidity (pH) measure at agreed suite of representative sampling stations
14.4 By 2020, effectively regulate harvesting and end overfishing, illegal, unreported, and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics	.1 Proportion of fish stocks within biologically sustainable levels

Shellfish harvesting is one of the most popular fishing aspects in Murrells Inlet. In particular, the American oyster *Crassostrea virginica* is widely focused on within the estuary. Not only are oysters desired as a seafood element, but they also play a key role as a regulate for marine estuaries. Oysters create habitats for other crustaceans, fish, bivalves, marine mammals, and seabirds. While they create a great habitat for these species, as of 2005 they have faced degradation and decline due to coastal development, local dredging, and runoff disturbing the natural habitat. Coastal Carolina’s Environmental Quality Lab (EQL) involves monitoring spots throughout the estuary by measuring pH, salinity, dissolved oxygen rates, and other data related to the inlet’s health (Coastal Carolina Environmental Quality Laboratory, 2021). In turn to the large decrease in natural oyster beds, the SCDNR proposed a series of restoration methods are listed as follows:

1. Expand shell recycling efforts in the Murrells Inlet region
2. Evaluate the status of oyster beds in Murrells Inlet and prioritize areas most suitable for habitat restoration
3. Use recycled shells to establish large scale restoration sites, particularly targeting areas closed to shellfish harvesting
4. Monitor the success of restored areas
5. Utilize the SCORE program to involve citizens in hands-on activities

In Georgetown County as a whole, commercial fishing plays a significant role in not only the economy, but with the culture. The fishing economy in Georgetown County is supported by wetlands due to the high biodiversity they have to offer. Revenue is not only brought in by commercial fishermen, but by recreational and charter fishing as well (NOAA, 2020). Fish need proper water conditions to thrive, without the help of oysters regulating water quality it could impact fishing, which is a livelihood for some Murrells Inlet locals.

Commercial Fishing	County	State
Jobs	107	797
Output from Businesses	\$2.2 million	\$13.4 million
Revenue from Self-employed	\$3.7 million	\$21.9 million

Table1. NOAA Wetland Benefits, the revenue that both county and the state bring into Georgetown County and South Carolina state in commercial fishing

Huntington Beach State Park acts as a shell drop-off station and happens to be the most popular station in the state. Various restaurants from the Marsh Walk in Murrells Inlet participate in the shell drop-off station and have a sticker they place that establishes that “We participate in SCDNR’s Oyster Shell Recycling Program, you should too!” influencing others to bring their shells to help build artificial reefs. All shells brought to this drop-off are repurposed into rebuilding the Murrells Inlet estuary. More than 249 oyster beds have been identified and 145 of those were categorized as new, due to older reefs branching off (Anderson et al, 2005). Murrells Inlet has implemented these practices to keep the biodiversity flourishing, and in turn help fishermen have the resources they need to keep themselves in business.



PROTECT, RESTORE AND PROMOTE SUSTAINABLE USE OF TERRESTRIAL ECOSYSTEMS, SUSTAINABLY MANAGE FORESTS, COMBAT DESERTIFICATION, AND HALT AND REVERSE LAND DEGRADATION AND HALT BIODIVERSITY LOSS

Target(s)	Indicator(s)
15.1 By 2020, ensure the conservation, restoration, and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains, and drylands, in line with obligations under international agreements	.2 Proportion of important sites for terrestrial and freshwater biodiversity by protected areas, by ecosystem type
15.2 By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests, and substantially increase afforestation and reforestation globally	.1 Progress towards sustainable forest managements

Murrells Inlet has multiple locations available that are historic and provide unforgettable experiences for its locals and the visitors. Some of the most popular places in the Murrells Inlet are Huntington Beach State Park, Brookgreen Gardens, and The Marsh Walk. All these locations offer quality time, enjoying nature, the beauty it brings, and the natural resources they supply.

Huntington Beach State Park is a national park and a wildlife preserve. Huntington offers three miles of beach and 2500 acres of total land to explore. This preserve is known for the abundance of birds, reaching over 300 species spotted, birding is a popular activity here. Huntington offers 173 campsite spots where families from all over come and can enjoy the nature trails and sights that the park has to offer (Huntington Beach, 2021).



Huntington Beach State Park, September 2015. Photo taken by Julia Angell.

The Marsh walk is a half mile stretch of boardwalk that lines a natural estuary, which historically is known as the center of the Murrells Inlet fishing village. The walk offers spectacular landscape sights as you can see across the estuary to Garden City from any angle. Along the boardwalk there is a series of waterfront dining establishments that occasionally offer live music (Murrells Inlet Marsh walk, 2021). While the Marsh walk is an immensely popular tourist destination, there was no firm data available on the revenue brought in by Huntington Beach State Park, Brookgreen Gardens, or The Marsh walk.

Brookgreen gardens is another popular preserve in Murrells Inlet, inhabiting 9127 acres of land, Brookgreen focuses on conserving the natural ecosystems and wildlife that have been there forever. The founders Archer and Anna Hyatt Huntington were environmental conservationists, so the structures applied within Brookgreen were meant to ensure preserving the flora and fauna within this site. Synthetic ponds and pools were implemented and connected to the Waccamaw river to allow drainage, promoting water recycling. The botanical gardens consist of a variety of plant species along with the largest collection of American statues in the country, giving people a peaceful yet eye-opening view along the paths (Brookgreen, 2021).

