Appendix H: Resilience & Sustainability

Contents

Introduction

Resilience and sustainability are key components of a transportation network and are factors within the 2050 MTP Goal # Safety and Security and Goal # System and Environmental Preservation. This chapter serves to meet the 23 CFR § 450.306 requirement for MPOs to include within the scope of the metropolitan planning process, where MPOs must "Improve the resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation;" (23 CFR 450.306(b)(9)) and " assess capital investment and other strategies to preserve the existing and projected future metropolitan transportation infrastructure, provide for multimodal capacity increases based on regional priorities and needs, and reduce the vulnerability of the existing transportation infrastructure to natural disasters" (23 CFR 450.324(f)).[1] Further it incorporates FHWA policy on preparedness and resilience to climate change and extreme weather events as established by FHWA Directive 5520 Transportation System Preparedness and Resilience to Climate Change and Extreme Weather Events.[2]

Goal: Safety & Security

- Reduce the rate, frequency, and severity of crashes, injuries, and fatalities for all modes and freight and at-grade rail crossings
- Improve emergency response and incident clearance times
- Increase the resiliency of infrastructure to risks; helping prepare for, respond to, and recover from emergencies, including extreme weather and environmental conditions
- Increase resilience of infrastructure to reduce flooding on roadways

Goal: System & Environmental Preservation

- Meet industry, state, and national standards for infrastructure and asset quality, condition, and performance for all public transportation and transit infrastructure
- Support funding for transportation maintenance
- Reduce emissions and energy consumption
- Increase the application of green infrastructure in projects
- Reduce stormwater impacts of surface transportation
- Maintain and improve our existing roads, transportation infrastructure, and facilities

FHWA defines resilience as "a capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to social well-being, the economy, and the environment."[3] In respect to a project, resilience includes "the ability to resist hazards or withstand impacts from weather events and natural disasters; or to reduce the magnitude or duration of impacts of a disruptive weather event or natural disaster on a project; and to have the absorptive capacity,

[1] https://www.ecfr.gov/current/title-23/chapter-I/subchapter-E/part-450/subpart-C/section-450.306
[2] https://www.fhwa.dot.gov/legsregs/directives/orders/5520.cfm
[3] https://www.transportation.gov/priorities/climate-and-sustainability/definitions

adaptive capacity, and recoverability to decrease project vulnerability to weather events or other natural disasters."[4]

The National Environmental Policy Act (NEPA) defined sustainability as a national policy "to create and maintain conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations."[5] Sustainable transportation is defined by the United Nations as the ""the provision of services and infrastructure for the mobility of people and goods—advancing economic and social development to benefit today's and future generations— in a manner that is safe, affordable, accessible, efficient, and resilient, while minimizing carbon and other emissions and environmental impacts."[6]

This chapter will cover topics including natural and man-made threats, climate change, energy and emissions, biodiversity and wildlife conservation, stormwater management, and green infrastructure as they relate to resilience and sustainability in the transportation sector.

Hazards

The transportation network within the CORE MPO region is susceptible to natural and man-made hazards. Natural hazards include changes in temperature and precipitation, sea level rise, storm surge, and flooding, whereas man-made hazards include infrastructure failures, cybersecurity threats, terrorism, active shooters, and hazardous material spills. Hazard Mitigation Plans (HMPs) identify and assess hazard risk mitigation to better protect the people and property from the effects of natural and human-caused hazards. This section will reference the Bryan, Chatham, and Effingham County HMPs, and the State of Georgia Hazard Identification and Risk Assessment (HIRA).

According to the Chatham County Multi-Jurisdictional Pre-Disaster HMP, Chatham County is at high risk for extreme heat, hurricanes, flood, hazardous materials event, sea level rise, wildfire, severe winter weather, tornado, severe weather, and drought. The county has a moderate risk of earthquake, erosion, terror threat, and a low risk of dam failure (FIGURE X).[7] The Effingham County Joint HMP identified tornadoes, inland flooding, hurricane wind, severe weather, and coastal hazards as high priority, drought, severe winter weather, wildfire, wind, and extreme heat as medium priority, and seismic and geologic hazards as low priority (FIGURE X). The Bryan County HMP identified coastal storms, drought, flooding, hurricanes/tropical storms, tornadoes, wildfires, and windstorms as the greatest threats (FIGURE X).

