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# MURRELLS INLET ASSESSMENT 2022

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# COASTAL CAROLINA UNIVERSITY

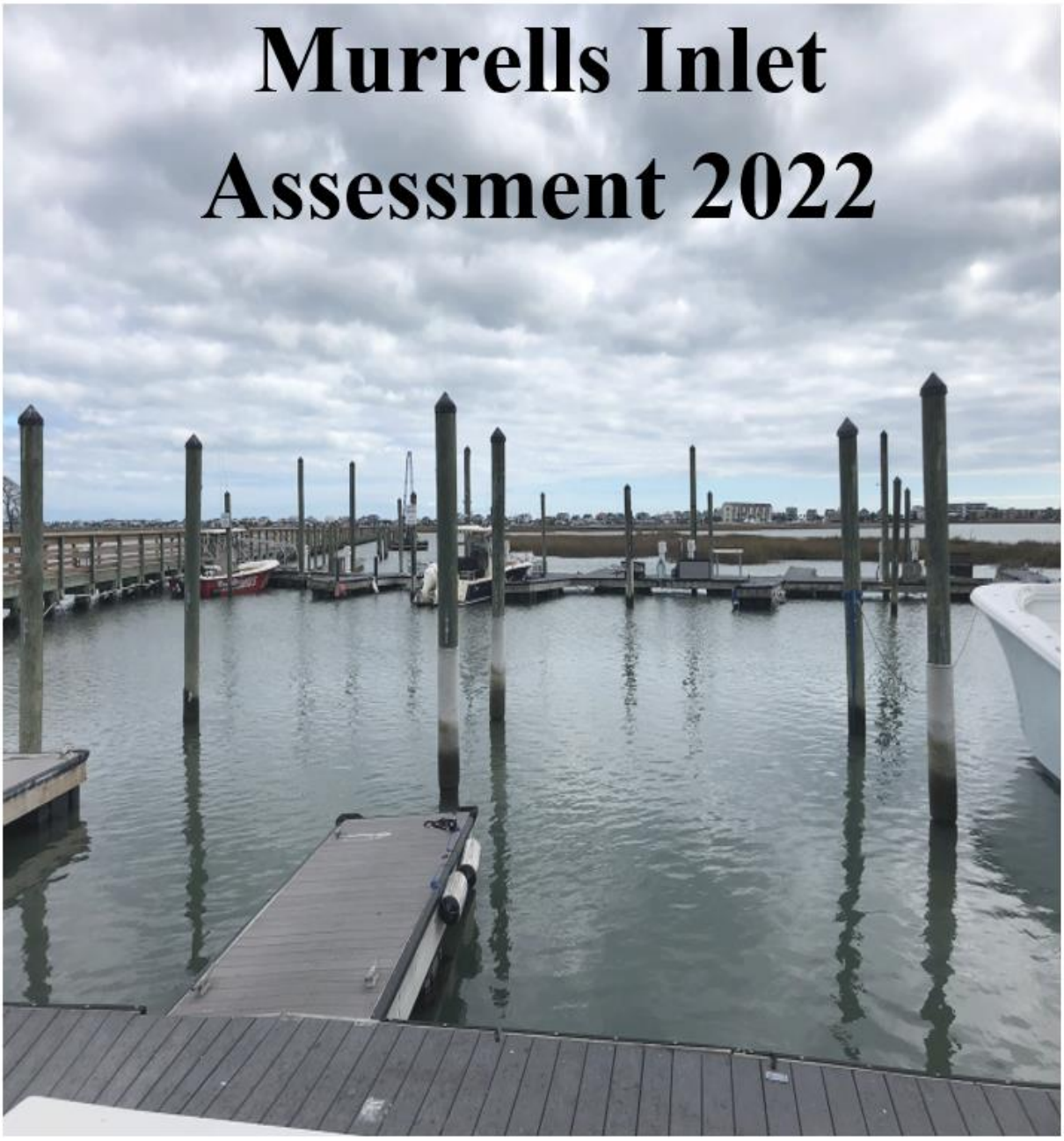


**Photo taken by Tyler Whitlow, November 12th, 2022, Annual Oyster Festival**

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Murrells Inlet, SC. Marshwalk and Eastern Gray Squirrel 2022.

Pictures taken by Katelyn Cilino.

# Introduction

## Assessment Question

Using the sustainable development goals as a framework, how are the community, economy, and nature connected in Murrells Inlet?

### Community

The Murrells Inlet community is built upon a combination of 9,292 permanent residents and the estimated 10 million tourists that visit the Grand Strand each year (Census, 2020) (myrtlebeach.com 2017). The Murrells Inlet community has a rich history and was officially named Murrells Inlet by the post office in 1913. The Murrells Inlet community lies at the northern terminus of the Waccamaw Neck. The Neck is a long narrow peninsula between the Atlantic Ocean and the Waccamaw River ending just north of the historic seaport of Georgetown (McAden, 2022). The completion of the Marshwalk in 2000 had a significant impact on this once quaint fishing town. The Marshwalk gave tourists even more reasons to visit and gave the community another fun activity to enjoy.

### Economy

Tourism is the main driver of the economy in the Murrells Inlet area. There are a variety of restaurants, shops, and businesses that play a role in the economy. The Marshwalk is a blend of nature and the economy coming together where small-business, live music, the marsh environment, and southern food all mesh into one community. The Gross Domestic Product (GDP) for Murrells Inlet is currently unavailable, though the GDP for Georgetown County in 2021 was $2.959 billion- up approximately $245 million from last year's metric. See this site for data: https://fred.stlouisfed.org/series/GDPALL45043. For the state of South Carolina, the GDP is currently approximately $224 billion and had an increase of 2.0% from 2021 (IBISW, 2021).

### Nature

Murrells Inlet has a plethora of both biodiversity and ecosystems. Examples include Goat Island at the Marshwalk and the marshes seen at the inlet. The marsh is an important ecosystem that holds plant life and wildlife, the oyster beds of the marshes are particularly important to the identity of the community. Another key aspect of the value of the marsh is the flood waters it contains.

### Connections

As the model we have created indicates, many pillars of Murrell Inlet are built on nature. The people can be seen at the frequent beach clean-ups because of how important they view the environment. The economy is heavily reliant on the environment and the marsh itself has an estimated value of approximately $720 million (WMBF 2014). This can be seen in the tourism sector, wherein people come to the area to fish and to see the beautiful scenery. In tourism alone, $2 million was generated in Georgetown County. The economy also relies on the fishing industry. In Georgetown County the estimated value of harvested seafood is $4.4 million (Georgetown County 2013). Without the nature in Murrells Inlet, the community would have nothing to support itself.

# Unit of Analysis


**Figure 1**. *Mapquest 2022.* The red parameter represents the unit of analysis focused (MapQuest 2022)

**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.

# General overview of organizations and people who play a role in Murrells Inlet's community:

**Global:**

World Health Organization, United Nations, Labor Organization, numerous treaties of the USA with other countries Sendai Framework, World Health Organization, International

**Federal:**

FEMA, US Environmental Protection Agency, National Institutes of Health, further governmental agencies, and representatives

**State:**

South Carolina Chamber of Commerce, South Carolina Department of Health and Environmental Control, South Carolina Office of Resilience, S.C. Department of Employment and Workforce, State Senators

**County:**

Georgetown County (Economic Development Office of Georgetown County, Building, Planning & Zoning Department, Parks & Recreation Department, Animal Control Department), Waccamaw Regional Council of Governments (works in three different counties), Georgetown

County Chamber of Commerce, County Council member

**Local:**

Businesses, Preserve Murrells Inlet, Murrells Inlet 2020, South Atlantic Fishermen's Association, Restaurants and hotels, other businesses, Residents, Coastal Waccamaw Stormwater Education Consortium, Coastal Carolina University

Photo of an otter lounging in Murrells Inlet. Photo taken by Jenna Monroe January 16th, 2021.

# Methodology

**Tools Used**
Google Forms: to collect interview data on businesses
Interviews and observations of the area
ArcGIS for surveys and flood mapping
Environmental Quality Lab water quality data
Local News Reports
Scientific Journals
Community Assessment Plans
United States Census Data
Official reports and statistics published by Georgetown County
Georgetown County Budgeting plans
NOAA Coastal Flood Exposure Mapper
FEMA Flood Mapping Climate Resilience Toolkit map

**Methods:** In order to gather all data needed to draw necessary conclusions and prepare a list of recommendations to help answer our general research question, extensive research was conducted by students during the fall semester beginning in August and ending in December. Sustainable development is best measured through both valuing recent pathways of development and analyzing potential effects of policy or other future methods of sustainable development. All group members participated and conducted various interviews and participant research, visiting Murrells Inlet to collect survey results, look at case studies, and compare data analysis to make inferences to suggest better improvements.

- Interviews of business; the Wicked Tuna, the Claw House, CreekRats, Dead Dog Saloon, Express Sports, and the Lazy Gator occurred October and November 2022 to gather data on flooding, waste generation and sustainable products businesses use.
- Interview with local resident and Senator Stephen Goldfinch on October 19th, 2022, to get updated information about Murrells Inlet and Georgetown County social issues.
- Water quality data was supplied by the Environmental Quality Lab at Coastal Carolina University. Data was taken from a five-year time frame from October 25th, 2018, to October 25$^{th}$, 2022, to show a relevant trend of recent data.
- Interview with county councilman and local, Clint Elliott on November 1st, 2022, to find out his plans for Murrells Inlet and what he can do to provide a better future for residents and the environment.
- On November 8th, 2022, the ArcGIS Survey was given to some residents of Murrells Inlet at the Marshwalk to gather data about flooding.
- On November 12th, 2022, ArcGIS Survey was distributed to residents at the 18th annual Oyster festival to gather more data about flooding.

# Framework

Throughout our research and studies, we have connected our findings in the Murrells Inlet community to numerous Sustainable Development Goals (SDGs) by the United Nations. The SDGs are the blueprint for countries to transition to a more prosperous and sustainable future for their environment and people. The goals we focused on were organized into a pyramid figure. Nature is the basis of our framework since quality of life and economic success relies heavily on the environmental health of the location. Above that we have people, referring to tourists, generational residents, and new residents. At the top we put economy referring to local businesses, job opportunities, and economic growth. A balanced and healthy relationship throughout all levels will allow the community to reach their potential for a sustainable future. Through our research we did not find any dramatic changes that would have caused a change in the approach from the 2021 report.

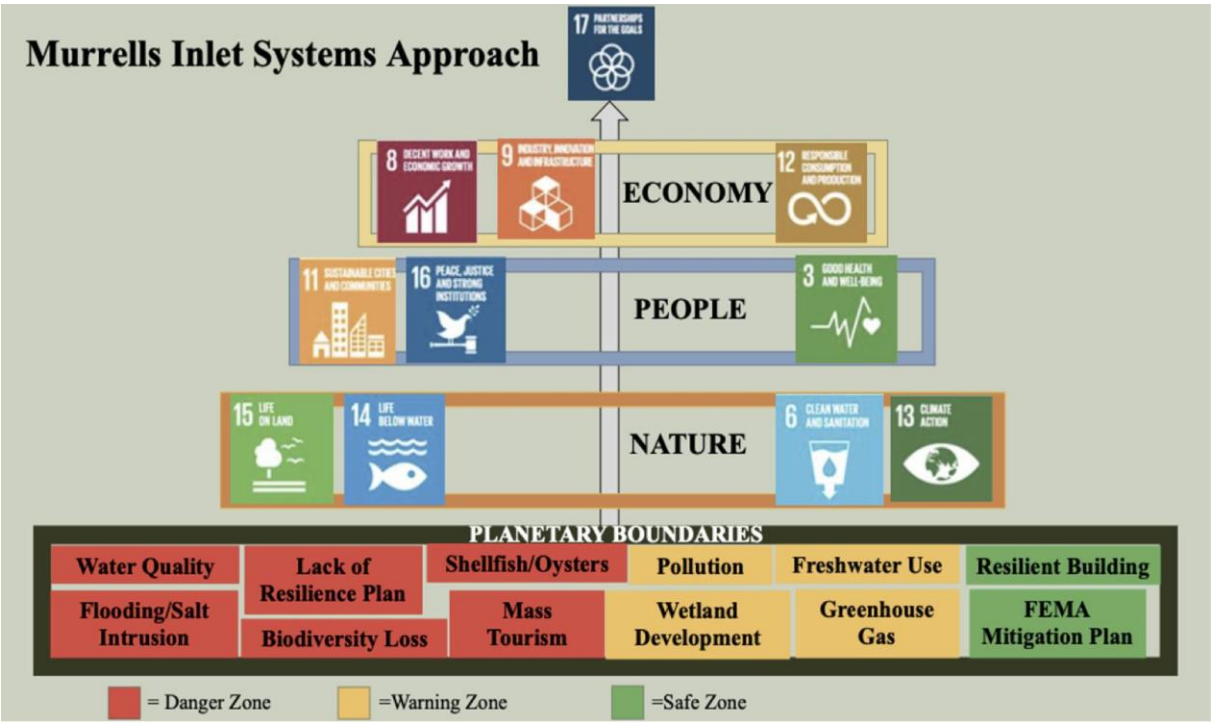



**Figure 2.** *Murrells Inlet Assessment 2021.*The Murrells Inlet Systems Approach. Designed to show how our group connected SDGs to nature, people, and the economy of Murrells Inlet. Planetary boundaries relate to topics touched upon throughout the report.

**Planetary Boundaries:** Each of the areas highlighted represents 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 five 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).

Photo of Murrells Inlet estuary on October 4, 2022. Photo taken by Jordan Roballo.

# Sustainable Development Goals Overview

| Sustainable Development Goal | The United Nation's Definition of SDG | Connection |
|---|---|---|
| **3**- Good Health and Well Being | Ensure healthy lives & promote wellbeing for all, at all ages (United Nations 2022). | The state of the estuary and the local businesses built upon its natural beauty rely on the area to be of sound health to continue to provide for the community. |
| **6**- Clean Water and Sanitation | Ensure availability & sustainable management of water sanitation for all (United Nations 2022). | The quality of water throughout the community reflects the sanitation available to the people and wildlife that share the area. |
| **8**- Decent work and Economic Growth | Promote sustained, inclusive, sustainable economic growth, full & productive employment, & decent work for all (United Nations 2022). | GDP growth, employment opportunities, growth of tourism and other industries. |
| **9**- Industry, Innovation, and Infrastructure | Build resilience infrastructure, promote inclusive & sustainable industrialization & foster innovation (United Nations 2022). | Support economic development and human well-being. |
| **11**- Sustainable Cities and Communities | Make cities & human settlements inclusive, safe, resilient, & sustainable (United Nations 2022). | Plans businesses and individuals have made for flooding and hurricanes, offices and organizations to assist in the recovery from storms, and any changes to the infrastructure to better accommodate for possible disasters. |
| **12**- Responsible Consumption and Production | Ensure sustainable consumption and production (United Nations 2022). | Locally caught fish and farmers markets to decrease the amount of imported goods. |
| **13**- Climate Action | Take urgent action to combat climate change and its impacts (United Nations 2022). | Renewing attention to agricultural, natural resource, and ecosystem management strategies to adapt natural systems in order to help counteract future climate change impacts |
| **14**- Life Below Water | Conserve and sustainably use the oceans, sea, and marine resources for sustainable development (United Nations 2022). | Sustainable fish and shellfish harvest, improve water quality for the health of people and the environment, and conserve areas to prevent overharvest and development. |
| **15**- Life on Land | Protect, restore, & promote sustainable use of terrestrial ecosystem, sustainably manage forests, combat forestation, provide access to justice for all, & build effective accountable and inclusive institutional at all levels (United Nations 2022). | A flourishing life on land is the foundation for our life on this planet. |
| **16**- Peace, Justice, and 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 (United Nations 2022). | Providing inclusivity and representation allows for policy progression and unity. |
| **17**- Partnerships for Sustainable Development | Strengthen the means of implementation & revitalize the global partnership for sustainable development (United Nations 2022). | Implement ordinances and fund projects that improve and enable further initiatives pertaining to other SDGs. |


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

| Targets | Indicators | Data |
|---|---|---|
| **3.6** By 2020, halve the number of global deaths and injuries from road traffic accidents | **3.6.1** Death rate due to road traffic injuries | 43 deaths due to car accidents in Georgetown County since 2019 (SC Health and Public Safety 2022) |
| **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 | **3.8.1** Coverage of essential health services | 250 deaths due to Covid since 2020 in Georgetown County (CDC 2022)<br>59% fully vaccinated (CDC 2022)<br>26% received a booster (CDC 2022)<br>88.9% insured (U.S. Census, 2020)<br>11.1% uninsured (U.S. Census, 2022) |
| **3.9** By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination | **3.9.1** Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services)<br>We localized the target for Murrells Inlet to include pollutants in the water. | 400CFU/100ml E. Coli levels found at Woodland Drive Pond<br>75CFU/100ml E. Coli levels found at Point Drive Canal<br>75CFU/100ml E. Coli levels found at Marine Colony Pond<br>175CFU/100ml E. Coli levels at Bike Bridge |

Sustainable Development Goal 3.8 is about achieving universal and affordable health care coverage. The COVID-19 pandemic emphasized the necessity to work toward this goal. The population in Murrells Inlet has steadily increased over the past decade from approximately 7,500 people in 2010 to approximately 10,000 people as of 2022 (U.S. Census 2020). It is crucial for residents to receive proper medicines and vaccinations that will help them and their community, stop the spread of any communicable diseases like the flu or COVID-19.

As indicator 3.8.1 suggests, one way to ensure people's health and well-being is to provide access to the needed services. About 89% of the Inlet's residents have health insurance, either through their employers, Medicaid, Medicare, or non- group plans. Though this is the majority of the population, that still leaves 11% of the population uninsured. This number is rising as well, between 2019 and 2020, the uninsured rate grew from 8.7% to 11%. Being uninsured for many can mean they do not have access to adequate healthcare. This increases the vulnerable population of Murrells Inlet, particularly when combined with other risk factors of flood, storm, etc. CITATION

Tidelands Health Community Care Network supports those ages 19-65, uninsured or underinsured, in Georgetown, Horry, and Williamsburg counties to provide any necessary medical services they may need. These services come at a fraction of the cost, while also sharing resources for long-term insurance opportunities for residents enrolled in the program. No one should ever be denied medical attention, and this program has made huge changes throughout the community. To acknowledge the impact, the program even received the award for Outstanding

Community Health Project or Initiative. They have positively impacted more than 7,500 people with primary and specialty care, affordable medication, and even rides to appointments (Tidelands Community Care, 2022).

Covid vaccinations are another way to measure the health of the community. Currently, 59% of Georgetown County is fully vaccinated with a COVID-19 vaccine. However, only 26% of people have a booster (CDC and U.S. Census, 2022). With the presence of flu season, Tidelands Health is advising everyone to get a booster and flu shot. To promote well-being for all in a more efficient way, people can receive these vaccines during the same appointment. With COVID-19 killing more than 371 people in Georgetown County since 2020 it is evident that the pandemic has had a negative impact on the community (SCDHEC, 2023). The 4.5% increase in Murrells Inlet's population since 2020 only adds to the potential harm of COVID-19 and other communicable diseases. The presence of the pandemic emphasizes the importance for residents to stay cognizant of their community and stop the spread. Vaccinations create a healthier and safer environment.