Camping revenue had gone up for both state parks, Myrtle Beach and Huntington Beach even though overall camping occupancy rates at both parks have been slightly down this year due to being closed during key times during the governor’s COVID-19 orders, according to state figures provided by the S.C. Department of Parks, Recreation and Tourism. At Huntington Beach, camping revenue is up 114 percent, from \$400,000 in 2019 to more than \$850,000 as of the end of July. At Myrtle Beach, camping revenue is up by 20 percent from \$980,000 in 2019 to almost \$1.2 million. “People are looking to camp more, and our day’s activities are also up, where people are finding ways to get out of the house, keep social distance and spend some time with their family and friends,” McCormack said. “A lot of people showing up at the campgrounds is first-time campers. There are a lot more requests for help with set up and how campground operations work... Our staff has had a lot more requests for stuff that is common knowledge among regular campers.” (Rodriquez, 2020).

PROMOTE PEACEFUL AND INCLUSIVE SOCIETIES FOR SUSTAINABLE DEVELOPMENT, PROVIDE ACCESS TO JUSTICE FOR ALL AND BUILD EFFECTIVE, ACCOUNTABLE AND INCLUSIVE INSTITUTIONS AT ALL LEVELS

Target(s)	Indicator(s)
16.6 Develop effective, accountable, and transparent institutions at all levels	.1 Primary government expenditures as a proportion of original approved budget, by sector (or by budget codes or similar) .2 Proportion of population satisfied with their last experience of public services
16.7 Ensure responsive, inclusive, participatory, and representative decision-making at all levels	.1 Proportions of positions in national and local institutions, including (a) the legislatures; (b) the public service; and (c) the judiciary, compared to national distributions, by sex, age, persons with disabilities and population groups .2 Proportion of population who believe decision-making is inclusive and responsive, by sex, age, disability and population group

To develop effective, accountable, and transparent institutions at all levels (Target 16.6), several hindrances need to be overcome in Murrells Inlet.

On the federal level, due to its size, Murrell's inlet often seems to be overlooked which is underlined by the lack of complete data in the US Census online database (US Census Bureaus, 2020). However, the main problem lies within the local level. Murrells Inlet does not have a major and until now also did not get a seat on the County Council, so its voice did not seem to have been heard on the county level. In the next census, it will receive a seat on the city council, but this still might not be enough to influence decisions on county level.



Brookgreen Gardens, January 2021. Photo taken by Julia Angell

Hence, many residents feel that Murrells Inlet has been underappreciated by Georgetown County, and that some of the problems also result from the lack of a clearly defined governing body. Moreover, the clashing opinions between new residents, mostly retired persons from northern US states, and residents who have lived in Murrells Inlet for many years or even generations impede easy decision-making. While the latter wish to restore the calm atmosphere and protect nature, new residents often desire more attractions for leisure, more development, new housing opportunities and a vibrant life. These difficulties have increased because now, new residents take up a higher percentage of the total population than locals in Murrells Inlet (Goldfinch, 16 November 2021).



A best practice example for responsive, inclusive, and participatory decision-making (Target 16.7) can function as an impulse for planning. The case of the German town Grimma, further explained on page 16, demonstrates how institutions working on different scales can cooperate in risk reduction management. Four main scales are relevant: The European Union, the federal level, the state level, and the county of Leipzig with the town of Grimma. In accordance with the Directive 2007/60/EC of the European Parliament and Council on the assessment and management of flood risks (European Parliament, 2007), the natural disaster risk reduction management in Grimma follows four steps



1. Single out risk-areas with a potentially significant flood risk (Federal Agency for Civic Education, 2013) Saxon State Office for the Environment, Agriculture and Geology (state level) and administrative district of Leipzig (county level): Flood protection concept Mulden 2005.

2. State Environmental Agency Leipzig (2005): Specific hazard and risk maps for Grimma

Saxon State Ministry for Environment, Agriculture and Geology: 2003 decree on the processing of flood protection concepts for Grimma; with Technical University Dresden: Risk management plan 2004 (Performance of the watercourse sections in the urban area of Grimma, flood risk, possible measures to improve flood protection, flood forecasting, establishment of early warning systems, preparation of hazard mitigation plans, building bans in flood-prone areas, methods of soil cultivation (Technical University of Dresden, 2006)

Continuity and updates in risk management - City of Grimma: Updated concepts of flood measures in 2004, 2006, 2007, 2011, 2017 and 2019 (State Dam Administration Free State of Saxony, 2019).