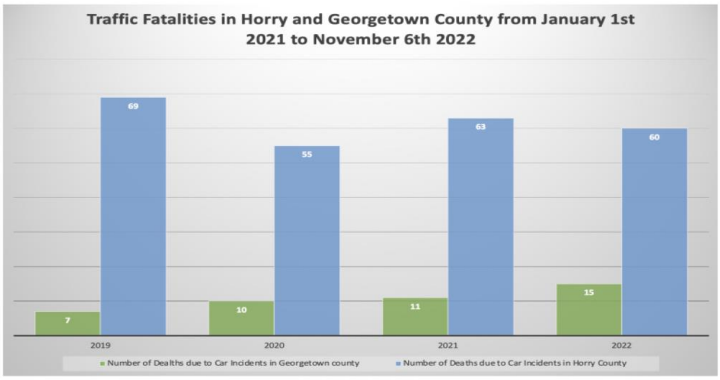



Figure 3. Graph created by Hannah Hicks using data from S.C. Public Health and Safety Department

An influx in vehicular traffic has also affected many of Murrells Inlet's residents. Goal 3.6 focuses on reducing traffic incidents and injuries. Poor road conditions are worsened by storms, heavy flooding, and potholes. These infrastructure issues create a dangerous driving environment. Texting while driving, in-car distractions, and drinking while driving also create dangerous driving conditions. This figure compares the number of car-related fatalities from Horry and Georgetown County, per South Carolina Department of Public Safety records. Since public transportation options are very limited, personal vehicles are needed for transportation. It is important for residents to stay alert and focused when driving. The high levels of traffic in Murrells Inlet can also be a factor in the accidents. According to the Grand Strand Area Transportation Study, Murrells Inlet faces the worst traffic in Georgetown County (GSATS, 2022).

The residents' health can be directly related to the health of their environment. Residents currently face water contamination issues due to chemicals and excess nutrients running into the water supply and waterways, which can have negative impacts on their health and wellbeing talked about is goal 3.9. The Volunteer Water Quality Monitoring Program by the Environmental Quality Lab at Coastal Carolina University compiled data from eight different locations in

Murrells Inlet, with four of these locations being where people in the community live. *E. coli* was present in all four of these locations, with Woodland Drive Pond having the highest levels. (Figure 3). *E. coli* is harmful to humans and can cause fever, nausea, upset stomach, and in very extreme cases death. To ensure healthy lives for the people of Murrells Inlet, proper water sanitation must be upkept for bacteria levels to be minimized. Water and soil pollution is detrimental to people's health, and if these contaminants are present in groundwater, it is likely that it is a part of people's water consumption.

Shellfish consumption has also become an issue, due to the decreasing water quality in Murrells Inlet. Currently, large portions of the oyster reef are un-harvestable because of contamination of the water and, ultimately, the oysters themselves. The standard of water quality must be raised if people want to continue consuming shellfish in a healthy, sustainable way. Looking at how this relates to SDG 6: Clean Water and Sanitation and SDG14: Life Below Water, water greatly affects all organisms. The Inlet's location allows residents to enjoy the scenery but also leaves them susceptible to any issues it may have from pollution or runoff. Comparing figure 4, as well as figure 5 under SDG 6, Marina Colony Pond has very similar levels of *E. Coli* and Coliform in the water. *E. Coli* can be devastating to aquatic organisms and human drinking water. Coliform can also be an indicator for disease causing bacteria. For the health of the ecosystem, it is important to remain on top of these levels and work towards maintaining sustainable values.

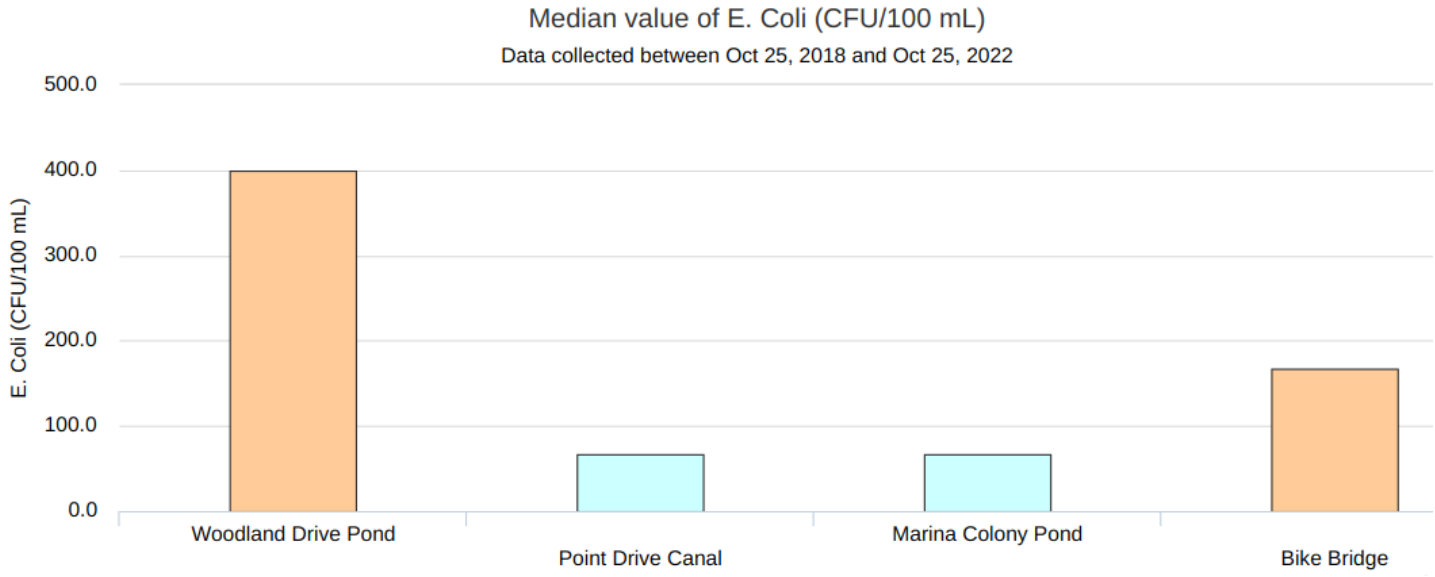
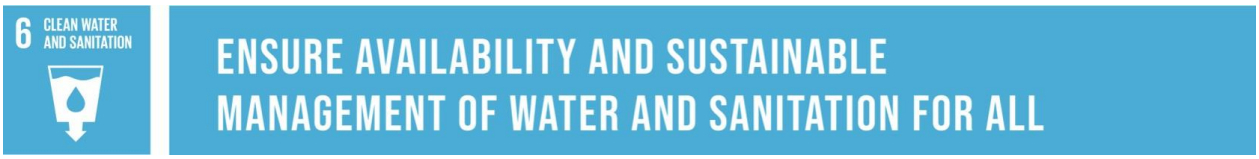



**Figure 4**. Median levels of *E. coli* are present in four different communal areas in Murrells Inlet. Data retrieved from the Waccamaw Watershed Academy Volunteer Program at Coastal Carolina University.




| Targets | Indicators | Data |
|---|---|---|
| **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 | **6.3.1** Proportion of domestic and industrial wastewater flows safely treated | Active water monitoring in the community<br>Pet waste standards notified to all in Murrells Inlet<br>Volunteer-based litter cleanup |
| **6.5** By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate | **6.5.1** Degree of integrated water resources management<br>**6.5.2** Proportion of transboundary basin area with an operational arrangement for water cooperation | Minimize sewer overflows and infrastructure problems<br>NPDES Construction General Permit and Municipal Separate Storm Sewer System General Permit |
| **6.6** By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes | **6.6.1** Change in the extent of water-related ecosystems over time | Shellfish habitat restoration<br>Watershed water monitoring sites<br>Litter cleans up |
| **6. b** Support and strengthen the participation of local communities in improving water and sanitation management | **6.b.1** Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management | Planting trees in parks and neighborhoods<br>Raising public awareness by putting up multi-langue signs for sanitation<br>Establishing a common area for displaying reading and clean up materials |

The economic development of Murrells Inlet is linked to the community's biodiversity and natural resources. Fisheries and restaurants sell the products available from the waterways, which is a great way to show tourists and locals what the area has to offer. If Murrells Inlet's water quality were to decline due to litter, flooding, and other unsustainable occurrences, the economy would suffer. This coastal ecosystem continues to provide fish, shellfish, and shoreline recreation to the community. The community has an obligation to ensure, through sustainable management policies, that future generations can enjoy the same benefit

A major form of pollution affecting water quality is pet waste (Target 6.1), which is suspected to be the second largest source of bacteria. Fecal pollution appears to be deposited into Murrells Inlet from urban areas through stormwater runoff. In recent years water monitoring has yielded above-average results of total coliform. The Waccamaw Watershed Academy (WW) at Coastal Carolina University has a Volunteer Water Quality Monitoring Program that assesses the volume of Total Coliform present in Murrells Inlet. Such results show that there are high levels of bacteria in Woodland Drive Pond, Point Drive Canal, Marina Colony Pond, and Bike Bridge in Murrells Inlet as displayed in Figure 3. In the figure shown, the informal water quality standard is represented by the green line, equaling 1,000 CFU/100ml. Most of the levels of total coliform rise above that line, meaning levels are most often higher than average. Other than the 4 locations shown here, SC DHEC identified 8 out of 24 monitoring stations within the Murrells Inlet estuary that exceeded the water quality standards for fecal coliform bacteria, which led to the development of a TMDL for the Murrells Inlet estuary (Murrells Inlet Watershed Plan 2014). According to the Watershed Plan, a TMLD "is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant" (Murrells Inlet Watershed Plan, 2014). Pollution sources include both point source (wastewater treatment facilities, stormwater discharges, and animal feeding operations) and non-point source (anthropogenic and natural background sources) forms.

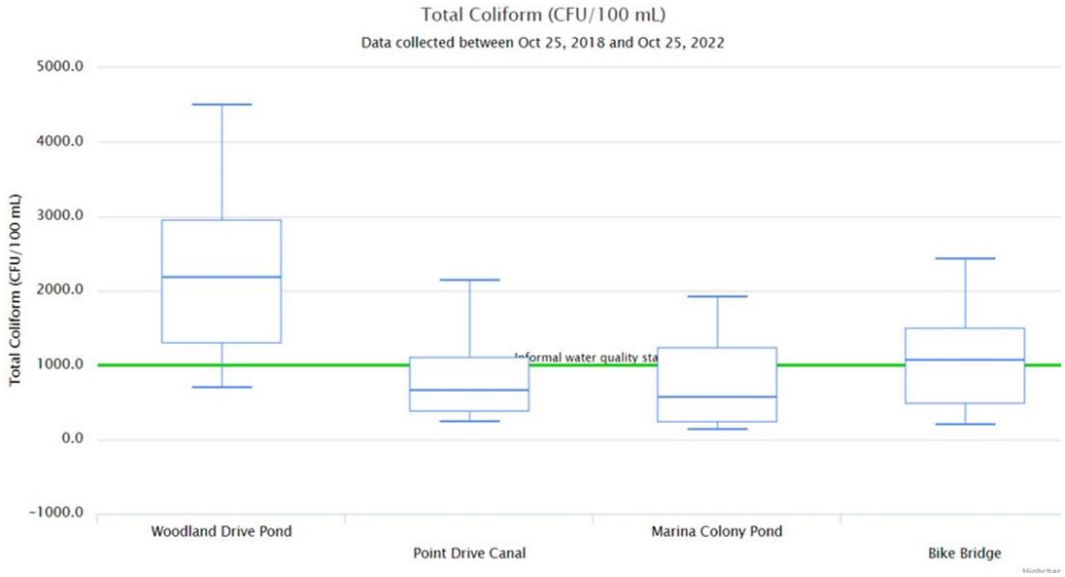



**Figure 5.** Box plots of the levels of Total Coliform in Woodland Drive Pond, Point Drive Canal, Marina Colony Pond, and Bike Bridge in Murrells Inlet, South Carolina, showing the minimum, median, and maximum values. Data retrieved from the Waccamaw Watershed Academy Volunteer Program at Coastal Carolina University. Outliers not shown to better display the data.

Moving forward to look for solutions will require integrated water resource management (Target 6.5) that examines overall water usage and excess quantity within the hydrologic system. Part of the management of bacteria includes addressing concerns related to the transport mechanisms, particularly stormwater runoff, the drainage ditch network, and sedimentation (Murrells Inlet Watershed Plan 2014). The Georgetown County Water and Sewer District and Grand Strand Water and Sewer Authority have implemented several preventive maintenance measures to ensure the system is running efficiently, as well as working toward minimizing sanitary sewer overflows and other infrastructure problems. Georgetown Country is also working on stormwater management to reduce the amount of runoff entering water systems. Currently, there are 2 permits focusing on stormwater concerns. The first is the NPDES Construction General Permit which regulates stormwater discharges from construction sites because poor mitigation runoff can cause erosion and siltation. The second is the Municipal Separate Storm Sewer System General Permit, which addresses stormwater discharges that drain through the area's storm sewer network (Murrells Inlet Watershed Plan 2014).

Murrells Inlet's system is connected to the businesses and residents who use the water, the ecosystem and biodiversity living off that water, and the excess flow that pollutes both. To sustainably use water and protect biodiversity all aspects of growing populations, environmental damage, cultures, and politics must be considered when managing a vast water network (Bell 2018). Goal 9 pertains to commercial and residential development that reduces the land's ability to absorb water, which will worsen flooding in the community. Gaining control over the urban water supply before it reaches the estuary can help lower the toxicity levels.

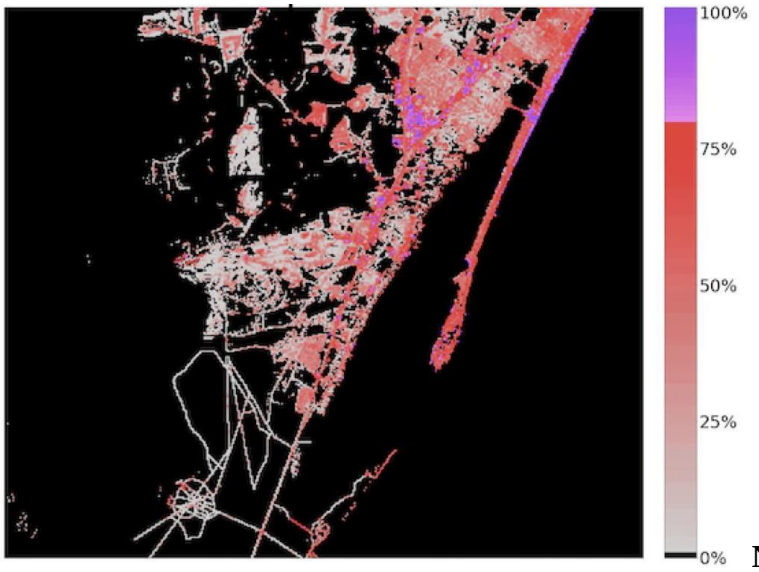
Target 6.b.1, local water and sanitation management should also be addressed. This target is important as its focus is supporting and strengthening the participation of local communities in improving water and sanitation management. The Murrells Inlet Watershed Plan relies heavily on partnerships throughout the community and educating locals and tourists on proper waste management. Partnering with organizations such as Coastal Conservation League, Brookgreen Gardens, Huntington State Park, and local marinas will aid the process of raising public awareness on sustainable practices. Important environmental areas found within these organizations as well as others throughout the community would benefit from signs in multiple languages that state the value of sanitation. One common area that may be utilized for educational purposes is the Murrells Inlet Community Center where reading and clean up materials can be displayed. The same facility could provide space for meetings for all to learn about water sanitation. Education is the core of true progress and should be the foundation of focus in Murrells Inlet.

As public awareness increases action will follow with collective planning among residents and community organizations. The active campaign for pet waste disposal can continue outreach by collaborating with real estate companies to inform vacation renters of the community standards. Ways to infiltrate eco-friendly practices should include volunteer-based activities involving litter cleanup, shellfish habitat restoration, and watershed monitoring sites. (Murrells Inlet Watershed Plan 2014). The smaller acts to keep the community's water clean matter as well. It is imperative to realize that water outlets like toilets and sinks are not trash cans, and that wastewater is recycled to become drinking water. To address the increased flooding, we encouraged planting more moisture absorbing plants in neighborhoods and parks which will help tremendously in soaking up stormwater that floods roads and homes.

Murrells Inlet, being a coastal community that thrives on a healthy water system, needs to take into consideration the benefits of integrated water management. Future assessments and physical changes should explore how the community can come together to execute viable, sustainable solutions for their water system.

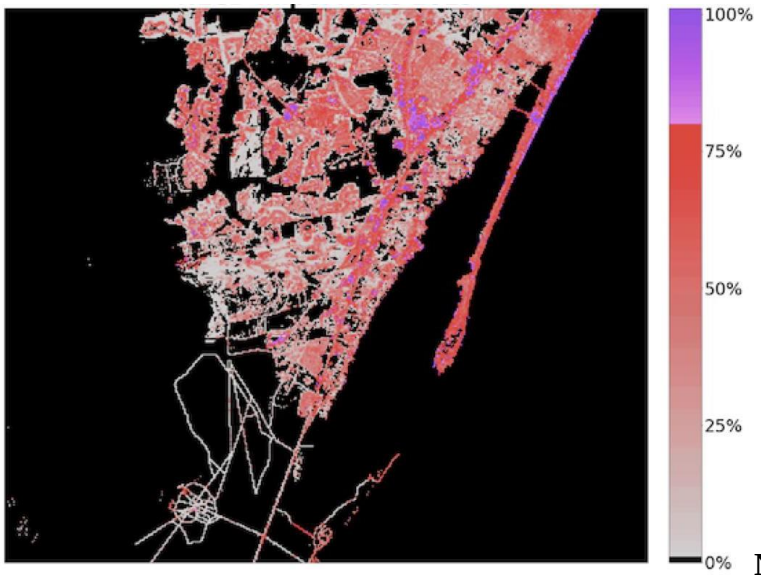
# Impervious Land Cover

Impervious land coverage includes any surface that allows little to no water to penetrate the ground. This includes things like pavement, concrete, and house roofing. As shown in the figures below since 2001 the amount of these surfaces has greatly increased which allows for debris and chemicals to directly run off into nearby bodies of water, in this case the Atlantic Ocean.




**NLCD Impervious 2001**

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

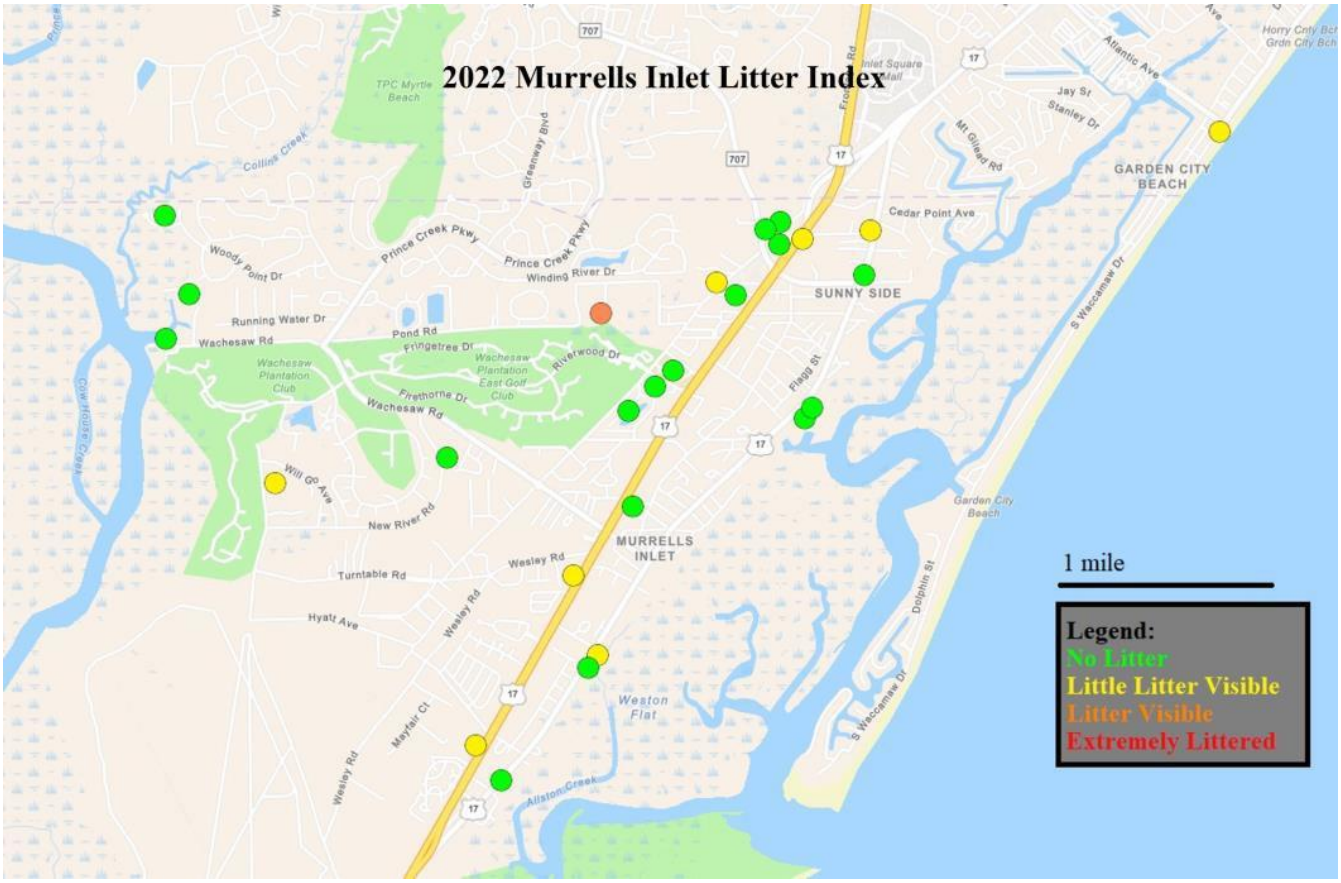



**NLCD Impervious 2019**

**Figure 7.** Murrells Inlet: Even Closer NLCDC 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.

# Debris Pollution- Litter Index

**Figure 8.** ArcGIS Map by Tyler Whitlow



Members of our team assessed multiple areas throughout the community and assessed the levels of litter present on a scale of 1 to 4, 1 being no litter and 4 being extremely littered. Students traveled to the Inlet to help survey selected areas to count the amount of trash found on the ground.

Data collectors assessed each location based on amounts of litter found. If there was a disagreement on the liter visibility, a third party would assess the location to make a final decision. Forms of litter included plastics, such as bags, straws, latex gloves, tires, and food packaging; paper such as fast-food bags, newspaper, cardboard, and receipts or office paper; metals such as beer and soda cans, electronics, and e-cigarettes; glass such as bottles and miscellaneous broken glass; and organics such as pet waste and food waste. Thanks to businesses having someone that cleans up trash in the mornings, most places were recorded as having no litter. Eight locations had little litter, one had litter visible, and no locations had extreme levels of litter.

Litter near the water can lead to microplastics being consumed by local aquatic species. In one study, a collection of 120 adult fiddler crabs were collected between September and October of 2021 at Atlantic Avenue and Oyster Landing in Murrells Inlet. They found there were approximately 5 pieces of microplastic were found per mL of saltwater from the crabs at the Oyster Landing and approximately 6 pieces of microplastic were found per mL of saltwater from the crabs at Atlantic Avenue (Conner, n.d). People may consume these crabs containing microplastics. Exposure to these microplastics and the chemicals in them can cause harm to people’s overall health.


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

| Targets | Indicators | Data |
|---|---|---|
| **8.1** Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries | **8.1.1** Annual growth rate of real GDP per capita | 3.24% employment rate increase (US Census 2020) |
| **8.5** By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value | **8.5.1** Average hourly earnings of female and male employees, by occupation, age and persons with disabilities | Average male salary is $41,162 and average female salary is $25,651 (Murrells Inlet Population 2022) |
| **8.9** By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products | **8.9.1** Tourism direct GDP as a proportion of total GDP and in growth rate | Tourism contributes more than $2 million in tax revenue for Georgetown County yearly (Georgetown County, 2013) |

Goal 8 aims to "promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all" (United Nations, 2022). Targets 8.1 is focused on the development and maintenance of a growing economy. Despite a wide acceptance of growth in Murrells Inlet, which is confirmed through interviews with politicians and interactions with residents and business owners, there is little numerical evidence for this growth. Data for just the inlet is drowning in information about the entire United States, South Carolina, and the greater Grand Strand area. Because of this lack of data, we would recommend for future research to be conducted on the specific economic impact that Murrells Inlet, both locally and in the sense of tourism, has on the Grand Strand.

Though there was a lack of data about the GDP for Murrells Inlet, employment rate growth data indicates a growing economy. There was a 3.24% employment rate increase from 2019 to 2020. This increase in employment can be correlated to an increase in GDP and an increase in the overall health of the economy of the Inlet (US Census, 2020)

In the 2020 census, the median income per capita was $48,329, with 51.5% of people over 16 working and 49.2% of females over 16 working (US Census, 2020). The US median income was $35,384 per capita, with 63.0% of people over 16 employed and 58.4% of females over 16 employed (US Census 2020). Murrells Inlet has a higher per capita income than the United States average. Though the employment percentages are lower in Murrells Inlet than the United States as a whole, this can be explained by the large number of Murrells Inlet residents who are of retirement age.

Target 8.9 focuses on the effects of tourism on the economy. Most business owners interviewed confirmed the growing number of tourists. One event that brings tourists is the annual Oyster Roast. The 2021 Oyster Roast brought over 1,000 people to the inlet. Profits from this event go toward to the Murrells Inlet 2020 organization (Varnier, 2022). This aligns with the sustainable development goal of using tourism for the betterment of sustainability. The attendance in 2022 was similar.

## Sustainable Business Certifications

The Surf Rider organization is a global organization that features local chapters throughout the world. One of these chapters can be found in Murrells Inlet. Each chapter has a different focus. The high litter volumes that will be discussed in the pages to come is the issue that the Murrells Inlet chapter is mostly focused on. They frequently host beach clean ups where Surf Rider members along with community members collect litter from the beach. They also host a yearly Oyster Roast and Bloody Mary Competition. This festival raises money for the organization to fund the remainder of its projects throughout the year.

The work done by this organization is critical to the upkeep of the Inlet. Though the organization is already doing so much for the community, the global Surf Rider organization could have even more to offer to the local chapter. Through the global organization there is a business certification. Though the organization provides both resources for restaurants and retailers, the most well-defined certification is the one provided to restaurants, which is why we would primarily suggest the use of the restaurant one. This certification could be adopted by the local chapter and implemented by the restaurants in the area.

In order to receive the ocean friendly restaurant certification, a restaurant must follow the criteria in the below listed table. In the mandatory criteria, the restaurant must follow all 7 of the requirements, but they can select 3 listed as optional criteria. If they follow all the optional criteria, then they can receive the title of a Platinum Level Ocean Friendly Restaurant. Then once they discover that they can use a forum found on the previously linked website. Once completing the forum, the restaurant will be reviewed and will receive their certification if they are approved. In Murrells Inlet, CreekRatz, Dead Dog Saloon, the Claw House, and the Wicked Tuna could apply for the Ocean Friendly Restaurant Certification through Surfrider if a few changes to their business are made (seen in Table 2).

Both consumers and the owners of the restaurants would benefit from using this resource. It would give the consumer peace of mind, knowing that the food they are consuming is not causing harm to the ocean. For the owners of the restaurants, the benefits are countless. It would attract customers who are seeking out an ocean-friendly dining experience. it would give the business advertisement as their business name would be included on the Surfrider website and possibly in newsletters. Also, it would give them discounts on sustainable products they may already be using in their establishment.

**Table 1**. *Shows the criteria listed for the Surfrider Ocean Restaurant Certification Friendly Certification*

| **Mandatory Criteria (reports must follow all 7 listed below)** | **Optional Criteria (businesses must pick at least 3 to follow)** |
|---|---|
| Only reusable food ware is used for onsite dining | A discount is offered for customers with a reusable item (e.g. cup, container, bag). |
| Proper recycling practices are followed. | Vegetarian and vegan food options are offered on a regular basis. |
| Paper straws are provided only upon request. | All seafood is ‘Best Choice’ or ‘Good Alternative’ as defined by Seafood Watch, or no seafood is served. |
| No expanded polystyrene use (aka Styrofoam) | Water conservation and pollution mitigation efforts are implemented |
| No plastic bags are used for takeout or to-go | Energy efficiency efforts are in place. |

| | |
|---|---|
| orders | |
| Beverages are not sold in plastic bottles. | Concessions and pre-packaged food items are not sold in plastic packaging. |
| Single-use utensils, straws, condiments, and other accessory items are provided only upon request. | Composting efforts are in place for food waste. |
| | Neither single-use plastic nor bio-based plastic containers are used for takeout or to-go orders, reusable containers are preferred. |

## Possible Certifications for the Inlet

There are a variety of sustainable businesses certifications that local Murrells Inlet businesses can apply for. The sustainable business certifications create an opportunity for marketing, which can increase sustainable tourism for the area. Therefore Target 8.9 "By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products" (United Nations 2022) applies. Figure 7 shows evidence of increased tourism and customers to Murrells Inlet if businesses had sustainable business certifications (see table 2).

The Green Business Bureau (GBB) is a great certification program for business in Murrells Inlet. GBB certification is the most automated and guided certification available. GBB's certification process is entirely online, and it is initiative based, so a company will receive points for each activity completed. As more initiatives are fulfilled over time, the EcoScore will increase, granting an opportunity to reach gold and platinum certification levels (Zujewski, 2022). The GBB Certification is an option to self-certify over time, and this checklist will allow businesses to access the types of requirements the businesses would need to implement. All of the six businesses are eligible (seen in Table 2) for this GBB Certification. If more of the requirements are fulfilled now and in the future.

After interviewing six restaurants and businesses in the Murrells Inlet Area, all six stated that they do not have a certification, but they would be interested in one. Table 2 lists sustainable business certifications that could apply for to each of the businesses that were interviewed. Based on the certification requirements, all six of the businesses listed in table 2, do not qualify fully for the certifications. The six businesses could be certified in the near future, if some of the requirements are fulfilled (see table 2). The Green Restaurant Association Certification (Table 2) is a point system that is awarded based off various categories (Figure 9). Restaurants such as CreekRatz, the Wicked Tuna, Claw House, and Dead Dog Saloon could be eligible for this certification if more of the requirements are met (Examples in Table 2).

# CERTIFICATION LEVELS

There are four certification levels shown below.
See below for the steps and GreenPoints™ required for each certification level.

| ITEMS | LEVEL 1 | 2 STAR | 3 STAR | 4 STAR |
|---|---|---|---|---|
| **STEP REQUIREMENTS** | | | | |
| No Polystyrene Foam | √ | √ | √ | √ |
| Recycling | √ | √ | √ | √ |
| Composting* | √ | √ | √ | √ |
| **GREENPOINTS™ REQUIREMENTS** | | | | |
| Energy | A minimum of 10 Green Points™ each in *any* 3 categories | 10 | 10 | 10 |
| Water | | 10 | 10 | 10 |
| Waste | | 10 | 10 | 10 |
| Disposables | | 10 | 10 | 10 |
| Chemicals | | 10 | 10 | 10 |
| Food | | 10 | 10 | 10 |
| Building | 0 | 0 | 0 | 0 |
| Education & Transparency | 0 | 0 | 0 | 0 |
| Minimum GreenPoints™ Required | 80*/62 | 100 | 175 | 300 |

*Composting and a total of 80 GreenPoints™ are both required in Baltimore, Boston, Chicago, Cleveland, Washington DC, New York City, Philadelphia, Portland OR, San Diego, San Francisco, Seattle, and St. Louis. For all other cities, 62 total GreenPoints™ are required and composting is not required.

**Figure 9.** *The Green Restaurant Association Certification.* In the above table Green Points™ are awarded based on the percentage of items that meet each criteria. To become a Certified Green Restaurant, enough Green Points™ must be earned across the eight categories, while earning badges like sustainable seafood, clean chemicals, vegetarian, etc. The categories include energy, waste, reusables & disposables, chemicals & pollution, food, buildings & furnishing, education & transparency (Green Restaurant n.d.).

### Incentives for Sustainable Business Certifications

All six businesses that were interviewed stated that incentives to obtain a certification would be helpful. Various incentives from the county could bring attention to sustainable business certifications. According to the South Carolina Chamber of Commerce, South Carolina "provides a nonrefundable income tax credit equal to 10% of qualifying expenditures to qualifying companies in the renewable energy field that are expanding or locating in South Carolina" (2019). Some of the businesses mentioned that tax and payroll incentives would be of interest to obtain a certification. One other benefit or incentive could be an increase in customer traffic. As businesses obtain their certifications, more customers would be willing to purchase their products and services. Therefore, an increase in sustainable tourism would be brought to the Murrells Inlet (Target 8.9). In order to further prove that sustainable business certifications can attract customers to Murrells Inlet a 4 question consumer survey was conducted to residents from Horry and Georgetown Counties. Figure 10 shows 97 Horry-Georgetown County Residents participated in the survey. 70.1% of participants stated that sustainably certified businesses appeal to the participants. Therefore, obtaining a sustainable businesses certification could increase tourisms and bring more customers to Murrells Inlet.

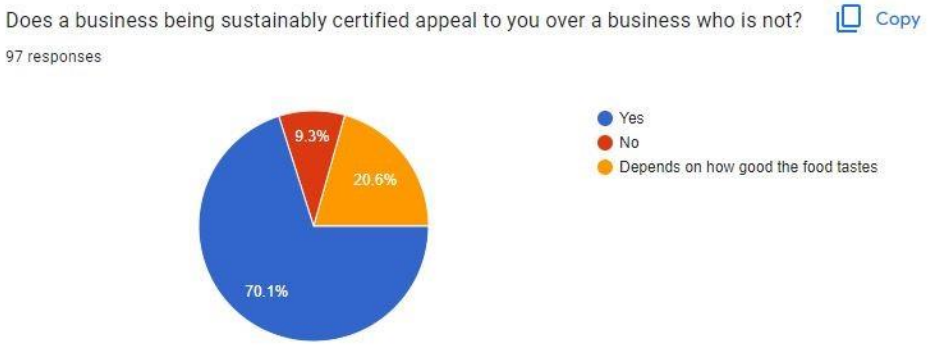



**Figure 10.** *Shows the responses of consumers, which explains that sustainably certified businesses are appealing.*

## Example Cities with Sustainable Business Certifications

### The California Green Business Network

Santa Monica, California is a pioneer for incentivizing businesses for sustainable development The Sustainable Quality Awards is just one example of how the city shows their appreciation for businesses successfully putting sustainable practices into action. Over 158 businesses in Santa Monica received the SQA Award (SQA 2019). This award is desired by businesses in Santa Monica because of the incentives provided including coverage in local publications and City TV, recognition at SQA annual ceremony where over 300 people attend and highlighted presence on Green Business Tours (SQA 2019). By obtaining a Green Business Certification in Santa Monica businesses earn a listing on the California Green Business Network. This website allows consumers to easily locate nearby Green Certified businesses. All these incentives increase the desire for Sustainable Certifications and awards. When there is more desire, the credibility builds for the businesses who are able to obtain these awards. If Murrells Inlet followed after Santa Monica and gave business owners a reason to be excited about being environmentally friendly and a reason to overlook the upfront cost increase of using sustainable products, there would be an increase in the amount of sustainable practices being used all over Murrells Inlet.

The California Green Business Network makes going green convenient to businesses. High House Tap, a local restaurant in California, looks very similar to tap houses found in Murrells Inlet, including Southern Hops. High Parks Tap House has all LED lighting, new water efficient dishwashers that save up to 5000 gallons monthly, elimination of all Styrofoam products and reduced chemical cleaning products (CGBN 2020). Though there would be upfront costs to businesses like Southern Hops who are considering making switches towards these practices, through time the benefits would greatly outweigh the initial costs. Another example of a business that has received this certification, The Mighty Bin , is San Diego's first zero waste grocery store. Unlike the High Park Tap House finding out the benefits of going green later in its life, The Mighty Bin began its life with intentions to be as low waste as possible starting from the infrastructure process. Isabelle DeMillan is behind The Mighty Bin. DeMillan provides free donated mason jars and containers and totes for purchase.

Though California and SC are different states , both value sustainability. Murrells Inlet should take inspiration from these incentives provided by local governments and certification authorities. As they give business owners a reason overlooks the initial financial increase and express their creative tendencies while also not carrying the burden of producing excessive waste.

**Delray Beach, FL Green Business Certification Program**

Delray Beach, FL is another city that has a Green Business Certification Program (GBCP). This program is voluntary but aims to join both a workplace and the environment "through increasing efficiency of energy, water, and waste" (Delray n.d.). The GBCP for Delray, FL allows for businesses to receive the certification and be included on list of Certified Green Businesses, so residents and customers can recognize the sustainable actions taken (Delray n.d.). Delray Beach gives businesses a certification checklist based on the type of business, whether this be a restaurant, hotel, or any other business. The questionnaires for Delray Beach, FL must be filled out, and questions one to five must be met to receive a "green" certification. Each business could become a "sliver" or "gold" certified business by providing additional sustainable measures. The incentives for this program include being added on a "list of Green Business in Delray Beach on the City's website and receive a Green Business Certificate for display the in business" (Delray, n.d.). These incentives can draw in customers to come to each of the businesses, while also keeping the well-being of the environment and ecosystems in mind. Yaxche Tearoom and Emporium is a certified Green Business in Delray, FL and is gold certified. Currently, there is only one businesses that utilized the Green Business Certification Program. So, this shows that Delray, FL needs to expand to other business, and provide better incentives for businesses to utilize their program.

Murrells Inlet could implement a certification program at a small scale similar to Delray Beach, FL. This program could eventually reach the popularity similar to the California Green Business Network. Delray Beach, FL is small coastal city that is similar to Murrells Inlet. Even though, Murrells Inlet does not have a local government like Delray Beach, Georgetown County could implement a Green Business Certification Program. The program could allow businesses in the county to apply to this program, and to qualify for a certification. Georgetown County could use also do similar incentives to Delray Beach, including a list of certified green businesses on their county's website. As mentioned in Delray Beach, FL not many businesses applied for the program. This could be due to the lack of communication among the city and the business community. So, Georgetown County would need to advertise its Green Business

Program, and provide incentives that are of interest to the business community. The business certification ties to SDG 8 but also SDG 6: Clean Water and Sanitation, SDG 14: Life on Land, and SDG 15: Life Above Water. If businesses are becoming more sustainable and switching to non-plastic products less plastic and litter would be seen in the Marsh, local waterways, and in local areas. SDG 8 and sustainable business certifications go hand in hand. If more businesses are seen with certifications there could be an increase in tourism, sustainability jobs, and opportunities (target 8.9). Sustainable Business Certifications paves the way for sustainable infrastructure and innovation, therefore SDG 9 is another link to the certifications.