STRENGTHEN THE MEANS OF IMPLEMENTATION AND REVITALIZE THE GLOBAL PARTNERSHIP FOR SUSTAINABLE DEVELOPMENT

Target(s)	Indicator(s)
17.4 Assist developing countries in attaining long-term debt sustainability through coordinated policies aimed at fostering debt financing, debt relief and debt restructuring, as appropriate, and address the external debt of highly indebted poor countries to reduce debt distress	.1 Debt service as a proportion of exports of goods and services
17.7 Promote the development, transfer, dissemination, and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed	.1 Total amount of funding for developing countries to promote the development, transfer, dissemination, and diffusion of environmentally sound technologies
17.17 Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships Data, monitoring and accountability	.1 Amount in United States dollars committed to public-private partnerships for infrastructure

Institutional and governance drivers influence several factors in the outlined system for Murrells Inlet. Literature on environmental sustainability established extensive evidence that only a combination of the public and private sector with society, including private persons and organizations, initiatives and similar, enables a functioning governance towards sustainability (Hanim Mohamad Zailani, 2012).

Especially on the local, county, state, national and global level, numerous public and private sector drivers directly or even indirectly influence decision making, policies, laws, and strategies. As established in prior reports, those actors’ interests differ greatly (Crone, 2020). For example, business associations aim at maximizing profits, while environmental protectionists maximize the protection of natural habitats. The public sector strives to balance all parties’ interests. However, the multi-faceted landscape of actors can also be seen as an opportunity for Murrells Inlet to achieve an integrated approach on governance. The case example of Grimma, see page 15 & 16, shows how partnerships amongst different scales can be strengthened to achieve a common goal.



Stephen Goldfinch Interview:

1. You also mention on your website that you believe decisions should be made locally and closest to the people. What kind of dialogue with the people in MI exists now? And how do the federal, state, and local levels cooperate?
 They do not cooperate well, but they do. Georgetown County has neglected Murrells Inlet for a long time because it has never had a representative, thus it has no voice. The federal government never cared in the first place because Murrells Inlet is not a major seaport or economic hub. The only people who ever cared about Murrells Inlet are the state government. Only they care. But changes will come with seats for MI in the county. But traditionally, state money flows in for dredging, etc.

2. Based on this, would you say the voices of residents in MI are heard by the various levels of public authorities?
 Not sufficiently. The local government does not listen. The state does, we’re too small for the federal government to care about. What would be needed is good local representation. We need a clearer governance structure locally (Goldfinch, 2021).

Cooperation is hard for Murrells Inlet because there are various groups of people that have directly opposite viewpoints. From the outside looking in, there are two big quarrels between groups, older residents vs. younger residents and residents originally from the South vs Residents originally from the North. This is understandable as the cultures of the North and South are so different, as is the culture of the younger generation vs the older generation. Because of this, the cultural identity of Murrells Inlet has been lost. A place that had previously been all about being in touch with nature, preserving and caring for what they have is now changing to a culture built around tourists and partying. The culture used to be about the simple life, living in harmony with the inlet and living off the land, not worrying about the pressures of the outside world. With the internet and screens now being everywhere, Murrells Inlet is losing that culture fast.

Collaboration doesn't function correctly in Murrells Inlet, because of the two directions the area could go in. With no collaboration, nothing will be done for the best interest of the area going forward. There needs to be a middle ground that both sides can agree on, so Murrells Inlet can have a positive, clear direction to head in for the future. This SDG is vital for anything to work in harmony for both sides of the quarrel. There needs to be a new structure of cooperation between federal/state/local and business owners, residents, etc.

Systemic Connections Among the SDGs

As visible in the data concerning the different SDGs we chose to focus on, they are closely interrelated among each other. The following graphic representation depicts the complex system and reciprocal connections between the quality of life, nature, people, governance, and other drivers. They all function as a dynamic process from local to global level that is influenced by exogenous factors such as climate change and natural disaster.