***Table 2.*** *Shows the various sustainable business certifications that businesses could apply for, and how each business can be eligible for these certifications.*

| **Murrells Inlet Businesses that this Certification can applies to** | **Current Sustainable Practices** | **Some of the Certification Requirements** | **Can this certification be applied?** |
|---|---|---|---|
| -CreekRatz<br>-Dead Dog Saloon<br>-Claw House<br>-The Wicked Tuna<br>-Lazy Gator<br>-Express water sports | -Biodegradable to-go containers<br>-Boxed water | **Green Seal**<br>-Sanitary products like toilet paper, paper towels, napkins, etc. are safe for human health, made from recycled material, and it is biodegradable<br>-Food service packaging like **to-go containers** includes recycled material, is compostable, free from chemicals, and is unbleached (Green Seal n.d.).<br>-Paper produced in food preparation is safe for human health and is made from recycled paper (Green Seal n.d.)<br>-This is not the full standard list for more standards click: Green Seal Standards | Yes, if the business makes additional sustainable changes, they are eligible for the certification. |
| -CreekRatz<br>-Dead Dog Saloon<br>-Claw House<br>-The Wicked Tuna | -Recycling (see table 4.1)<br>-Paper Straws (only requested) | **Surfriders Ocean Friendly Restaurant Certification (These 7 are required)**<br>-Only reusable food ware is used for onsite Dining (Surfrider 2022).<br>-Paper Straws are provided only upon request (Surfrider 2022)<br>- No Styrofoam used<br>-No Plastic bags are used for takeout or to-go order (Surfrider, 2022).<br>-Single-use utensils, straws, condiments, and other accessory items are provided only upon request (Surfrider, 2022).<br>-Beverages are not sold in plastic bottles (Surfrider, 2022).<br>-Proper recycling practices are followed (Surfrider, 2022).<br>-For more information click the link: Surfrider Ocean Friendly Restaurants | Yes, if the business makes additional sustainable changes, they are eligible for the certification. |

| | | | |
|---|---|---|---|
| -CreekRatz<br>-Dead Dog Saloon<br>-Claw House<br>-The Wicked Tuna | -Recycling<br>-Oyster shell recycling<br>-biodegradable to-go containers<br>-reusable cleaning cloths<br>-noodle straws | **Green Restaurant Association Certification (points are given to various categories)**<br>- Food sourced within 100 miles like poultry, pig, cow, fish, dairy, and other items (Green Restaurant n.d.)<br>- Vegan and vegetarian options<br>-Sustainable sourced seafood with sustainable food certifiers<br>-Reusable hand towels in restrooms<br>-Menus available by QR code or chalk board<br>-Paper disposables and reusable alternatives are made with recycled material<br>-Grease recycling<br>-No printed receipts<br>-Composting programs<br>This is not a full standards list, so for more information on their standards click: Green Restaurant Association Certification Standards | Yes, if the business makes additional sustainable changes, they are eligible for the certification. |
| -CreekRatz<br>-Dead Dog Saloon<br>-Claw House<br>-The Wicked Tuna<br>-Lazy Gator<br>-Express Water Sports | -Biodegradable To-go Containers<br>-Reusable plates and cups<br>-Noodle and paper straws<br>-Boxed water | **The Green Business Bureau Certification**<br><br>-Use compostable, biodegradable packaging<br>-Use packaging from recycled products or materials (Green Business 2022)<br>-Purchase reusable plates, cups, cutlery, and kitchenware<br>-Locally sourced foods (Green Business 2022)<br>-Low flow plumbing (Green Business 2022)<br>This is not the full list of qualifications, but for the checklist click: GBB Checklist | Yes, if the business makes additional sustainable changes, they are eligible for the certification. |


# BUILD RESILIENT INFRASTRUCTURE, PROMOTE INCLUSIVE AND SUSTAINABLE INDUSTRIALIZATION AND FOSTER INNOVATION

| Targets | Indicators | Data |
|---|---|---|
| **9.3** Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets | **9.3.1** Proportion of small-scale industries in total industry value added | 5 of the 10 most recently added businesses to the Murrells Inlet Chamber of Commerce are locally owned (Murrells Inlet Chamber of Commerce 2022) |
| **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 acting in accordance with their respective capabilities | (To apply this to the Inlet we altered the indicator to be more local)<br>**9.4.2** Value of upgrades being made to infrastructure | -Businesses and individuals are making changes. Average dock repair is $30,000 and 270 docks needed repaired after Hurricane Ian, meaning $8.1 million dollars is being spent on dock repairs (Greenbeach, 2022)<br>-See table 3 |

Changes in property values in Murrells Inlet are cause for concern for residents of Murrells Inlet. Within the inlet, there has been an increase in residential real estate valuations of properties on the marsh by at least $194 million (Herazo, 2022). In the past summer a 300-apartment complex was built, these luxury complexes are an insight into the future of real estate in the inlet (Caines, 2022). As the number of permanent residents in the area increases it has started to overdevelop, disturb wildlife, and slowly decrease any resilience factors. For many people they also see this growth as a disruption to the life they were once accustomed to. As Senator Goldfinch stated, “Well, you can count the number of people that are from Murrells Inlet on one hand that are left here and there are just not many of us, not that many of us from Georgetown and Horry County at all. I don't think people want to see it become anything more than what it is if that makes sense. Most people don't want to see it turn into an economic hub of any kind. Most people want it to stay the same or even go back 30 years quite honestly. I am sort of one of the people who want to see it go back 30 years.” (Goldfinch, 2021). Though this is a sentiment expressed by many residents of the community, living in coastal regions has become increasingly popular and inlet is expanding. Due to this expansion, the smaller infrastructure is beginning to fail.

These failures can be seen through the businesses that are continuously affected by hurricanes and frequently face damages. Murrells Inlet business owners and managers were interviewed and asked about the flooding and repair cost. While visiting Murrells Inlet to identify the impacts Hurricane Ian had on Murrells Inlet, we were able to conduct interviews with some local restoration services. Green Beach Builders workers informed us that around 270 docks needed to be repaired with the average cost per repair being $30,000 (Greenbeach Builders 2022). Instead of rebuilding these unreliable docks repeatedly, we suggest the addition of floating removable docks. The upgrades of these docks applied to target 9.4. The affordability and sustainability of floating removable docks make them a viable option for those with standard docks that repeatedly face damages. Table 3 lists other property damage that was incurred by local businesses. Property damage has an important economic impact on businesses in the area, but this damage could be mitigated with proper infrastructure upgrades. Infrastructure upgrades in relation to sustainable business certifications (See Table 2) mentioned SDG 8: Decent Work and Economic Growth can provide an opportunity for innovation and create a sustainable Murrells Inlet.

**Table 3.** *Lists the property damage costs that businesses experienced during various hurricanes. These are rough estimates that the business had to pay for. It was unclear if their flood insurance covered the costs of some of this damage.*

| Business | Cost in Property Damages during storm events, hurricanes, and floods after 2015 |
|---|---|
| Wicked Tuna | $20,000-$40,000 (Scott, 2022) |
| Lazy Gator | Under $1,000 (Batten, 2022) |
| Express Water Sports | Over $45,000 (Express Water Sports, 2022) |
| Dead Dog Saloon | Over $65,000 (Campbell, 2022) |

Though for many the addition of new businesses is seen as possibly detrimental to the environment and lifestyles of the residents, it can lead to a sustainable economy for the community and build community connections when done correctly. It is important for a community to have a high proportion of businesses that are locally owned to have a sustainable economy (Target 9.4). For Murrells Inlet this is not an issue. As 5 of the 10 most recently added businesses to the Murrells Inlet Chamber of Commerce website were locally owned (Murrells Inlet Chamber of Commerce, 2022). This is above the average percentage of locally owned businesses. It is important for Murrells Inlet to continue to value these smaller-scale businesses.

Photo of storm damage to a pier during Hurricane Ian, September 30th, 2022. Photo by Brandon Roberts.

Photo of the reconstruction of a boat dock after Hurricane Ian, October 4th, 2022. Photo by Aaron Osborn.


# MAKE CITIES AND HUMAN SETTLEMENTS INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE

| Targets | Indicators | Data |
|---|---|---|
| **11.b** By 2020, increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels | **11.b.2** Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies | The need of Murrells Inlet Plan |
| **11.3** By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries | **11.3.1** Ratio of land consumption rate to population growth rate | 45.45% population growth vs. 14% increase in developed land |
| **11.4** Strengthen efforts to protect and safeguard the world's cultural and natural heritage | **11.4.1** Total per capita expenditure on the preservation, protection and conservation of all cultural and natural heritage, by source of funding (public, private), type of heritage (cultural, natural) and level of government (national, regional, and local/municipal) | $271,742.79 requested for environmental protection |

Photo of major flooding during Hurricane Ian, September 30th, 2022. Photo taken by Brandon Roberts.

The rapid development of Murrells Inlet can be related to the importance of building a sustainable city. One way to view the goal of a sustainable city is to divide it into the 3 pillars of sustainability: equity, economy, and environment. Below is a table that does this for the community of Murrells Inlet.

| Equity | Economy | Environment |
|---|---|---|
| For some, the impacts felt by a natural disaster are worse than others. It is often those already facing lower incomes who feel the effects of disasters the hardest. The South Carolina Resilience Revolving Act was introduced in 2019 to help reduce the impacts of flooding on the coast. This allows properties that experience flooding in South Carolina to apply for a buyout to complete floodplain restorative projects. (SC Office of Resilience, n.d.)<br>The American Rescue Plan Act (ARPA) also has a Stormwater Infrastructure program to lessen the impacts of flooding and give funding to the South Carolina Office of Resilience. (U.S. Climate Resilience Toolkit, n.d.) | In an interview Greenbeach Builders informed us that they were going to need to repair 270 different docks with an average repair cost being around $30,000 (Greenbeach Builders 2022). Though this is beneficial to their construction business, for those covering the repair bill this could be a major additional cost for which they didn't budget. A solution to this issue could be replacing the current docks with a floating dock. This would allow for the owners of the docks to remove them from the water before the storm comes. Though the upfront cost would be high, the long-term investment would eliminate the costly repair bills. | Estuaries have faced degradation and declining health due to coastal development, dredging, and toxic runoff. Using the US Climate Resilience Toolkit, the community of Murrells Inlet can create a climate action plan using the USCRT Steps to Resilience. These steps include understanding exposure, assessing vulnerability and risk, investigating options, prioritizing and planning, then acting. Reducing the risk of coastal hazards is especially important due to the frequency of tropical storms and hurricanes which cause detrimental damage and flooding to the area. (U.S. Climate Resilience Toolkit n.d.) |

**Table 4**. *Goal 11 in the Different Branches of Sustainability*

Though this is an important outlook on the sustainability of the development of Murrells Inlet, it is also important to consider other data that we collected. It is well known that the community is growing. One of the indicators of sustainable development is the land development percentage compared to the population growth rate. For Murrells Inlet the population growth rate has been approximately 44% since 2000 (USA Today 2022) while there has only been a 14% increase in land usage (Fratwell, 2021). One explanation is the increase in structures that have vertical development, such as the apartment complex mentioned in goal 9, as this would allow for an increase in the number of residents without increasing the amount of land used. Though this is positive that there has been a much higher population growth without nearly as much land use growth, it is still important to consider the overall land available in Murrells Inlet for development. Since there is not as much land that can be developed it is important to continue to conservatively use this precious resource.

# Raleigh North Carolina: A Best Practice Example

Raleigh, North Carolina is a parallel to what Murrells Inlet could be. Though it is 50 times larger than Murrells Inlet, the successes that they have experienced could be felt by a smaller inlet community like Murrells Inlet. Raleigh is one of the cities in the southeast that has devised a community climate action plan. For those who are unaware of what this means, it is simply a set sustainability climate action-based goals for a community and an outline of ways these goals will be achieved and assessed.

For Raleigh everything from energy and new construction to climate equity are outlined in the community climate action plan. Having a set plan has been a success for Raleigh. These successes can be the same for Murrells Inlet, although on a smaller scale, if a similar plan is implemented. For Murrells Inlet, the Sustainability Assessment that preceded and followed is the plan that can be implemented and lead to successes.


North Carolina Museum of History. Photo by Jenna Monroe July 20th, 2019

Raleigh has a long history of working towards a more sustainable future. Beginning in 2007, the town adopted the “US Mayor's Climate Protection Agreement”. The accolades and achievements, as well as further additional planning, have been plenty since this. They have been ranked among the best cities for electric vehicles, one of the first cities in North Carolina to receive a 4-star rating through the STAR rating system (a system for ranking based on a series of sustainability goals) and have received many accolades from the Public Technology Institute (PTI) for the progress they have made.

It is important to remember the value of time for progress. The US Mayor's Climate Protection Agreement began being used in 2007 and for most of the awards received, 6 to 7 years had passed since 2007. But this should not deter communities looking to make progress from the beginning of the process. It should instead be a call to make the change now. If we all knew that progress was not guaranteed and could take years to happen, then starting toward progress would have much more of an urgency to it.

Photo of a shipwrecked boat in the Murrells Inlet estuary.
Photo taken by Jordan Roballo on October 4th, 2022.


| Targets | Indicators | Data |
|---|---|---|
| **12.2** "By 2030, achieve the sustainable management and efficient use of natural resources" (United Nations, 2022). | **12.2.1 "**Material footprint, material footprint per capita, and material footprint per GDP" (United Nations, 2022).<br>**12.2.2** Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP" (United Nations, 2022). | - Interviewed 6 business and determined the amount of waste generated (see table 5.1) |
| **12.5** "By 2030, substantially reduce waste generation through prevention, reduction, recycling, and reduce" (United Nations, 2022) | **12.5.1** "National recycling rate, tons of material recycled" (United Nations, 2022) | - Interviewed 6 businesses and determined if the business recycled (see table 5.1).<br>-2 our 6 business do not recycle<br>-4 out of 6 businesses do recycle<br>-Business were interviewed regarding their sustainable products |

Tourism, water quality, environmental health, and the local economy in Murrells Inlet all relate to responsible production and consumption. Restaurants and businesses along the marsh can directly and indirectly affect the health of the marine ecosystem through food waste, plastic trash, single-use items and chemicals. These cause eutrophication[1], sediment build-up, even strangulation to marine life.

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 vegetables), 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. Between 40 and 150 bags of trash (see table 5.1) are thrown out daily during the busy summer season by restaurants surveyed on the Marshwalk in 2022 (CreekRatz, Gamble, & Scott, 2022). However, that might not be viable in every case.

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 municipality action, the fines rarely get enforced. Providers of sustainability 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 Marshwalk 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 environment or art are also relevant.

[1] The process by which photosynthetic algae accumulates in a body of water

Reviewing major events hosted throughout the year can help to better understand focal points in the Inlet's tourism activities. Bigger events led to more consumption of to-go containers and increased pollution going 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 through the food chain to eventual human consumption.

Murrells Inlet, Marshwalk Walkway, 2022. Example of how oyster shells are recycled. Picture taken by Katelyn Cilino.

While in Murrells Inlet, six local businesses were interviewed regarding their waste generation, sustainable products, and flooding. As the survey in Murrells Inlet was taken, only three out of the six businesses interviewed recycle bottles, cans, and cardboard. Restaurants in the Murrells Inlet area generate a high volume of waste during the summer season. For example, CreekRatz generates roughly 20 bags full during the off season and about double during the summer season per day (CreekRatz, 2022). Lazy Gator is not a restaurant and generates less than one bag a day (Batten, 2022). Compared to bigger restaurants the Claw House generates 100-150 bags a day during the busy Summer Season (Gamble 2022), but the Claw House recycles their oyster shells. This indicates that Target 12.5 indicator 12.2.1 and 12.2.2 are works in progress for restaurants in the Murrells Inlet area. One indicator to improve measuring the SDG 12 targets and indicators, suggested by the UN, could report a recycling rate for each business located in the Murrells Inlet area. Murrells Inlet needs to implement a more efficient recycling and waste management system to reduce their waste consumption. A compost and recycling collection pick up could also be implemented. Coastal Carolina University is one example of this because they hired a company to pick up their compost from dining halls multiple times weekly.

As mentioned above, in various interviews collected from Murrells Inlet businesses and restaurants, four out of six businesses interviewed recycle (see table 5.1). The Claw House, The Wicked Tuna, Lazy Gator Gifts, Express Watersports, and CreekRatz have stated that between the businesses, they use cloth napkins, paper and biodegradable straws, glassware, and "no-throw away" cups (see table 5.2). The same businesses rated the importance of using organic and/or chemical free products, fresh and local ingredients, reducing waste, using reusable and paper-based products, and eliminating single-use plastics between 3 and 5. Being sustainable is particularly important to the Murrells Inlet business community.

| Businesses | Waste Generated Daily (Summer Season) | Recycles |
|---|---|---|
| Creek Ratz | 40 bags (Creek Ratz 2022) | No |
| Express Water Sports | 5-7 bags (Express Water Sports 2022) | Yes |
| Claw House | 100-150 bags (Gamble 2022) | Yes & oyster shells |
| Wicked Tuna | 60 bags (Scott 2022) | Cardboard |
| Lazy Gator | Less than one bag (Batten 2022) | No |
| Dead Dog Saloon | At least 15-20 bags (Inman 2022) | Yes |

***Table 5.1*** *Shows the amount of waste that is generated during a busy summer season, and the businesses were also asked if they recycle.*

## Sustainable Products and Practices Already Being Used in Murrells Inlet


Photo taken by Tyler Whitlow November 12th, 2022, Annual Oyster Festival

In Murrells Inlet there are a variety of local businesses, restaurants, gift shops, and residential communities. These businesses and communities play a role in the overall consumption and waste generation within Murrells Inlet. Various businesses located in Murrells Inlet were interviewed from October to the beginning of November 2022 about their sustainable products and practices. To elaborate on table 4.2, Ms. Brooke Gamble explained that the Claw House cleaning cloths are not thrown away, but instead they are sent out to be washed (Gamble, 2022). This practice eliminates the cloths being sent to the landfill, so target 12.2 is displayed. The Claw House also recycles their used oyster shells. The oyster shells are washed and shipped to be sold for other uses. The picture above shows an example of recycled oyster shells. Therefore, target 12.5 is amplified at local Murrells Inlet Businesses. Some issues, Mr. Campbell noted that the supply chain for these sustainable products has been "broken," because larger businesses corporations are buying all the cheaper sustainable products in bulk and leaving nothing but plastic products and more expensive sustainable products. Smaller businesses like Dead Dog Saloon, cannot afford to buy in bulk (only small amounts) or to purchase more expensive products (Campbell, 2022). This impacts SDG 12, in a negative way because both the Claw House and Dead Dog must purchase plastic products because there are not enough sustainable products readily available for the business to purchase.