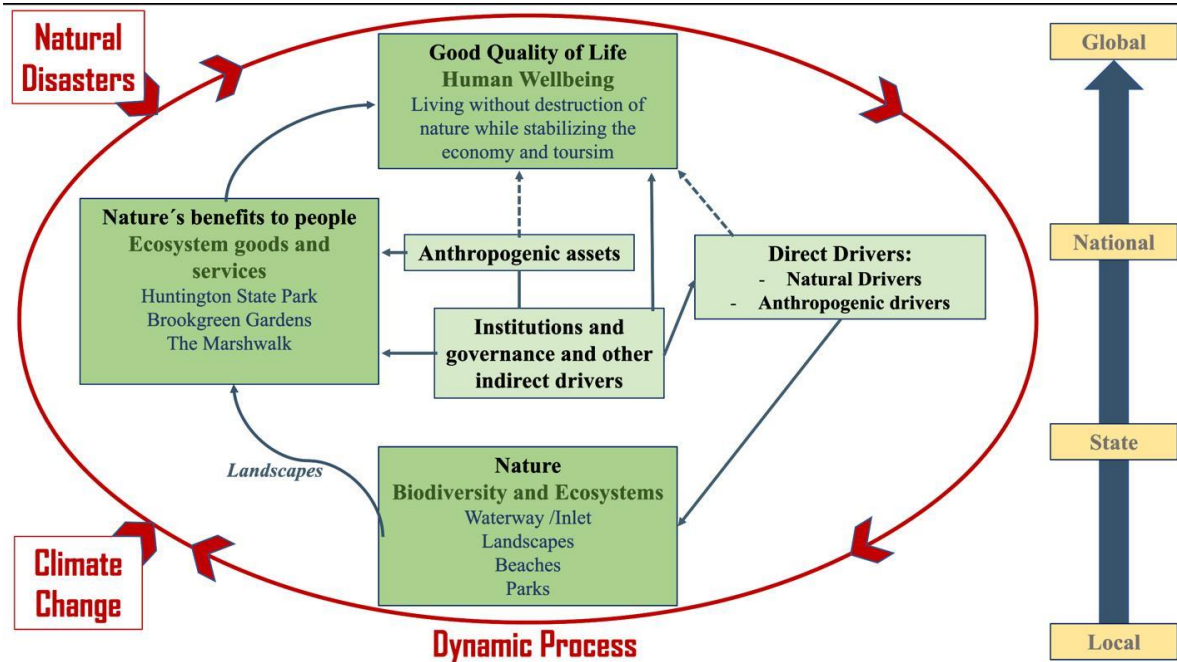
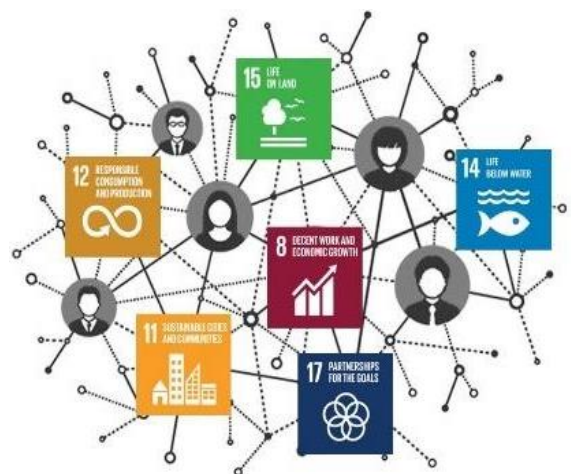


Figure 10. Connection between nature and people in Murrells Inlet. Own elaboration.

The SDGs presented in this report need to be seen as a network of factors. Although it is important to prioritize, the most critical point is to recognize that if one factor is missing, the entire network will collapse. As visible in the figure, nature directly benefits humans, for example through the marsh, Brookgreen Gardens and Huntington State Park.

One example for the interrelated nature of the SDGs are SDG 16 and SDG 17. Partnerships between the county and state level, e.g., the Georgetown County council and the State Senate, cannot be realized if these are not effective, accountable, and transparent institutions, as depicted in target 16.6. Domestic resource mobilization (target 17.1.) would not be possible without achieving target 16.6 either. Similarly, economic growth (target 8.1) cannot be achieved if all developments are reversed by a hurricane or flooding due to insufficient capacity strengthening for climate action (target 13.1). Following this logic, a complex spider web of connections is created.



Equity, Peace, & Justice

When talking about equity, it is important to understand that it is not a synonym for equality. While equality means giving each relevant actor the same opportunities and resources, equity recognizes that everyone has diverse needs, desires and circumstances and intends to allocate resources accordingly.



In Murrells Inlet, the median household income is about \$59,429 (2019). A comparison to the median household income of Georgetown County, \$48,456 (2019), and of Horry County, \$50,704 (2019), shows the relative wealth of Murrells Inlet's residents compared to the surrounding area average. It is slightly below the US average of \$62,843 (2019), which stresses the strong economic position even more, as even the South Carolina average is only \$53,199. The median value of owner-occupied housing units is \$264,000, more than \$70,000 more than the numbers of Horry and Georgetown County (US Census Bureau, 2020). The gap between rich and poor is lower than the average in South Carolina (National Association of Realtors, 2021), also underlined by a lower poverty rate (US Census Bureau, 202). All this data shows the main hindrances to achieving equity in Murrells Inlet do not necessarily relate to financial or monetary aspects such as poverty.

In Murrells Inlet, the main hurdle towards justice and equity are very differing and contrasting opinions of different stakeholders, as explained earlier. Especially the older generation who lived in the area for generations or grew up in it does not want a strong influence on the Inlet from outside, but keep it a quiet, relaxed and nature-oriented area. New residents, however, move to Murrell Inlet, especially from Northern states, and bring innovative ideas to the Inlet. Together with tourists, they wish for a vibrant life, including a night life, events, and new activities of all kinds (Crone, 2020; Goldfinch, 16 November 2021). Being fair and impartial while having every voice heard is therefore hard for local, county, and state actors, as opinions often seem irreconcilable.

This accentuates that Murrells Inlet is not characterized by one unique social and cultural identity. In 2019, the median age was 59.6 years, with 33 % of the population being 65 years and older, and an absolute majority of European descendant (US Census Bureau, 2020). However, especially within the last years, a shift from a nature-oriented calm community towards a more multi-faceted area including activities for younger generations ensued (Crone, 2020). Increased residents from other states and tourists are attracted by Murrells Inlet. The population has experienced an immense growth during the last years and is also projected to continue growing (WMBF News, 2014), as well as the currently incredibly attractive housing market (Strong, 2021). While some residents are concerned about overpopulation, the interest in Murrells Inlet as a new home keep rising (Goldfinch, 16 November 2021). This also leads to difficulties between different generations, as the superior number of older generations opposes many ideas young residents, tourists, or other stakeholders' voice. This leads to problems in achieving intergenerational justice, which describes the concept of fairness and justice between different generations. Only 12.4% of Murrells Inlet's residents are 18 years or younger, making them a minority group. This also connects to racial justice, as an overwhelming 84.0 % of the population is characterized as white by origin (US Census Bureau, 2020).

On the one hand, these developments lead to an enriching diversity in the community with new inputs. On the other hand, however, the lack of one unique cultural identity might lead to disputes among the community. Initiatives like the non-profit Murrells Inlet 2020 emphasize the quiet and laid-back atmosphere of the community and promote natural conservation" without "flashing neon signs or roller coasters" (Murrells Inlet 2020, 2021). In contrast, several party fishing boats advertise renting out boats for party experiences in the Murrells Inlet salt marshlands (compare Crazy Sister Marina, 2021; East Coast Brew Boat, 2021; Myrtle Beach Booze Cruise, 2021).

Risk Reductions

In this section, the vulnerability and risk of Murrells Inlet will be assessed using the U.S Climate Resilience Toolkit as well as the United States Racial Inequality in delivering SDGs. Vulnerability will be assessed in terms of natural disasters, access, and equity.

The Climate Resilience Toolkit has a variety of interactive maps that will be used for the assessment of Murrells Inlet. Below (Fig. 12) is a map with statistics explaining the different vulnerable aspects that this specific tract of Georgetown County faces. While this does not account for our exact study area, it includes most of it, excluding the south part towards where Huntington Beach State Park is located. A substantial risk this region faces is there is a good portion (36%) of the region in the hurricane flood zone. This area also lacks natural protection from tree canopies (77.5%) so most architecture is exposed and in the open (Headwater Economics, 2021).

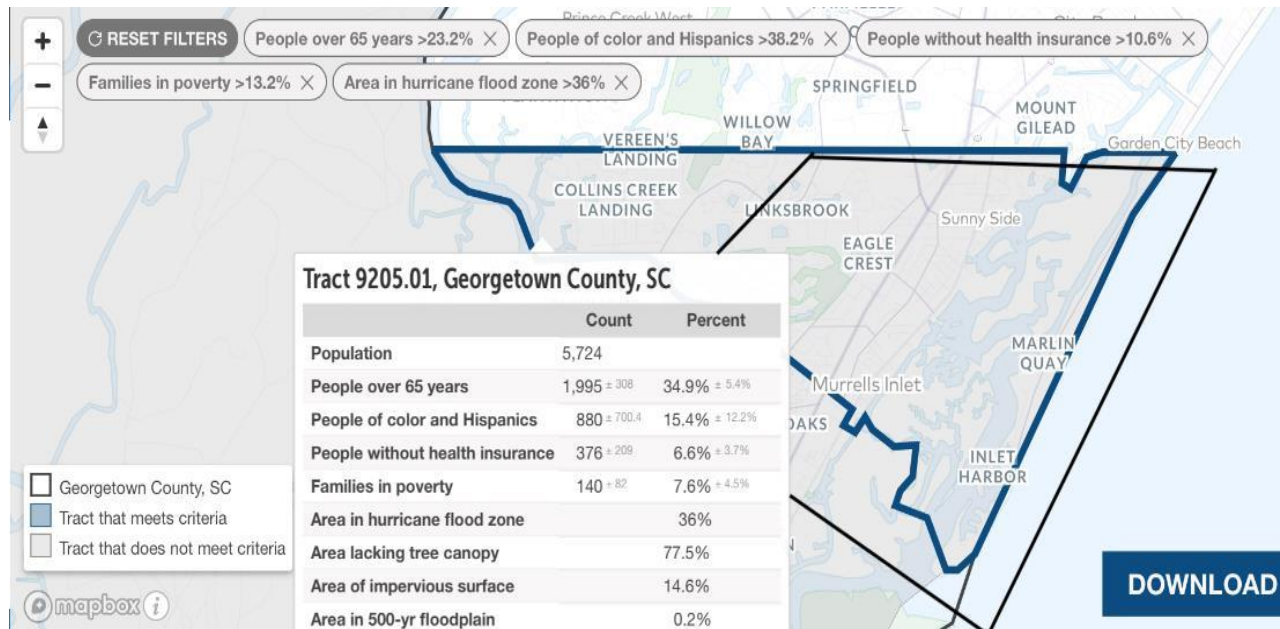


Figure 12. Headwaters Economics Map. Exploring neighborhoods and their vulnerability. Tract 9205.01, Murrells Inlet area of Georgetown County, SC. Black box represents our focus area of Murrells Inlet.