As seen in table 4.2, businesses are making small sustainable changes, and therefore can apply for various business certifications (see table 2) in SDG 8: Decent Work and Economic Work. As businesses shift to more sustainable and plastic free products, less plastic litter could be seen in Murrells Inlet as seen in the litter index (see figure 8). Which can lead to improved water quality (SDG 6: Clean Water and Sanitation) and decrease the effects on marine life (SDG 14: Life Below Water).

| Business Interviewed and/or Completed Survey | Sustainable Products and Practices |
|---|---|
| Brook Gamble, the Assistant General Manager of the Claw House | Recycled paper straws<br>Biodegradable to-go containers (Gamble, 2022)<br>Cleaning cloths are washed and reused<br>Oyster shells are recycled |
| Mr. Mike Campbell, Managing Partner of Dead Dog Saloon and the Claw House | Recycled paper straws<br>Biodegradable to-go containers (Campbell, 2022) |
| Express Water Sports | Boxed Water<br>No straws used (Express Water, 2022) |
| Emily Scott, the Front House Manager at the Wicked Tuna | Noodle straws<br>Cardboard straws<br>Reusable cups<br>Plates are non-breakable reusable plastic (Scott, 2022). |
| Lazy Gator, JD Batten, Partner | Paper bags<br>Paperboard candy boxe**s (**Batten, 2022) |
| CreekRatz | Biodegradable to-go containers and straws (CreekRatz, 2022). |

***Table 5.2*** *Shows six businesses that were interviewed regarding what sustainable products and practices are being used. See table 2 for sustainable business certifications that could apply.*

**Sustainable Products that Could be Used**

To promote SDG 12: Responsible Consumption and Production we can look at the products and practices used in restaurants, gift shops, tourism activities and boating companies. These directly tie to the natural elements like the marsh and oceanside when considering waste disposal and considerable pollution. The importance of choosing sustainably made products to use or sell encourages visitors and other businesses to be conscious consumers. Non-plastic substitutes, reusable containers, and supporting ethically made products from renewable and responsible sources is important for businesses and consumers to be aware of. If restaurants in Murrells Inlet could adopt the use of cloth napkins, paper straws, composting, minimizing food waste, choosing to use eco-friendly cleaners, and updating energy efficient appliances, their carbon footprint may significantly decrease. Among other efforts by shopkeepers to sell jewelry made from the ocean, including trash that's been collected as an attempt to clean up local beaches and the ocean. Reusable water bottles, trendy flip flops and tote bags made from recycled materials, perhaps localized or in partnership with other beachside towns can bring people together to minimize disposable products made in China and support other local sustainable businesses. Companies like 4Ocean make sustainable products, many from recycled products like plastic bottles, tire rubber, and microplastics found in the ocean. A

collective effort to clean up our oceans and choose sustainable products could limit Murrells Inlet tourism's effect on our environment, and support and encourage along the way.

A sustainable product that can be used in several of the restaurants in the area would be implementing eco-friendly cleaning products such as Blueland products. Blueland is a company that offers sustainable household cleaners like laundry detergent, toilet cleaners, dish soap, and other cleaning products. This company focuses on reusable products such as their bottles which they call “forever bottles" and their shipments do not contain any liquid or anything that could spoil or end up in a landfill. “We’ve been carbon neutral since 2020 and climate neutral certified since 2021” (Blueland, 2022), so Blueland is an excellent company to support. Another sustainable product that could be used in restaurants would be reusable napkins instead of the classic paper towel napkins that can just be thrown away. Reusable napkins can be washed and used again. Since COVID-19 some practices have changed forever. Businesses could implement a compost bin in the kitchen for food waste and a recycling bin to make sorting waste easier.

Furthermore, noodle straws are a great substitute for plastic and paper straws. Wicked Tuna located at the Marshwalk is one example of a restaurant that uses this product (See Table 4.2). Made from real noodles, they last an hour in a cold drink and are easily disposed due to fast decomposition in contrast to plastic that sits in landfills for millions of years (Stroodles, 2022). Other eco-friendly straws are even made from avocado pit, corn, grass, bamboo and of course medal. Implementing a more environmentally conscious straw will decrease waste and potential pollution generated by Murrells Inlet restaurants.

Photo of washed-up boat found in Murrells Inlet between a restaurant and the Marshwalk. Photo taken by Brandon Roberts, October 4th, 2022.

Photo of plastic bottle floating in the inlet. Photo taken by Lindsay Brown, September 28th, 2022.

Single use plastic bags are harming our planet in unimaginable ways, so by switching to reusable shopping bags we can alleviate this issue. Businesses can stop giving out plastic bags to customers and could qualify for a sustainable business certification (See Table 2). Murrells Inlet gift shops and stores could start a reusable bag program and eliminate the usage of single-use plastic bags. Murrells Inlet and Georgetown County can start a plastic bag ban, like North Myrtle Beach, SC. Banning single-use plastic bags can financially benefit both business owners and the environment. The business can see a reduction in their day-to-day costs by not purchasing single-use plastic bags.


# TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS

| Targets | Indicators | Data |
|---|---|---|
| **13.1** Strengthen resilience and adaptive capacity to climate related hazards and natural disasters in all countries | **.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 | Barriers are supposed to separate ecosystems to protect the natural environment. The removal of barriers can drown the wetland. |
| **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 | Since the construction of jetties in 1970, creeks have become shallower.<br>Population has increased 4.5% since 2020 (COVID-19 population increase), meaning the need of abundant sustainable resources is growing. |

The natural environment interacts with everything, living and nonliving, resulting in both many advantages and disadvantages (Target 13.1). Understanding the nature of the issue and what might be having significant negative effects on the natural ecosystems is the first step toward maximizing the benefits and minimizing the drawbacks.

Renewing attention to agricultural, natural resource, and ecosystem management strategies will be necessary to adapt natural systems to help counteract future climate change impacts. Plans, policies, and guidelines that support conservation and development practices must comprehend biodiversity and ecosystem services and incorporate them into all aspects of planning if they are to be in harmony with the environment (Target 13.2). Due to the size and complexity of the problems, an interdisciplinary approach is required. To create effective plans to direct development that is in harmony with nature and that will help combat climate change, planners will need to consult with experts and practitioners in ecosystem management, agriculture, forestry, and public health (American Planning Association, 2021). Because they improve water quality, reduce coastal erosion, protect against flooding, sequester carbon, and support marine fisheries, the marshes that replace inundated forests and farmland are considered among the most valuable ecosystems in the world.

Barriers are supposed to separate marshes/estuaries and the human population/businesses (or another land region) to not only protect the natural environment but to make sure one ecosystem does not blend into the next, i.e., 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 forests.

The formation of ghost forests and the wholesale reorganization of ecosystems start with more subtle changes that can be predicted with a better understanding of the ecological processes that link sea level rise and land conversion. Live trees may exhibit reduced sap flow and annual growth during the early stages of groundwater salinization, though this is not always observed. Forest distress becomes more visible during the next stage of ghost forest formation. Tree recruitment stops and young trees die noticeably. The tree age distributions skew towards older trees at lower elevations because recruitment stops before the death of mature trees, and relict trees act as waiting ghost forests (Kirwin, 2019). As adult trees die, salt-tolerant species take hold in the understory, helped by improved light penetration and seed delivery from storm-wrack deposits. The transition from forest to tidal wetland is frequently dominated by shrubs (Kirwin, 2019). A striking final indicator of uplands that have been displaced by sea level rise and saltwater intrusion is dead trees highlighted by wetland vegetation.

Photo of flooding in Murrells Inlet during Hurricane Ian, September 30th, 2022. Photo by Brandon Roberts.

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). Once those jetties were added there was visible change to the landscape of Murrells Inlet. 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).

Murrells Inlet must ensure abundant, accessible, and sustainable natural resources. From 2020 to 2022, Georgetown County has seen a 4.5 percent population increase (World Population Review, 2022). For the citizens of Murrells Inlet, this means people are now driving more miles, consuming more land, and increasing recreational activities. Not only does increased population entail increased individual consumption of natural resources, but it also means a larger ecological footprint for Murrells Inlet. During a discussion with Murrells Inlet residents, a strong focus was placed on the importance of climate action. Several Murrells Inlet residents are dealing with massive floods and erosion of their personal property.


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

| Targets | Indicators | Data |
|---|---|---|
| **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 nutrient pollution and (b) plastic debris density | Nutrient pollution (TDS) Index- Graph that shows TDS levels in 2 locations in MI<br>Litter Index |
| **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** Use ecosystem-based approaches to managing marine areas, such as oyster reefs | Oyster shell recycling, prioritization of areas suitable for habitat restoration, use of recycled shells to create artificial reefs for new habitat, utilize SCORE Program |
| **14.3** Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels | **.1** Average marine acidity (pH) measured at agreed suite of representative sampling stations | Consistently measure average pH levels at numerous sampling sites |
| **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, and create habitats to increase fish populations | Monitor fish stock levels to ensure no overfishing<br>Stock game fish for sport to make sure population levels are stable<br>Create artificial reefs to increase fish populations |
| **14.5** By 2020, conserve at least 10 percent of coastal and marine areas, consistent with national and international law and based on the best available scientific information | **.1** Coverage of protected areas in relation to marine areas | Conserve shellfish harvest areas and protect endangered species<br>Classification of shellfish harvest areas as Approved, Conditionally Approved, Restricted, or Prohibited |

Stormwater runoff is a major cause of the degradation of estuarine health as it pollutes the water with toxins that flow in from flooded areas. Nutrient pollution comes from stormwater runoff, which is one of the issues Murrells Inlet discussed regarding flooding impacts (Target 14.1.1). Nutrient pollution increases ocean acidification and unsafe water quality. Waccamaw Watershed Academy (WWA) at Coastal Carolina University has a Volunteer Water Quality Monitoring Program that assesses the quality of water along multiple transects in Murrells Inlet. In Rum Gully Creek and Oyster Landing, there are extremely large numbers of Total Dissolved Solids (TDS) (Figure 11).

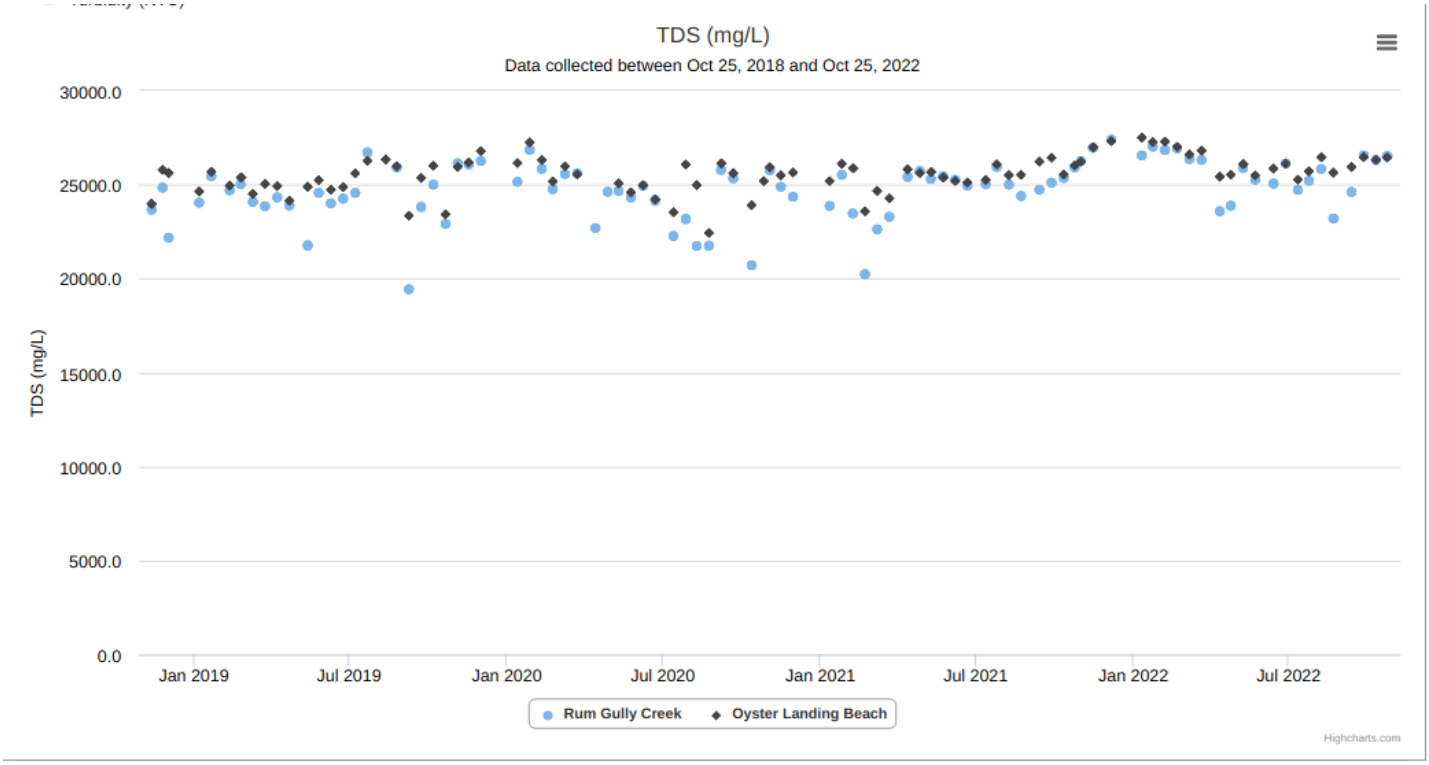



**Figure 11.** Time trend of the levels of Total Dissolved Solids in Rum Gully Creek and Oyster Landing Beach in Murrells Inlet, South Carolina. Data retrieved from the Waccamaw Watershed Acadamy's Volunteer Program at Coastal Carolina University.

Based on the data collected by WWA's Volunteer Monitors, the water in both locations of the inlet ranges from just below 20,000mg/L to just below 30,000mg/L. The 2014 Murrells Inlet Watershed Plan addresses water impairments in local shellfish harvesting areas, including Watershed Best Management Practices. The Low Impact Development (LID) focuses on several environmental principles, with management of stormwater being the main targeted goal. Design techniques, such as rain barrels, green roofs, permeable pavements, strategic tree plantings, rain gardens, engineered or restored wetlands, and bioretention facilities, have been installed as a functional part of the Murrells Inlet landscape to achieve the desired runoff reduction outcomes (Murrells Inlet Watershed Plan 2014). The

community also faces fluctuating levels of plastic debris pollution, which can be seen and explained by the litter index constructed by our team above (Figure 8).

Target 14.5.1 is important to assess, as conserving coastal and marine ecosystems is vital to maintaining the health of the inlet. This involves conserving the inlet and estuary, as well as natural resources and biodiversity. A vital ecosystem that must be conserved is the shellfish habitat. To ensure no overharvest and that unhealthy populations are able to recover, SC DHEC classifies Shellfish Harvesting Areas as Approved, Conditionally Approved, Restricted, and Prohibited (Murrells Inlet Watershed Plan 2014). Murrells Inlet is home to numerous endangered species which need to be protected, as well as their habitats. The Carolina Pygmy Sunfish is state threatened and recognized as critically imperiled, the Shortnose Sturgeon, Florida Manatee, and Loggerhead Sea Turtle are recognized as federally and state endangered, and all these species have highest priority for the SC Wildlife Action Plan (Tracked Species by County 2022). Sea birds that rely on the ocean for food, such as the Great Egret and Wilson's Plover, are also protected under the Migratory Bird Treaty Act (Tracked Species by County 2022).

In Georgetown County as a whole, commercial fishing plays a significant role in not only the economy, but the culture as well. The fishing economy in Georgetown County is supported by wetlands due to the high biodiversity they have to offer, such as oysters, mussels, redfish, barracuda, flounder, Gray Reef Snapper, Red Drum, etc. Fish need proper water conditions to thrive, and without the help of oysters regulating water quality it could impact the fishing livelihood of many Murrells Inlet locals. Healthy water conditions include proper levels of pH and dissolved oxygen (DO) (Target 14.3.1).

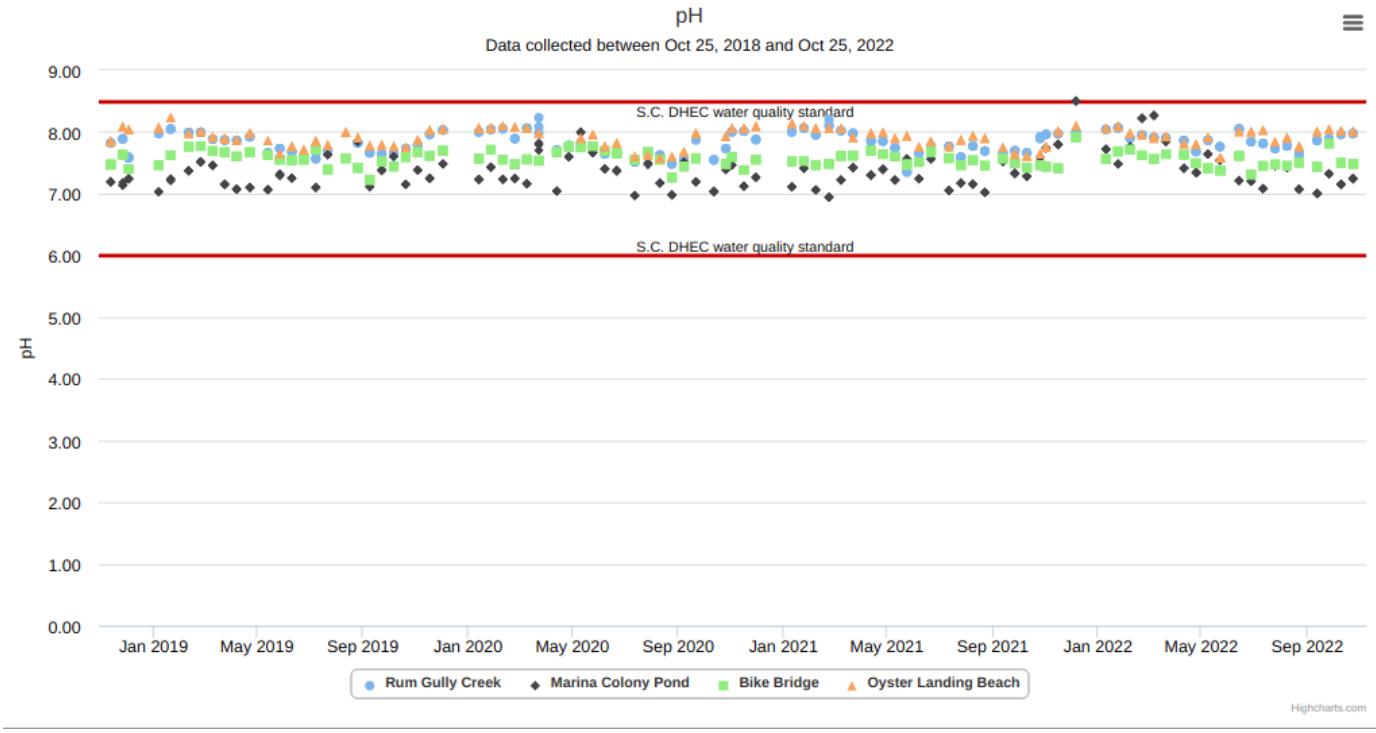



**Figure 12.** Time trends of the pH levels in Rum Gully Creek, Marina Colony Pond, Bike Bridge, and Oyster Landing Beach, located on the inlet in Murrells Inlet, South Carolina. Data retrieved from the Waccamaw Watershed Acadamy's Volunteer Program at Coastal Carolina University.

The standard pH level for the marine ecosystem is about 8.1 (“Dissolved Oxygen” 2019), and pH levels in Murrells Inlet have been at safe, rather consistent levels since January 2019. Marine fish thrive in pH levels between 4.5 and 7.8, and some levels in Murrells Inlet get up to about 8.3. If levels rise higher than they currently are, fish will either die or leave the area, and the prosperous fishing community of Murrells Inlet would diminish. Therefore, taking proper care of the estuary is vital, both environmentally and economically. DO levels are also important for the health of fish stocks because if dissolved oxygen concentrations drop below a certain level, fish mortality rates will rise. In the ocean, coastal fish begin to avoid areas where DO is below 3.7 mg/L, with specific species abandoning an area completely when levels fall below 3.5 mg/L (Dissolved Oxygen, 2019). The average DO level between the four sites is about 6.0, which luckily for Murrells Inlet is well above the SC DHEC water quality standard.