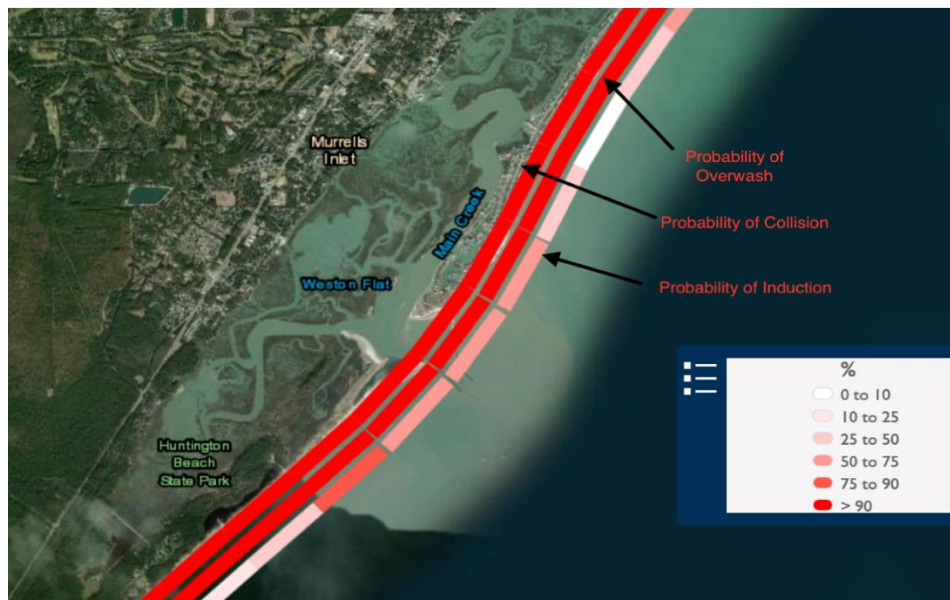


Figure 13. USGS Coastal Hazards Map. Hurricane Scenarios. Category 1 hurricanes show more than 90% over wash and collision rates. Induction rates vary from 0 to 75%.

Racial Inequalities in Delivering SDGs:

South Carolina is ranked twelve out of fifty states, regarding progress on the SDGs, Hawaii is the first state of 50 because of the progress the state has made towards fulfilling these goals. South Carolina is doing well in terms of making progress and staying up to par with other states. SC is behind other states for SDGS number six, eight, and fifteen (In the Red, 2021). Progress towards SDGs in this section is referring to racial equity.

Table 2. Low Ranked SDGS of South Carolina. The goals that SC scored the worst on in comparison to other states were clean water and sanitation, decent work and economic growth, and life on land.

SDG #	Goal	Good Progress or SDG Achieved	Challenges Remain	Significant Challenges Remain	Major Challenges Remain
6	<i>Clean Water & Sanitation</i>	X	- Drinking water violations - Air, water, and hazardous waste violation enforcement	- Dam safety	- Toxic Water Pollution
8	<i>Decent Work & Economic Growth</i>	- Racial disparity in employment	X	X	- Employment - Youth not in school or work - Racial disparity in youth not in school or work - Unemployment rate - racial disparity in unemployment rate
15	<i>Life on Land</i>	X	X	- Non-carbon ecological footprint	- Proximity to parks - Change in forest area

Table 3. High Ranked SDGS of South Carolina. The three highest scoring goals of SC were sustainable cities and communities, responsible consumption and production, and climate action.

SDG #	Goal	Good Progress or SDG Achieved	Challenges Remain	Significant Challenges Remain	Major Challenges Remain
11	<i>Sustainable Cities & Communities</i>	- Overcrowded housing in racial disparity in commute length	- Particulate matter exposure	- Affordable housing	- Rent burdened population
12	<i>Responsible Consumption & Production</i>	- Racial disparity in toxic air burden from nearby facilities	- SO2 emissions	- Toxic chemical pollution	X
13	<i>Climate Action</i>	- Racial disparity in pollution burden - Resilient building codes - FEMA mitigation plans	- Weather related injuries	X	- Pollution burden - Greenhouse gas emissions

South Carolina has made considerable progress where the goals have been assessed as ‘challenges remain’ for SDGS number eleven, twelve, and thirteen.

South Carolina remains at risk until more SDGS are in a state of timely progress or achieved. With risks like hurricanes and being in flood zones, it is important that Murrells Inlet tries to do their part in following sustainability guidelines to eliminate degrading any more of our natural barriers. An example state who is leading in SDGS is Hawaii, and South Carolina can learn from their strategies, Murrells Inlet can adopt some of their practices since both are coastal regions that are centered around fishing and tourism.

Flooding:

There have been 31 hurricanes/tropical storm events since 1851 that have landed in South Carolina; 14 of those affecting Georgetown County. Building codes have been in effect in Georgetown County for over 40 years. Georgetown County's relatively flat terrain (about 90% of the County is less than 40' above mean sea level (msl), coastal location, and abundance of water bodies contribute to its vulnerability to flooding (Hazard Mitigation, 2019, p.2/23). The area is particularly susceptible to flooding from rain events associated with tropical storms and/or hurricanes.

There are 338 properties in Murrells Inlet that have greater than a 26% chance of being severely affected by flooding over the next 30 years. This represents 7% of all properties in the neighborhood (Flood Factor). In addition to damage to properties, flooding can also cut off access to utilities, emergency services, transportation, and may impact the overall economic wellbeing of an area. The community is at a moderate risk of flooding over the next 30 years, which means flooding is likely to impact day-to-day life within the community.