To go along with the importance of pH and DO levels required for fish survival, implementing management plans to increase fish stocks are also important to ensure populations are large enough to stay in line with the maximum sustainable yield for fisheries. Off the coast of Murrells Inlet is Paradise Reef, which is a Special Management Zone where the use of a powerhead or bottom longline is prohibited and fishing can only be conducted with a handline, rod and reel, or spearfishing gear (South Atlantic Fishery Management Council 2022). In order to adhere with the Best Fishing Practices designated by the federal laws, the South Atlantic Fishery Management Council requires specific gear in order to legally fish for snapper and grouper (South Atlantic Fishery Management Council, 2022).

The National Oceanic and Atmospheric Administration (NOAA) designates Annual Catch Limits (ACLs) for commercial fish species along the Southern Atlantic coast, including Murrells Inlet. According to the preliminary landing for the 2022 fishing season, the Blueline Tilefish (102.8 ACL%; 2.8% over the yearly limit) and the Golden Tilefish (102.2 ACL, 2.2% over the yearly limit) were both overfished in the 2022 season, while all other fish landings remained within the yearly limits. The list also states which fish are prohibited from being caught, which includes the Goliath Grouper, Nassau grouper, Warsaw Grouper, and Speckled Hind (2022 Preliminary South Atlantic Commercial Landings, 2022). **Figure 13** shows a small example of the species allowed for commercial fishing, as well as their estimated landings, ACL, and ACL percentage (which shows how much of the total limit has been fished). Murrells Inlet stocks game fish, such as Red Drum, into local waters to ensure populations remain high and to have the ability to follow the survival and dispersal of hatchery-raised fish into the wild population (SC Marine Stocking Research Program, 2022). Murrells Inlet also has created numerous artificial reefs off the coast in order to attract fish to increase populations for the last 40 years, improving habitat and spawning grounds for a diverse array of fish and marine life (SCDNR News, 2019)

| Species Complex | Fishing Season ** | Estimated Landings (lb) | ACL (lb) | Units | ACL (%) | Current Status |
|---|---|---|---|---|---|---|
| Gray triggerfish [j] | 01/01/22–06/30/22 | 92,002 | 156,162 | ww | 58.9 | CLOSED |
| | 07/01/22 – 12/31/22 | 121,409 | 156,162 | | 77.7 | OPEN |
| Red Porgy [a] [n] | 01/01/22 – 04/30/22 | 17,328 | 49,200 | ww | 35.2 | CLOSED |
| | 05/01/22 – 12/31/22 | 42,506 | 114,800 | | 37.0 | OPEN |
| Snowy Grouper [n] | 01/01/22 – 06/30/22 | 76,102 | 107,754 | gw | 70.6 | CLOSED |
| | 07/01/22 – 12/31/22 | 35,231 | 46,181 | | 76.3 | OPEN |
| Vermilion snapper [j] [k][n] | 01/01/22 – 06/30/22 | 285,574 | 463,080 | ww | 61.7 | CLOSED |
| | 07/01/22 – 12/31/22 | 356,794 | 463,080 | | 77.0 | OPEN |

**Figure 13**. Preliminary Fish Landings from January 1st, 2022, to December 31st, 2022, in the Southern Atlantic. Data retrieved from NOAA Fisheries ("2022 Preliminary South Atlantic Commercial Landings," 2022)

One of the most popular aspects of fishing that is done in Murrells Inlet is shellfish harvesting. In particular, the American oyster (*Crassostrea virginica*) is widely focused on within the estuary. While they create a great habitat for these marine species, as of 2005 they have faced a lot of degradation and decline due to coastal development, local dredging, and runoff disturbing the oyster's natural habitats (Willis, 2021). In turn to the large decrease in natural oyster beds, the SCDNR proposed and are implementing a series of restoration methods (Target 14.2.1), such as expanding shell recycling efforts in the Murrells Inlet region, evaluating the status of oyster beds in Murrells Inlet and prioritizing areas most suitable for habitat restoration, using recycled shells to establish large scale restoration sites, monitoring the success of restored areas, and utilize the SCORE program to involve citizens in hands-on activities including construction of small reefs and water monitoring (Waccamaw Regional Council of Governments, 2014). Huntington Beach State Park acts as a shell drop-off station and happens to be the most popular station in the state. All shells that are brought to this drop-off are repurposed into rebuilding the Murrells Inlet estuary. 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.


| Targets | Indicators | Data |
|---|---|---|
| **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. | Brookgreen Gardens and Huntington Beach State Park are two locations in the Murrells Inlet community that focus on the conservation and sustainable use of terrestrial ecosystems. |
| **15.3** By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought, and floods, and strive to achieve a land degradation-neutral world. | **.1** Proportion of land that is degraded over total land area. | Synthetic ponds and pools were put in place and connected to the Waccamaw river to encourage drainage and promote water recycling. |
| **15.5** Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species. | **.1** Red List Index. | Agricultural land usage and exploration has affected the quality of the land and its surrounding ecosystems. In turn, this has caused problems for the threatened species and the biodiversity of the community. |
| **15.9** By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts. | **.1** Number of countries that have established national targets in accordance with or similar to Aichi Biodiversity Target 2 of the Strategic Plan for Biodiversity 2011-2020 in their national biodiversity strategy and action plans and the progress reported towards these targets; and integration of biodiversity into national accounting and reporting systems, defined as implementation of the System of Environmental-Economic Accounting. | Due to rapid coastal development and local dredging operations, there has been an increase in siltation, nonpoint source runoff and lack of husbandry in the Murrells Inlet community. |

Huntington Beach State Park is a 2500-acre wildlife preserve that includes 3 miles of beachfront property for the community to enjoy. Huntington Beach State Park is known for its variety of bird species that include over 300 species. Huntington Beach State Park is also a popular camping location that offers 173 campsites as of 2022 (Huntington Beach 2022). Brookgreen Gardens, located across from Huntington Beach State Park, is a popular preserve that inhabits 9,127 acres of land. Brookgreen Gardens focuses on conserving the natural ecosystems and wildlife in the area. The founders, Archer and Anna Hyatt Huntington, owned the area with the main goal of preserving the flora which refers to its plant ecosystems and fauna, the animals, within Brookgreen Gardens. 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). These areas are some of the most well protected areas in Murrells Inlet due to their biodiversity and natural beauty, and development of any kind is restricted.

Murrells Inlet is home to a diverse group of organisms ranging from marine/aquatic animals, terrestrial organisms, botanical environments, and human ecosystems. The community is threatened by both flooding and nonpoint/point source contamination, which in turn impacts the biodiversity in the local area. Flooding is one of the main concerns for many neighborhoods in Murrells Inlet. Countless community members have expressed concern regarding increased flood zones and the lack of drainage in these areas. Over time, flooding destroys the land and its preexisting layout, thus decreasing the amount of space available for terrestrial ecosystems to thrive. This can drive terrestrial animals out of their natural environments and push them towards less natural areas in the community or out of the local area altogether. As floodwater carries debris from eroded banks, silt is trapped in the water, deteriorating water quality and producing hazardous algae blooms. When suspended material falls out of water, it restricts riverbeds and streams, suffocating aquatic creatures and ruining habitats. Erosion and sedimentation have a larger

Photo of a Brown Pelican taken in Murrells Inlet by Mackenzie Ptasienski on April 20, 2022

Since Murrells Inlet is home to over 300 species of birds, many are protected under the Migratory Bird Treaty Act. Some of these species include MacGillivray's Seaside Sparrow, the Great Egret, the Great Blue Heron, the Swallow-tailed Kite, and the Baltimore Oriole (ArcGIS Experience 2022). The terrestrial ecosystem also has endangered plant and animal species that are protected under the Endangered Species Act, such as the Piping Plover, the Red-cockaded Woodpecker, the Black Rail, the seabeach amaranth, and the Wood Stork (ArcGIS Experience, 2022). The protection of terrestrial ecosystems is vital to ensuring the survival of these species, which coincides with the health of the community.

Murrells Inlet has a lot to assess when it comes to sustainable development in the next few years. There are contaminants that can be easily identified in the community, such as nonpoint source and point source contaminants. Motor oil, crop fertilizers, and sediments are all examples of nonpoint source contaminants that affect Murrells Inlet. Direct pollution of the inlet and stormwater runoff are

examples of point source contaminants (NOAA 2019). Stormwater combines with other sources of contaminants within the ecosystem such as private property, construction sites and heavy trafficked roads (Georgetown County Storm Division, 2022). Deterioration of land used for agricultural reasons is occurring due to both natural and anthropogenic factors, specifically erosion due to wind and water. An immediate turnaround of these changes to the land can be done through modified techniques in terms of agriculture. This can include crop rotations, agro-forestry, the reduction in tillage or no-till methods, cover crops, and vegetative filter strips (Saturday, 2018). With increased access to alternative agricultural techniques, the regeneration of Murrells Inlet is possible with the right initiative.

The latest Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Bongaarts Services Landmark Assessment Report highlighted that human activities are considerably degrading land and threatening the well-being of approximately 3.2 billion people (Bongaarts, 2019). Since both anthropogenic and natural processes can cause degradation, it is critical that these two are distinguished for the monitoring of Sustainable Development Goal 15. The effects of overflowing of stormwater, non-point source contamination, and land development have affected one of the most important economic resources in Murrell's Inlet, oysters. Murrells Inlet used to have extensive oyster reefs, but these have suffered in recent years as a result of rapid coastal development, increased siltation from local dredging operations, nonpoint source runoff, and a lack of husbandry in shellfish harvesting areas. Due to the lack of attention to these oyster reefs, serious issues have arisen, such as increased runoff as a result of upland clearing, increased contaminants that are especially harmful to larval stages, increased water quality closures that result in concentrated harvest pressure on open beds, increased harvesting (particularly recreational) and increased boat wake impacts (Handley and Anderson, 2005). Murrells Inlet may make some changes to their procedures when accepting new developments in their communities. A few ways to increase the conservation of biodiversity is to have stricter regulations on building permits, allow for better research on the history of erosion and flooding in specific areas in certain zones, and educate the public about the importance of biodiversity in the area.

Photo of Oysters in Murrells Inlet taken by Laura Bilson on June 27, 2022.

Residents, businesses, industry owners, visitors, and developers all benefit from effective stormwater management as it focuses on the protection of public roadways and property while ensuring concerns of flooding and quality of water are addressed (Georgetown County Storm Division, 2022). Community members are becoming more environmentally conscious, which can improve biodiversity in the present and future. Community members can see the effects of urban runoff on aquatic animals and organisms from different contaminants (Long Live the Kings, 2018). Mitigating factors may include the cleanliness of the roadways, vehicle maintenance (leaks promptly repaired), and the types of fertilizer and pesticide used by homeowners and municipal departments.

Georgetown County will partner with Clemson University/Carolina Clear and the Coastal Waccamaw Stormwater Education Consortium in order to efficiently reach as many citizens as economically possible through public involvement and participation efforts. In previous years, Georgetown County has developed a storm sewer system map showing the location of known outfalls, and names and locations of all waters that receive discharges from those outfalls. In addition, the County has performed full system inventory in high-priority areas of the County. The storm sewer map will be updated as needed to show new outfalls due to new developments (Georgetown County Stormwater Management Plan, n.d.).

Protecting and restoring diverse forms of life on land necessitates concerted efforts to protect, restore, and promote the conservation and sustainable use of terrestrial and other ecosystems. Goal 15 is focused on sustainable forest management, stopping and reversing land and natural habitat degradation, successfully combating desertification, and halting biodiversity

loss. All these efforts aim to ensure that the benefits of land-based ecosystems, including sustainable livelihoods, are enjoyed for future generations.

Photo of the sunset over the Murrells Inlet Marshwalk and estuary. Photo taken by Mackenzie Ptasienski, October 7th, 2022.


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

| Targets | Indicators | Data |
|---|---|---|
| **16.6** Develop effective, accountable and transparent institutions at all levels | **16.6.1** Primary government expenditures as a proportion of original approved budget, by sector (or by budget codes or similar)<br>16.6.2 Proportion of population satisfied with their last experience of public services | Received representation for county council after 20 years of having no representative.<br>New Councilman plans on using email or mail to keep residents up to date on topics like rezoning and planning |
| **16.7** Ensure responsive, inclusive, participatory and representative decision-making at all levels | 16.7.1 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<br>16.7.2 Proportion of population who believe decision-making is inclusive and responsive, by sex, age, disability and population group. | Only about 33% of registered voters came out to vote in the last election.<br>Murrells Inlet has a crime rate of 22.1 per every 1,000 residents. |

Murrells Inlet can still see improvements in developing effective, accountable, and transparent institutions (Target 16.6). Due to its small size in comparison to other census-designated places within Georgetown County, it is very easy for Murrells Inlet to be overlooked at a state or federal level when they do not have local representation. This often makes the residents within this community feel underappreciated by the government. One contributing factor to this sentiment is the lack of a seat on the county council. This was amended on November 8, 2022, with the election resulting in Clint Elliot becoming the new county councilman. Representation at the county level is necessary for Murrells Inlet to have an outlet for expressing its concerns at a level capable of funding adequate action.

Relating to SDG Target 16.6, having accountable and transparent institutions is an important aspect in building a functioning community. Through talking with community members during a September 13, 2022, Murrells Inlet community meeting, there seems to be a trend of overlooking certain aspects of the community including planning and zoning by residents. Though residents have clashing opinions when it comes to these topics, many zoning efforts came as a shock to them and, by the time they are aware, it may be too late to act in opposition of what is instated. This is one example of how more transparency and notice is needed before large changes are finalized. During an interview on November 1, 2022, with Clint Elliot regarding his new step into a county council position, he emphasized how crucial it is for government and planning institutions to be transparent with the community, though stated responsibility falls on the residents as well. Elliott expressed “It is surprising to see how many people do not open their mail. If it is from Georgetown County and it does not say ‘tax’ then it gets thrown out" (Elliot 2022). As the upcoming new County Council member, Elliott plans to attend most if not all Planning Commissions meetings and receive alerts from zoning directors in order to stay on top of what is happening in the community. To lessen the gap in transparency

and information access and viewing with planning and zoning he aims to get in contact with those affected by phone, in-person meetings, or potential YouTube videos so they personally know what, when, and where changes are being made.

Target 16.7 includes ensuring responsive and inclusion decision-making at all levels. The area of Murrells Inlet is filled with residents of very different, clashing opinions. Murrells Inlet is experiencing a 2.20% population increase annually, bringing in new residents from around the country (Murrells Inlet, South Carolina Population 2022, n.d.). Due to this influx of new people, clashing opinions may cause a divide, setting back decision-making. Some of the new residents wish to make changes and increase the number of attractions and activities available in Murrells Inlet while those who have been here longer want to protect and restore the calm nature that this place can provide. At a county level, Georgetown County is responsible for being responsive and inclusive to all those who reside within. The decisions they make will affect every resident. Regardless of whether decisions are liked by the community, they still need to ensure that the community as a whole and their needs are noted and respected. Promoting peaceful societies is the goal of SDG 16, which includes the safety of residents and visitors. In order to guarantee this, crime control and prevention should be analyzed closely. Murrells Inlet has a crime rate of 22.81 per 1,000 residents annually (SC: Crime Maps and Statistics, n.d.). Many of the crimes tend to be considered property crimes, as opposed to violent or otherwise. In comparison to the national average Murrells Inlet's crime rate is 30% lower than other places which ranks as grade B on average (Murrells Inlet, SC Crime Rates & Map, n.d.). In order to achieve a higher grade, an increase of law enforcement could benefit the community and residents. In order to apply this to the community, government funding for the area should be assessed to see which additions are applicable.

Photo of the Murrells Inlet Marshwalk. Accessed from Visit Myrtle Beach, 2022.

17 PARTNERSHIPS FOR THE GOALS

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

| Targets | Indicators | Data |
|---|---|---|
| **17.7** Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favorable terms, including on concessional and preferential terms, as mutually agreed | **17.7.1** Total amount of funding for developing countries to promote the development, transfer, dissemination and diffuse environmentally sound technologies | Comprehensive plan will bring federal investments into infrastructure improvements |
| **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. | **17.17.1** Amount in United States dollars committed to public-private partnerships for infrastructure | Approved solar farm in western Georgetown County will provide clean energy for its coastal residents<br><br>Partnerships between district representatives will allow for motions to be passed to push the county in the right direction |

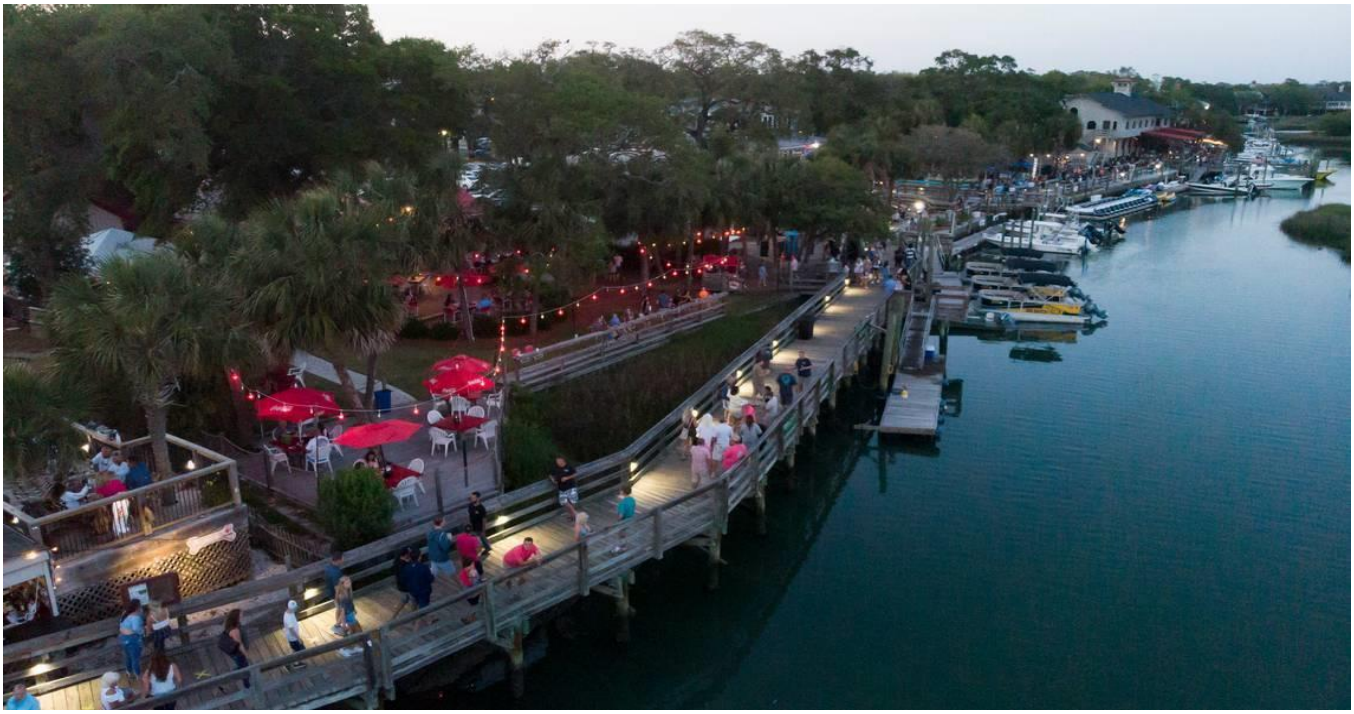
SDG goal 17 is the global partnership for sustainable development. This includes identifying the regions who are receiving very little funds from their governments and who are forced to act upon certain unsustainable lifestyles themselves, including unreliable and contaminated water, no local recycling system or lack of good education on sustainable habits. SDG 17 aims to bind global partnership through funding for the least sustainably developed regions.

*A dredge works behind the north jetty to Murrells Inlet in 2017, when the work was funded by Georgetown County.*

On November 15th, 2021, President Biden signed the Infrastructure Investment and Jobs Act which was a step toward achieving SDG 17 nationwide, as it approves policy that enables implementation of SDG 9. The Infrastructure Investment and Jobs Act provides "$550 billion in new spending on our nation's infrastructure over the next 5 years" (transportation.house.gov).

The hyperlinked text provides further information on how this Infrastructure Act plans on using this money for a more sustainable future. $17 billion of this $550 billion Act is being

implemented towards ports and waterways. Murrells Inlet was able to secure their fair share, obtaining $6.1 million all going towards the dredging of Murrells Inlet federal channel.



*Aerial view photo of the Murrells Inlet Marshwalk. Photo by Chase Karacostas of The Sun News, April 21st, 2022.*

Completion of this project would clear the bottom of the inlet, perpetuating the safe travel of vessels in the waterway. If their Comprehensive Plan is adhered to, Georgetown County will reap the benefits of the federal investment in sustainable infrastructure. Routine dredging will keep the inlet clear, and systems designed to mitigate runoff will further increase the efficacy and longevity of further dredges funded by county money. Such federal policies and funding open a gateway through which Murrells Inlet will be able to better maintain its infrastructure moving forward. This will enable Murrells Inlet to improve its infrastructure and conserve its own funds for use across other projects.

In Murrells Inlet, SDG 17 also presents itself through upcoming projects such as the construction of a solar farm (Elliot, 2022). The approval of solar projects directly influences SDG 7 “Affordable and Clean Energy,” as it would contribute clean energy to the grid servicing Murrells Inlet. When interviewed, Elliot expressed that quelling or at least satiating a “Not in my Backyard” mindset among residents was currently the foremost obstacle to the solar project and other similar initiatives, meaning pleasing groups affected by infrastructure and energy projects is as essential to furthering the implementation of sustainable development as the projects themselves (Elliot, 2022).

# Systemic Connections Among the Goals

The Sustainable Development Goals we decided to focus on are all intertwined. Since they rely so heavily on each other for success it is critical to understand how they are related. The figure below depicts the complex system and reciprocal connections between the quality of life, nature, people, governance, and other possible drivers. This dynamic process can be applied from a local to global level that can be influenced by external factors like climate change and natural disasters. Murrells Inlet is specifically affected by flooding, hurricanes, and storm surges. It is important to recognize these goals as a network of factors. Although emergent issues need immediate attention, balance is required to prevent a collapse of the framework.

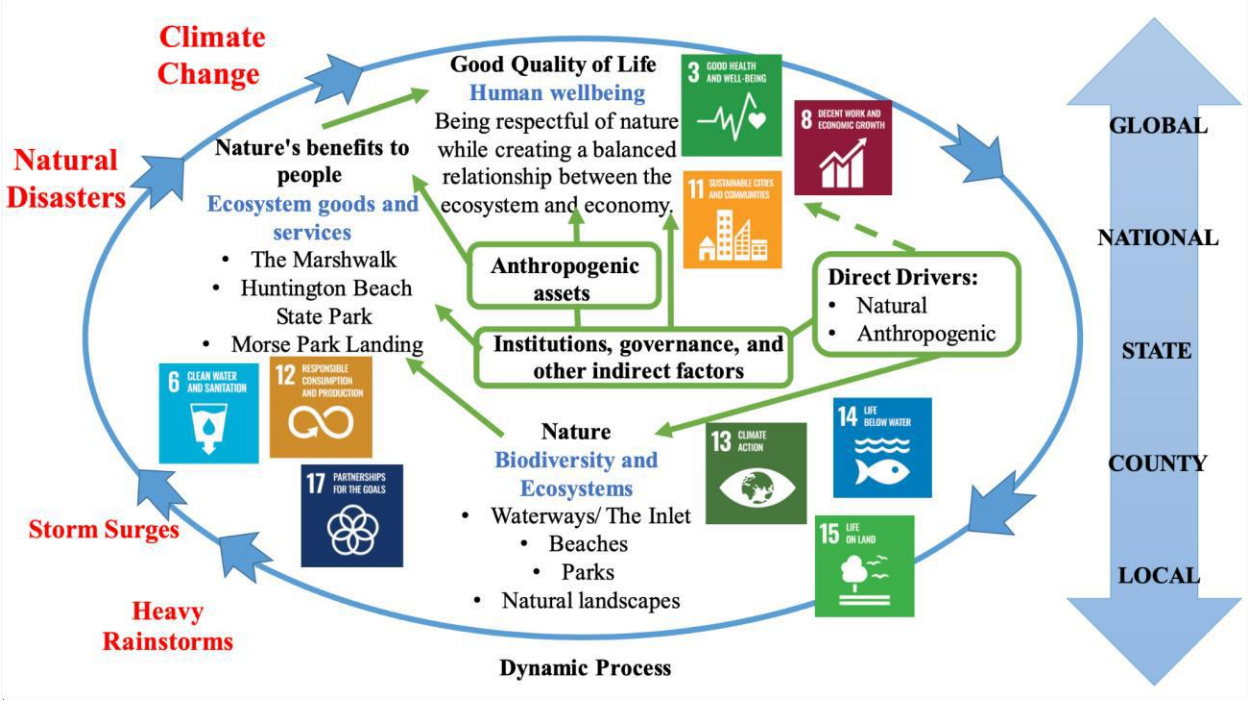



**Figure 14.** Connection between nature and the human wellbeing in Murrells Inlet

Humans have the largest impact on our surrounding environment. It is crucial for us to properly utilize our education, technology, and ability to adapt for us to create a symbiotic relationship with the ecosystems and our society. These goals all have indicators that are interrelated with one another. A great example would be to look at goal 8, Decent Work and Economic Growth, and goal 13, Climate Action. Initially, you would not think these two are related but, when events like natural disasters occur, the economy is affected. Any economic growth can be halted almost immediately by storms and flooding, but if the community is prepared with safety measures in place, resilience occurs faster. Understanding how climate change is affecting your area will allow for the economy to expand in ways that cannot be reserved. Similarly goals 16 and 17 have targets that rely on each other to happen. Goal 16 Peace, Justice, and Strong Institutions is about transparency of the government and other

powerful entities that have control over the area. Transparency is critical for goal 17 as well since its main idea is to create accountable and sustainable partnerships that will benefit the community. If there are not effective institutions throughout all levels, partnerships will not be obtained, and progress will not be made. Many of the other goals we focused on have similar connections that begin to create a whole network of connections.

# Equity, Peace, and Justice

Often equity, equality, and justice are all used interchangeably. Despite this apparent use, each of these terms has unique definitions. Equality can be used when all individuals are given the same treatment, while equity accounts for the unique situations that the individuals face. In equity individuals receive treatment in a manner that will allow them to have the same opportunities (Milken Institute, 2021).

There are many branches of justice listed in the below figure. Though all these different forms of justice could connect to an aspect of Murrells Inlet, the main aspect of justice this assessment has focused on is environmental justice. As the figure describes, environmental justice seeks to provide people with equity in regard to environmental burdens and benefits.

| Justice Type | Definition |
|---|---|
| Distributive justice | The equitable allocation of assets in society (Lamont, 2017) |
| Environmental justice | The fair treatment of all people with regard to environmental burdens and benefits (EPA, 2022) |
| Restorative or corrective justice | Seeks to provide retribution to those who have suffered unfairly (University of Wisconsin Law, 2022) |
| Retributive justice | Seeks to punish wrongdoers objectively and proportionately (Walen, 2020) |
| Procedural justice | Refers to implementing legal decisions in accordance with fair and unbiased processes (Yale, n.d) |

Equity theory focuses on stakeholder's perceptions of how fairly they are treated relative to others (American Psychology Association, n.d.). Murrells Inlet community-level stakeholders are individuals “able to provide a good understanding of the local environment and first-hand knowledge on how an issue affects members of the local population” (End Drowning, n.d.). These stakeholders include the residents of the inlet, tourists, business owners, real estate agents, government officials, and any organization with ties to Murrells Inlet. Clashes between these stakeholders is the current main cause of inequitable conditions in the Inlet. Though there are many separate views held by these stakeholders, the general disagreement surrounds the concept of whether to expand development.

For business owners, real estate agents, some residents, and tourists the answer to this question is a clear yes. Expanding the development has led to higher profits. One way to expand development is through dredging, a process where the bottom of a waterbed is cleared and the removed sediments are often used in beach renourishment projects along the shore. This is a previously practiced process in the Inlet. The response to this has been positive from those with hopes of increased development. One example is Rick Baumann, longstanding owner of Murrells Inlet Seafood. He has been on record stating that “said previous dredging projects have always had some benefits to commercial and charter fishing interests, which helps the local economy” (Yale, 2022).

Others are concerned about the disruption this may be to the local environment. For some they worry about what the dredging conditions might do to the local turtle populations. At a nearby beach residents, state agencies, and conservations voiced their concerns. These concerns first rose when a real estate company tried to bring sand to the shore through a 2-year period. Bringing this sand through a whole year period could disrupt the native sea turtle populations. Because of this the project altered its proposal, changing the timeframe of the project. As well as this time change, government officials have required the use of reflectors after March 31st for the turtles (Swenson, 2020).

The concerns around the development are not always as simple as adding reflectors to dredging equipment. For some situations the decisions made can lead to pollutants entering the waterway and reduce the progress towards a healthy inlet that community members have been striving for.

Going forward, choosing a direction may seem like an irreconcilable conflict of interests. Murrells Inlet stakeholders need information transparency about the costs and benefits of the available options in order to make informed decisions. The Charleston Climate Action Plan and the PittsburgVoluntary Local Review would serve as good guideposts.

# Risk Reductions

Risk reduction focuses on strengthening the resilience of a community as well as lessening the vulnerability to the members within the area. As a coastal community, Murrells Inlet faces a barrage of various environmental and human created hazards. From polluted runoff water that seeps into our coastline to hurricane flooding. While these issues have an immediate effect, they also present a magnified long-term effect that will be seen and felt decades from now. Thankfully, members of the Murrells Inlet community have made progress in ensuring the protection of their community, but despite all the progress that has been made there is still room for improvement.

Desires for progress in risk reduction have been slowed down by the desire to continue the development of the community. Increasing development has led to higher risks for flooding, as the impervious ground cover will prevent water from absorbing (Water Science School, 2018). In order to reduce this risk, the community should consider the use of a permeable ground cover to allow for the natural absorbance of water into the soil.

Other areas of risk that the inlet faces include the high costs that business owners and residents are presented with. Because of the increased risks of flooding, and the increased insurance costs, businesses and residents will be forced to move to a location that is less prone to these issues. The increased flooding leads to increased costs for these Murrells Inlet stakeholders, which will price out many potential residents and business owners.

Through interviews with businesses, particularly Emily Scott, the front house manager of Wicked Tuna, we found that the flooding has led to these high costs. This business employee stated that the business incurred thousands of dollars in damage during Hurricane Ian that is not covered by their insurance (Scott, 2022). This issue is multifaceted in the fact that it does not just apply to the business owners of Murrells Inlet; In a brief meeting with residents of Murrells Inlet one community member explained how new rules and regulations forced her into replacing and raising her air conditioning unit due to the high levels of flooding, which unexpectedly cost her thousands (Lane, 2022).

Flood insurance is an important way to reduce the risk of high costs associated with flooding. Though in some situations flood insurance does not cover the total costs of repair, it often keeps the repair costs as low as possible. A survey sent to Murrells Inlet businesses found that every business we contacted had flood insurance. This is an important start to maintaining a resilient community.

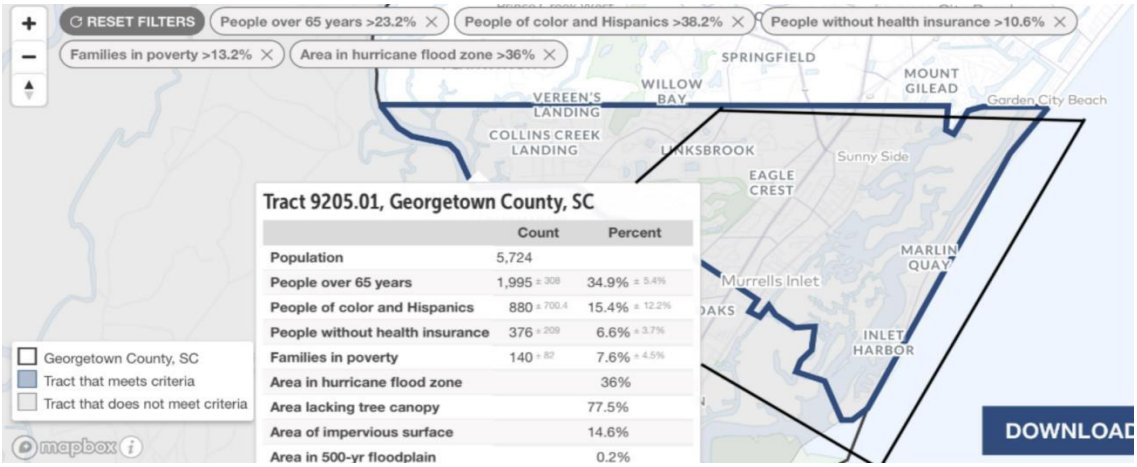
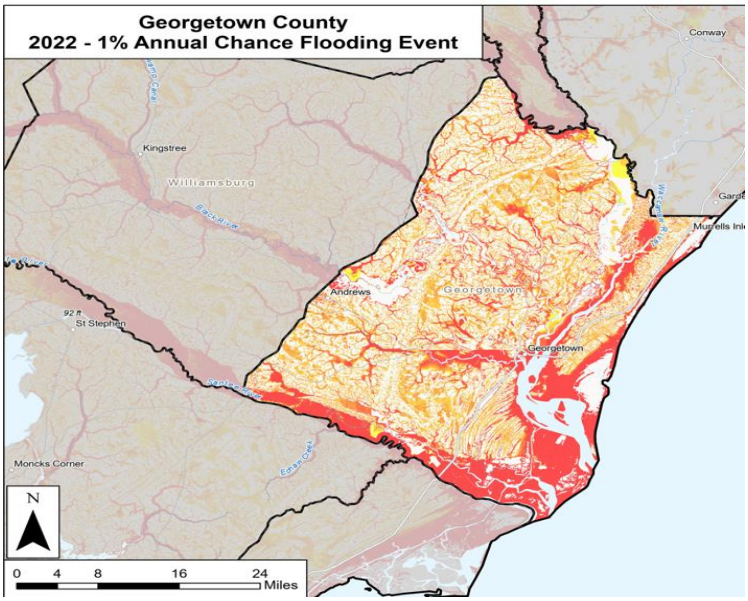



**Figure 15**. The Climate Resilience Toolkit map showing the statistics of dangers in the study area of Murrells Inlet.

Another key step is to confirm that the area where development is most concentrated does not have a high risk for flooding. The Climate Resilience Toolkit has a variety of interactive maps that could be used to assess what area should be further developed. The map above is an example of one of the maps that could be used to determine what areas face the highest chance of flooding (Figure 15). According to figure 15, the map shows that 38% of the area is in a hurricane flood zone, which still leaves a large portion, 62%, that can be further developed.

Another important map that could be used (Figure 16) is the NOAA Coastal Flood Exposure Mapper map. This map is another means of seeing what areas are most prone to flooding and could be used to make sure the areas with the highest level of development are not in the areas with the highest level of flooding. FEMA recommends using flood maps to make development plans, which agrees with our current suggestions (FEMA 2021.)


**Figure 16.** NOAA Coastal Flood Exposure Mapper. Murrells Inlet MarshWalk shows the general area where all the businesses were interviewed. Many of the businesses are in a flood zone, and therefore require flood insurance.




It is crucial to educate the community and local government officials about the risks they may face and how to best reduce the effects of these risks. This could mean spreading the availability of flood maps like those presented above, explaining alternatives that could reduce the risks, or making sure all those who would benefit from flood insurance have purchased the correct policy. The better informed a community is, the better equipped it will be to prepare for the inevitable environmental issues to come.

**Figure 17.** S.C. Office of Resilience 1% Annual Chance Flood Event

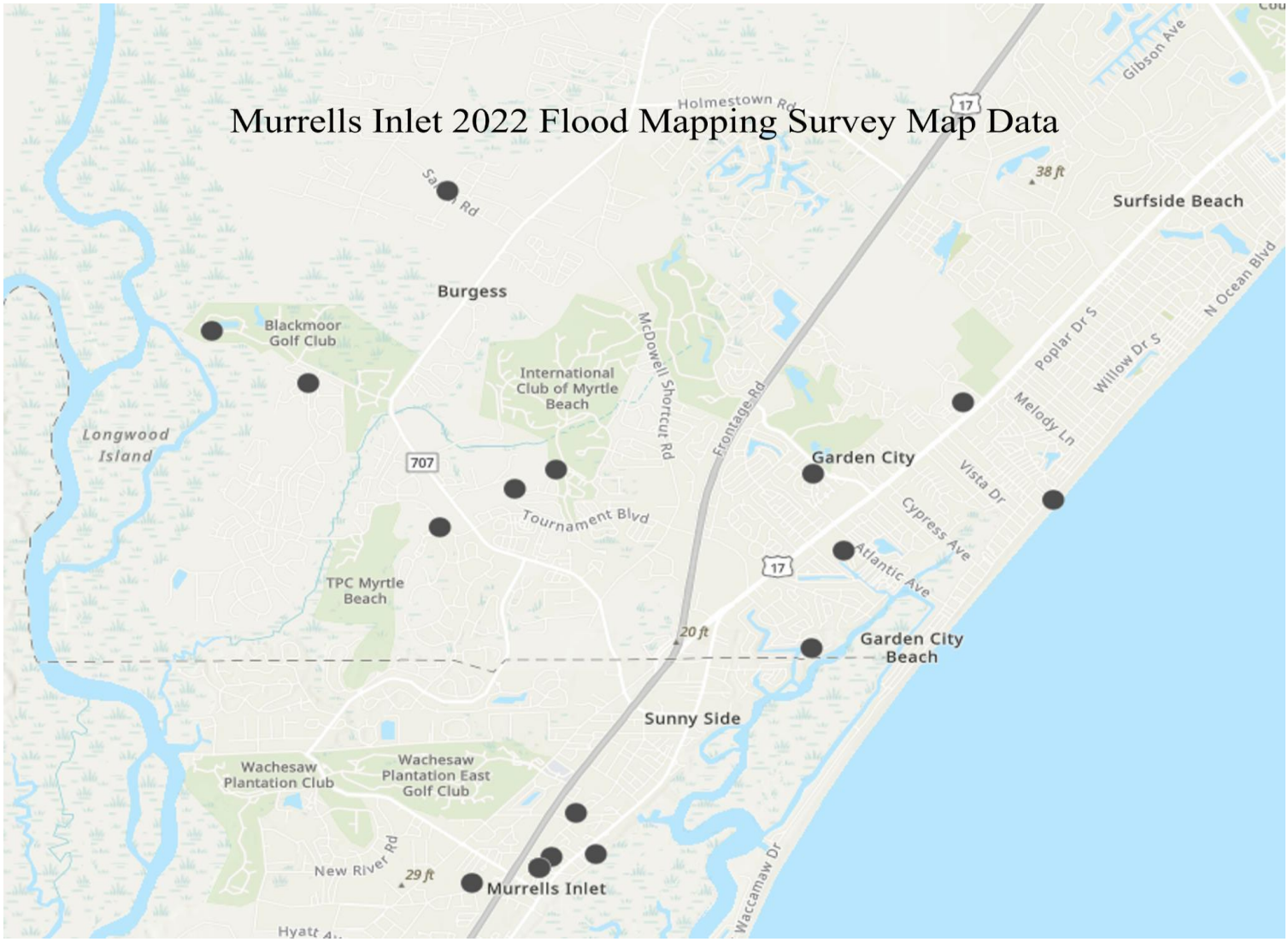



**Figure 15:** ArcGIS map by Tyler Whitlow containing location data from the 2022 Murrells Inlet Flood Mapping Survey.

*If you are a resident of Murrells Inlet, please take our online survey by scanning this QR code with your phone's camera to contribute to the flood mapping data. This is an ongoing study.*

# Survey Results

Our survey was created with the help of Katie Finegan of the SC Seagrant Consortium with ArcGIS software. After editing in class, we created an online survey for residents of Murrells Inlet to fill out to report the flooding they witness. On November 8th, 2022, students visited the Marsh Walk to ask residents of Murrells Inlet if they could fill it out. Students also spent time setting up a table at this year's annual Oyster Festival on November 12th, 2022, to continue gathering data on local flooding from residents. Our survey is still up and running so if you are a local resident and have not filled it out, yet we would love your input for future work. We would like to thank everyone who was able to contribute to our findings.