Floods are also significantly impactful on tree growth and the survival rate due to the damage that can be caused to the tree's root system. The exposure of roots and the supporting foundation shows there is poor infiltration, erosion, and rainfall energy because plants are supposed to grow their roots underground not above ground. The problem with deforestation is it is a wide spread of trees being cleared usually by developers. Forests account for 377 square miles, or almost 1/2 of the land area in the County. Evergreen forests cover 46% of the land, mixed forests cover 12%, and saturated bottomland forests cover 13%. Almost 1/2 of the soils found in Georgetown County are classified as hydric soils. The wetlands and forests provide food and cover for a variety of wildlife such as the eastern cottontail rabbit, gray squirrel, white-tailed deer, wild turkey, bobcat, bobwhite quail, and mourning dove (Hazard Mitigation, 2019, p.1/7). Not only do the wetlands and forests provide for the nature that surrounds Murrells Inlet but also help prevent flooding.



Huntington Beach State Park, September 2015. Photo taken by Julia Angell.

Timber harvesting is especially important this alleviates the problem of having uprooted or dead trees during severe storms. Practices and methods for forestry and agriculture can be implemented in Georgetown County to provide long term benefits for Murrells Inlet. What do we get from rebuilding the soil? Increased organic component and root density with increased organic recycling and nutrients, along with rebuilding soil micro and microorganisms. Increased water storage capacity and improved infiltration and filtration of water. Reduced erosion and sediment, and increased productivity from a variety of resources including plants and wildlife. Improved options for the landowner or manager (Law, D., & Hansen, W. 2009).

Private forests provide critical habitat for many species. Increased housing development in rural private forests can have many implications for at-risk species and may create even more hazards for the community. Populations of at-risk species may disappear, decline, or become more vulnerable with changes in the presence and distribution of private forest habitats (Robles et al., in press). Loss of habitat is highly associated with at-risk species that have declining populations, and it presents the primary obstacle for their recovery (Donovan and Flather 2002, Kerr and Deguise 2004). Decreases in habitat quality associated with housing development and roads can lead to declines in biodiversity (Houlahan et al. 2006), creation of barriers to movement (Jacobson 2006), and increases in predation (Kurki et al. 2000, Woods et al. 2003). Habitat degradation can also contribute to declines in fish numbers (Ratner et al. 1997). (Stein et al., 2007). By continuing to build homes, hospitals, and businesses on top of wetlands that are not meant to house buildings will only increase the hazard risks of flooding.

The probability of Georgetown County being hit by a stronger tornado is low according to the National Weather Service (NWS). Although no building or structure is "tornado-proof," certain building techniques can make structures more resistant to tornadoes:

- Attachment of the walls and floor to the foundation of the building
- Attachment of the roof to the rafters and walls
- Installing steel reinforcing rods in concrete or cinderblock walls
- Placing mortar between cinder blocks

So, when homes are being built using the practices above can help alleviate future problems. The major vulnerability regarding tornadoes is that most structures in the County do not have basements or below-grade shelter areas due to the area's high-water table and flood zone restrictions on basements. Manufactured housing is especially vulnerable to tornadoes since these structures are built to a different code than site-built structures (Hazard Mitigation, 2019).

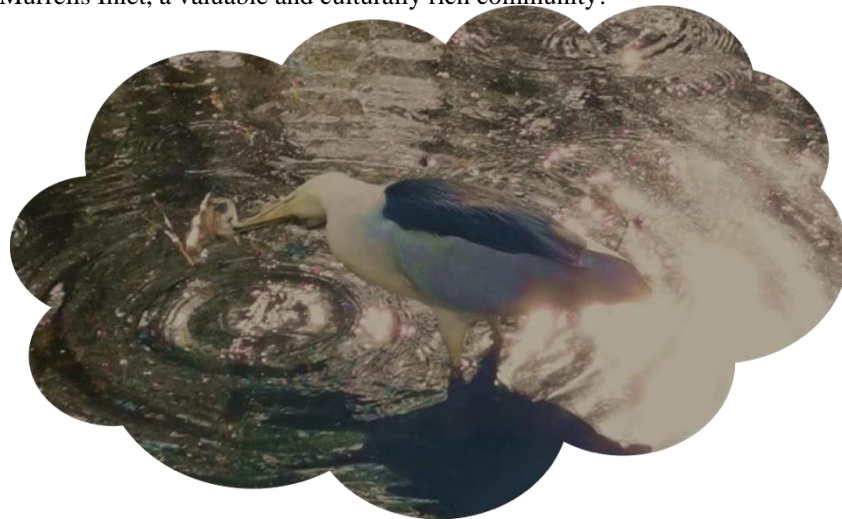
Conclusion



Oyster Beds at The Marsh Walk, October 2021. Photo taken by Anastasia Gluth.

This report intends to illustrate the diversity of spheres that contribute to the quality of life in Murrells Inlet - for people, wildlife, and the natural environment. It becomes apparent that Murrells Inlet is very advanced in certain areas while others still lack research, cooperation and clear goals and measures. On the one hand, the economy has flourished in the last decades and the calm fishing village turned into a vibrant community. On the official website for visitors, Murrells Inlet is described as a “fishing village” as well as “outdoorsman’s dream” (Myrtle Beach Area Chamber of Commerce, n.d.). It is promoted to be attractive not only to lovers of outdoor activities, musicians, visitors looking for vibrant entertainment, and art, golf, and history lovers, but also to people looking for a relaxed atmosphere (Atalaya Castle, 2021). However, these changes and new residents from other geographic areas in the US have created tensions that decelerate the pace to find a common ground and common beliefs and values for Murrells Inlet’s future. Additionally, many environmental problems already exist or are unavoidable in a near future. Since the environment is the basis of the quality of life in Murrells Inlet, they cannot be ignored. For this end, institutions need to work in a more coordinated way and cooperate better in the future. Especially the local and county level need to be strengthened to enable a meaningful basis for decisions. Throughout our research, we often noticed that many residents, initiatives, business owners and others do not feel heard by the authorities, which leads to more frustration. Differing opinions need to be heard and weighed more extensively to contribute to a future that everyone can agree upon. A focus on similarities in opinions, such as the Marsh and Inlet as a basis for the quality of life for residents and businesses as well as tourists, could be a possibility to reach this goal.

Due to the limited scope in terms of time and resources, this research merely constitutes a first overview and starting point for further research. It by no means encompasses all details that need to be taken into consideration and may also serve as a basis for discussions for all parties involved. We hope it can support the community to find the best possible future for Murrells Inlet, a valuable and culturally rich community.



Seabird at The Marshwalk. October 2021. Photo taken by Anastasia Gluth.

How well are the analyzed SDGs currently implemented in Murrells Inlet?



How far advanced is the current research and/or available information concerning the analyzed SDGs in Murrells Inlet?



The best implemented as well as researched SDGs are SDGs 3 and 8, followed by 9. However, the two visualizations clearly demonstrate that for most SDGs, more information and research is available than is implemented in Murrells Inlet. Additionally, SDG 17, which focuses on strengthening the means of implementation and establishing partnerships for sustainable development, is the SDG which is the worst implemented and worst researched goal. These two facts match the overall conclusion that resources available to Murrells Inlet are currently not being adequately used. This is due to a lack of clear governance and conveys the feeling as if “no one feels responsible”, as Murrells Inlet does not have the status of a town or city, no town hall, and no mayor. For example, extensive research on climate change (SDG 13) is available but lacks implementation.

To further sustainable development, we therefore recommend starting by finding a clear structure of implementation since many data resources are currently unused. This will also automatically enable better cooperation between actors on all scales.

Recommendations

- Restoring or constructing new marsh or wetlands provides areas for water to be stored, therefore reducing flooding.
- Beaches and dunes work as natural walls to reduce the impact of storm surges. Adding sand to make beaches bigger helps limit coastal erosion and protect communities from flooding.
- Restoring and building up natural infrastructure such as barrier islands, oyster and coral reefs, mangroves, seagrass, and salt marshes is a cost-effective and eco-friendly way to reduce flood risks.
- Rain gardens reduce flash flooding by collecting rainwater and allowing time for the water to be absorbed or carried away. Bioswales are larger but functionally similar, and usually a part of a larger stormwater drainage system.
- Floodplain regulations, drainage system maintenance and stormwater management
- Make ordinances that enforce healthier sanitation and promote better water quality
- Restrict more forests and park areas from being touched
- Integrate flood/hurricane protection into the landscape with as little disturbance as possible, so it is also widely accepted by all disparate groups in Murrells Inlet
- Find appropriate financing solutions for Murrells Inlet, also use importance for tourism in the entire area to receive more funding
- Intensify collaboration with universities, especially Coastal Carolina University
- Find a clear dialogue between disagreeing parties with a neutral mediator
- **Write a Sustainability Report considering all parties involved on federal, state, local public, and private level**

In 2020, Horry County released a county-wide plan draft to implement strategies that will reduce flood risks along the Waccamaw River, Pee Dee River, and Intracoastal Waterway in unincorporated Horry County. This plan encompasses FEMA’s Hazard Mitigation Grant Program and the South Carolina Disaster Recovery Office’s buyout program. It also addresses the improvement of infrastructure, removal of gray infrastructure, development of flood control projects, retention of stormwater, and the development of wetlands (Horry County Government, 2020). Although a good example of what could be done in Murrells Inlet, Horry County’s plan does not include the Murrells Inlet community, as it sits on the northern border of the neighboring Georgetown County.

Georgetown County implemented their Hazard Mitigation Plan in 2019; this plan was meant to assist the county in using state and federal funding for eligible hazard mitigation projects and programs. The plan included the dredging of the federal channel in Murrells Inlet, meaning the removal of silt and pollutants from the bottom of the body of water. Though not outlining exact guidelines for the Murrells Inlet community in specific, the plan was intended to be used to make decisions “regarding the best way to address the vulnerabilities to hazards in Georgetown County (City of Georgetown, 2019).” This is the closest proposal the community has gotten to a resilience plan.

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