It must be noted that as of compiling results from the survey, only 21 responses have been received, meaning the sample is not representative. It must also be noted that, for several questions, the answer, "I do not have flood insurance," was not consistently selected across the survey for individuals who selected that as their first answer. This skews the data away from the true values, meaning any results must be viewed with that in mind. While the trends that emerge may be skewed presently and may change as the survey approaches a closer likeness to the long-term average, it can still give a potential window into what the population might look like if it is assumed the data, is a good representation. An interesting pattern was the even split between having or lacking flood insurance. This data point, assuming it is accurate, concerns given climate forecasts in the region. A trend towards sea-level rise poses a risk as people without flood insurance risk taking uninsured property damage. Presently, however, according to survey results, 76.19 percent of respondents did not report flooding on their property, and only 3 respondents indicated flooding of over 6 inches. This does not align with anecdotal evidence provided by community members who attended the September 13, 2022, community meeting, though low sample size may be skewing the results one way or another.

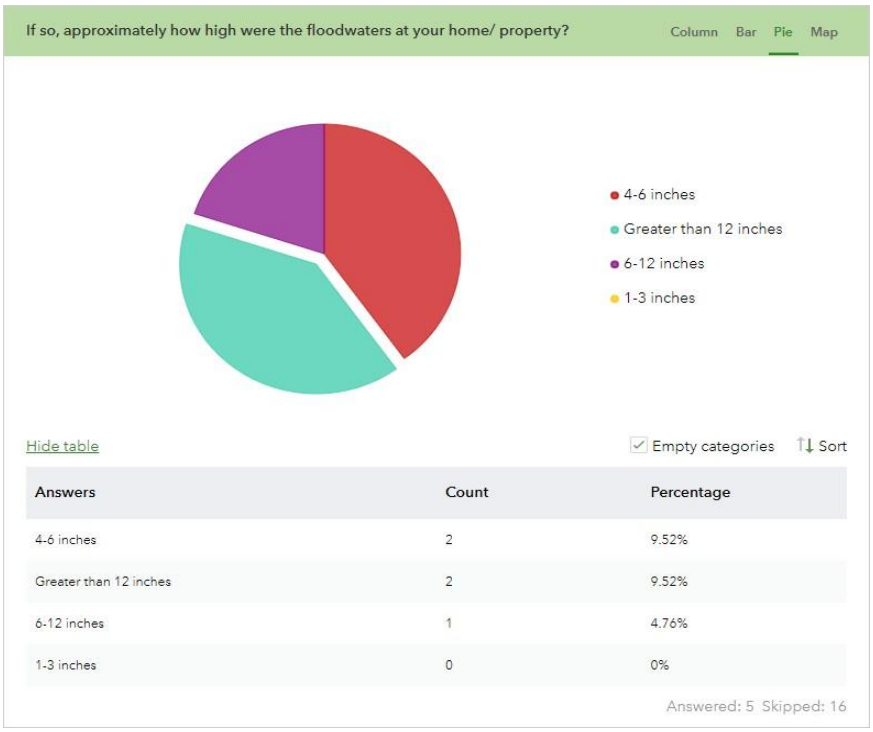


**Figure 18**: Survey response for the question, “How high were floodwaters on your property?”

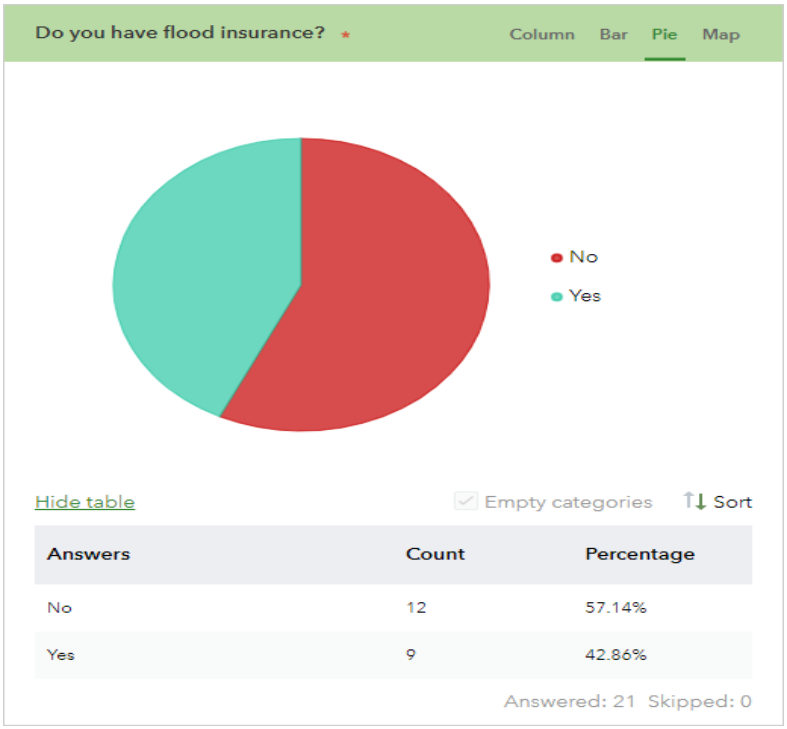



**Figure 19:** Survey response for the question, “Do you have flood insurance?”

# Flooding

Hurricanes, tropical storms, and frequent flooding are all things South Carolina citizens know too well. There have been more than fifty-two hurricanes that have affected South Carolina in the past twenty years, not including the two recent ones we received rainfall from. More than half of those have affected Georgetown County. Although all of these storms had different calibers, they have all taken a toll in one way or another. The relatively flat terrain (about 90% of the County is less than 40’ above mean sea level (msl), coastal location, and abundance of water bodies all make Murrells Inlet more vulnerable to flooding. (Hazard , 2019)

There are 1,627 properties in Murrells Inlet that have a greater than 26% chance of being severely affected by flooding over the next 30 years. This represents 42% of all properties in Murrells Inlet and 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 well-being of an area. The community is at a moderate risk of flooding over the next thirty years, which means flooding is likely to impact day-to-day life within the community.

In 1999, the South Carolina Department of Natural Resources became a Cooperating Technical Partner (CTP) with the Federal Emergency Management Agency (FEMA). There was a strong need for current and accurate flood maps to assess risk factors. In 2009, FEMA transitioned to the Risk Mapping, Assessment, and Planning (Risk MAP) program. This program put together five goals to help smaller coastal regions protect and prevent themselves from disastrous flooding. The goals are as followed:

1. Address gaps in flood hazard data to form a solid foundation for flood risk assessments, floodplain management, and actuarial soundness of the NFIP (National Flood Insurance Program)
    - FEMA provides tools and resources to help communities navigate NFIP requirements and implement higher standards of floodplain management. Meeting these requirements is the most cost-effective way to reduce the flood risk to new buildings and infrastructure.
2. Ensure that a measurable increase of the public's awareness and understanding of risk management results in a measurable reduction of current and future vulnerability to flooding.
    - The Building Resilient Infrastructure and Communities (BRIC) grant program seeks to categorically shift the federal focus from reactive disaster spending toward research-supported, proactive investment in community resilience so when the hurricane, flood or wildfire comes, communities are better prepared. BRIC

provides funds on an annual basis for hazard mitigation planning and the implementation of mitigation projects prior to a disaster.

3. Lead and support state, local, and tribal communities to effectively engage in risk-based mitigation planning resulting in sustainable actions that reduce or eliminate risks to life and property from natural hazards.
    - Many people do not understand how risky a floodplain can be. There is a 26% chance that a non-elevated home in the floodplain will be damaged during a 30-year mortgage period. The chance that a major fire will occur during the same period is only 9%. Building owners will save insurance money if they elevate above the Base Flood Elevation (BFE).
4. Provide an enhanced digital platform that improves management of limited Risk MAP resources, stewards' information produced by Risk MAP, and improves communication and sharing of risk data and related products to all levels of government and the public.
    - Flood Factor is an online tool that makes it easy for Americans to find their property's risk of flooding.
5. Align Risk Analysis programs and develop synergies to enhance decision making capabilities through effective risk communication and management.
    - No property is immune to natural disasters. Building and designing homes that are storm resistant means ensuring a home is properly elevated to a desired Flood Protection Elevation (FPE) or above BFE. Floodplain management is about building smart. It makes good sense to make reasonable decisions to help protect families, homes, and businesses. Development that complies with the minimum floodplain management regulations is significantly protected against major flood-related damage.
    - Floodplains are supposed to store floodwater. If storage space is filled with dirt and other fill, future flooding may be worsened. Floodplain fill can alter valuable floodplain functions, including wildlife habitat and wetlands. NOAA's Coastal Change Analysis Program (C-CAP) tool summarizes general change trends (such as forest losses or new development) and provides tables, maps, and reports to enhance communication and decision-making.


**Figure 20**. Murrells Inlet Census Designated Place (CDP) is outlined in white.

# Recommendations

- Georgetown County should implement its own sustainable and/or green business certification and incentive program.
- Businesses in Murrells Inlet should recycle and compost to decrease the number of materials being sent to the landfill.
- Attend local community meetings in order to be aware of changes that may be happening around you regarding planning, zoning, construction, etc.
- Speak to your county councilman and board if there are any questions or concerns.
- Get involved in community activities to stay up to date.
- Continue updating floodplain regulations, drainage system maintenance and stormwater management.
- Do your part to keep any drainage ways around homes clear and clean to allow proper water flow after high tides or heavy rainstorms.
- Restoring marsh or wetlands provides areas for water to be stored, reducing flooding.
- Rain gardens reduce flash flooding by collecting rainwater and allowing time for the water to be absorbed or carried away.
- Make ordinances that enforce healthier sanitation and promote better water quality.
- Restaurants can be keeping track of what products are being thrown away and how much, this can help with finding a solution with the amount of waste being produced
- If a great amount of plastic is being thrown away at a restaurant, only bring items like butter packets and straws to the customer upon request.
- Going digital instead of paper is an idea for restaurants to use. Using iPads or other devices for customers to get their checks and pay limits paper use.
- Implement floating removeable docks rather than wooden docks that are prone to destruction during hurricanes.

Two years have passed since Horry County and Sherwood design engineers announced the commencement of a 100+ page resilience flood plan. The plan was funded by FEMA HMGP with intentions to reduce flood risks along the Waccamaw and Pee Dee Rivers and the Intracoastal Waterway. This project began one year after hurricane Florence by gathering over one-hundred residents of Horry County to unite with members of the Flood Resiliency Board to discuss what can be implemented locally to address the improvement of infrastructure, removal of gray infrastructure, development of flood control projects, retention of stormwater, and the development of wetlands. The plan also aims to build long term strategies on flood prevention with the construction of green infrastructure throughout various neighborhoods as seen below. Although this plan does not include mitigation solutions for Murrells Inlet this is a great example

of what can be accomplished through the power of a community coming together and having conversation in order to solve the problem.

**Figures 21, 22, and 23.** Plans for possible new innovative green infrastructure from Resilience Flood Plan.

Digital sketch of green infrastructure plans for Horry County

Georgetown County implemented their Hazard Mitigation Plan in 2019. This plan is 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. Since then, Georgetown County has received $6.1 million dollars from federal infrastructure funds to dredge the commercial inlet and renourish Garden city beach. The last time a project like this was done was in 2017 (Swenson 2022). Since then, it has become dangerous for larger boats to maneuver through and with hopes of becoming a bigger seaport this is an enormous problem. The new plan does not have a start date but the county should have the funding sooner so it can begin. The county has also hired private engineers to look at other smaller dredging projects around Murrells inlet, these are needed because if the entire inlet is not dredged around similar times silt and pollutants will build up much faster from the sections left untouched. These efforts combined will transform the inlet and boost productivity.

## Stormwater Management Recommendations

Green infrastructure is an approach to water management that protects the natural water cycle; it is effective, economical, and enhances community safety and quality of life. Working with local landscapers to standardize the types and uses of fertilizers, herbicides and insecticides will homogenize the efforts to mitigate the collateral effects of using those products. Sand-gravel filters are passive filtration systems. No hard infrastructure is necessary to install them. As an intermediary step between no stormwater runoff filtration and a functioning municipal stormwater treatment system, sand-gravel filters are comparatively inexpensive, relatively easy to install, and the aforementioned studies provide scientific data to validate their effectiveness. We recommend a request be made to the Georgetown County Council to commission an engineering study to identify the best locations for sand-gravel filters.

# Conclusions

This report demonstrates the relationships between community, economy, and the environment in Murrells Inlet, South Carolina. More importantly, the updates in this report highlight the intersectionality of these basic components and how they relate to the community's overall ability to promote resilience. Like many communities, Murrells Inlet relies heavily on its natural resources. However, without a plan of action that promotes meeting the appropriate United Nations (UN) Sustainable Development Goals (SDGs), Murrells Inlet will lack sustainability and longevity. The members of this community demonstrate a significant amount of initiative, but they also face some obstacles. Conversations with residents of Murrells Inlet indicate that cooperation between key actors/stakeholders within the community could be improved.

Additionally, more research to clearly measure SDGs is necessary. Community members easy access to data on sustainability and current environmental conditions. More access to digestible data and additional research, as well as promoting effective communications between stakeholders will make Murrells Inlet more sustainable. Data and visuals, supported by empirical evidence, will give community members the voice they need to work in congruence with Horry Georgetown County local officials. Through extensive research, interviews, fieldwork, and observations, this report clearly demonstrates that Murrells Inlet has the vast potential to become a sustainable and resilient community.


Found: Symbol accessed from the Sustainable Development Goals website.

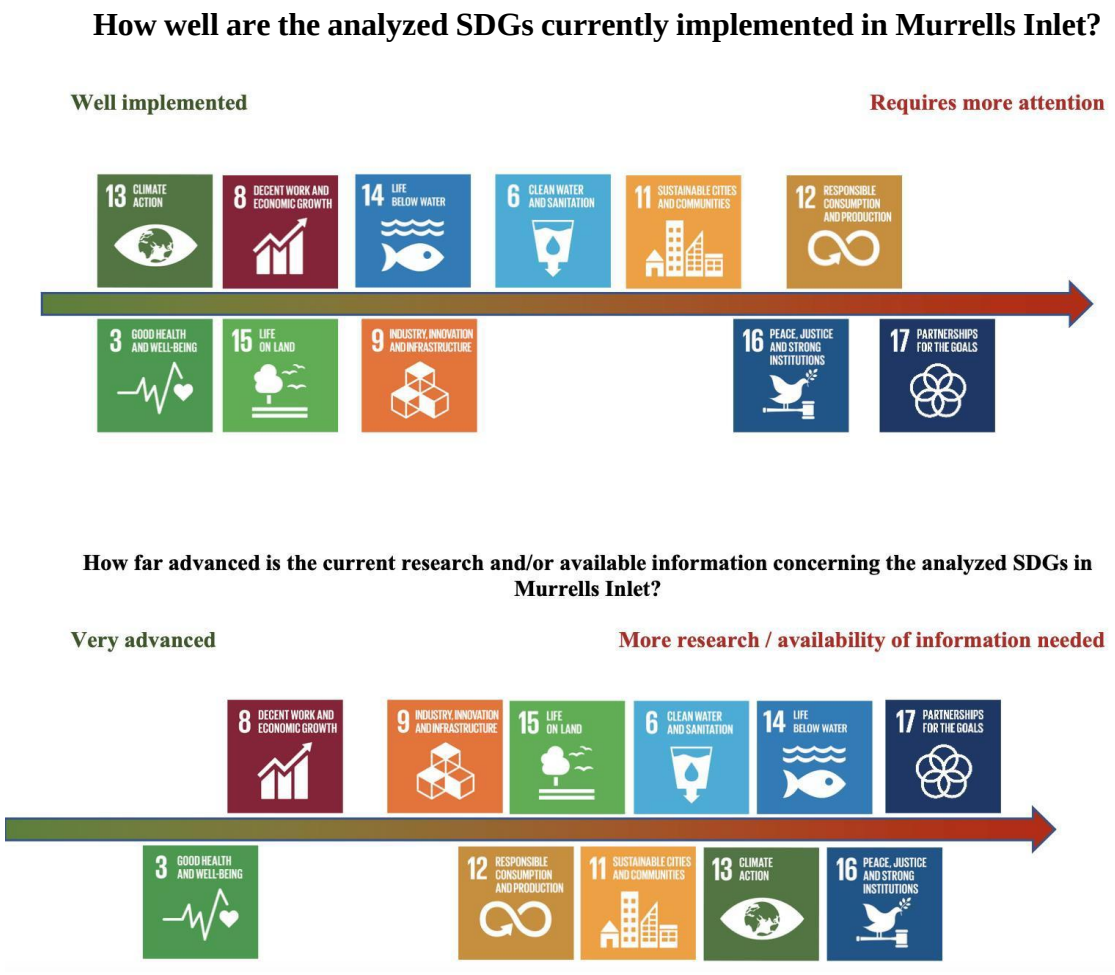



**Figure 24.** Sustainable Development Goals organized on scales from well implemented to requires more attention, and from very advanced to needs more research.

As depicted in Figure 24 above, Sustainable Development Goals 3, 8, and 9 and the most researched and implemented through Murrells Inlet. With many community festivals, growing businesses, increase in jobs, and beginning to fix outdated infrastructure starts to put the Inlet on the right path to achieving its sustainable goals. On the contrary goals 16 and 17 are the least researched and have the worst implementation. Since this will be the first time the Inlet has received representation in twenty years there is room for change within the government institutions and hope that residential issues will finally be met with real, effective answers. These goals do rely on one another to happen so falling short in one section could gravely affect work being done in other areas. Although there is access to some information that can put communities on the right track, the resources available to Murrells Inlet are not being adequately used. To further sustainable development, we recommend starting with a clear structure of implementation. It can be difficult to know where to begin but solid leadership is

needed. Listen to what the community needs and see what could make a difference. When working with large scale ideas like the goals, it is important to remember to break it down to your community's level. In order to continue benefiting from the ecosystems there needs to be change from everyone and the community to maintain public greenspaces and other prosperities we reap from the environment.

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