[4] Source: Public Law 117-58, also known as Bipartisan Infrastructure Law
[5] https://www.epa.gov/sustainability/learn-about-sustainability#care
[6] https://sdgs.un.org/sites/default/files/2021-10/Transportation%20Report%202021_FullReport_Digital.pdf
[7] https://chathamemergency.org/About/Plans

Table 2.88 – Summary of Hazard Risk Classification

High Risk (> 2.4)	Extreme Heat Hurricane Flood Hazardous Materials Incident Sea Level Rise Wildfire Severe Winter Weather Tornado Severe Weather (Thunderstorm Wind, Lightning, Hail) Drought
Moderate Risk (2.0 – 2.4)	Earthquake Erosion Terror Threat
Low Risk (< 2.0)	Dam Failure

FIGURE X. Chatham County Multi-Jurisdictional Pre-Disaster Hazard Mitigation Plan Summary of Hazard Risk Classification (2020)

Vulnerability Ranking			
Rank	**Hazard**	**Score**	**Priority**
1	Tornado	34	High
2	Inland Flooding	32	High
3	Hurricane Wind	30	High
4	Severe Weather	28	High
5	Coastal Hazards	27	High
6	Drought	26	Medium
7	Severe Winter Weather	26	Medium
8	Wildfire	24	Medium
9	Wind	17	Medium
10	Extreme Heat	17	Medium
12	Seismic Hazards	10	Low
13	Geologic Hazards	6	Low

FIGURE X. Effingham County Joint Hazard Mitigation Plan Vulnerability Ranking (2023)

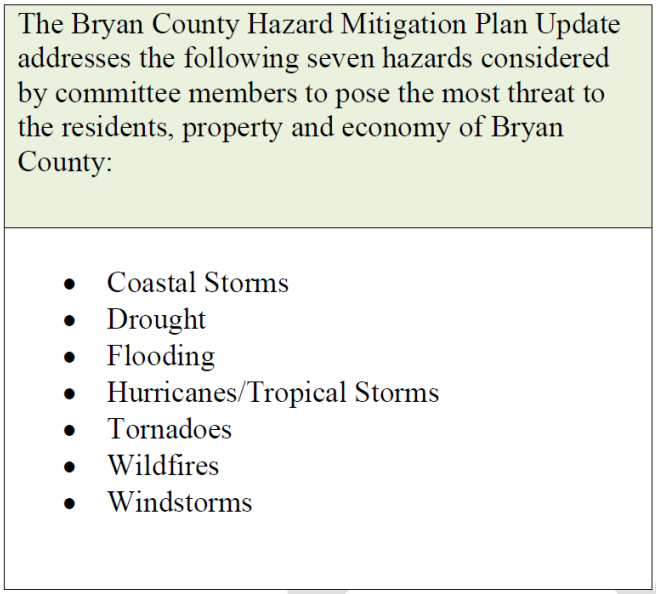


FIGURE X. Bryan County Hazard Mitigation Plan Update Threats (2019)

The HMPs identified extreme heat, flood, hurricanes, sea level rise, tornadoes, severe weather, drought, wildfires, and windstorms as the primary threats to the tri-county region. Therefore, this section will focus on describing future conditions of climate hazards of extreme temperature, precipitation, sea level rise, storm surge, and wind using data from the Climate Mapping for Resilience and Adaptation (CMRA) Assessment Tool and National Oceanic and Atmospheric Administration (NOAA). Man-made threats of hazardous materials incidents, cybersecurity incidents, active shooters, radiological releases, and infrastructure failures on the transportation system will be described using the Chatham County HMP and Georgia Hazard Identification and Risk Assessment (HIRA).

Natural Hazards

The CORE MPO region can expect to experience several natural hazards as a result of climate change. FHWA defines climate change as "changes in average weather conditions that persist over multiple decades or longer. Climate change encompasses both increases and decreases in temperature, as well as shifts in precipitation, changing risk of certain types of severe weather events, and changes to other features of the climate system."[8] The region will need to adapt to the changing environment while also mitigating the effects by reducing the emissions of greenhouse gases.

The CMRA Assessment Tool was utilized to report on the future climate hazards for the year 2050. CMRA is hosted by NOAA and was developed in 2022 by an interagency partnership working under the U.S. Global Change Research Program (USGCRP) with guidance from the U.S. Federal Geographic Data

[8] https://www.transportation.gov/priorities/climate-and-sustainability/definitions

Committee (FGDC). CMRA is designed to work with the US Climate Resilience Toolkit and help organizations assess their exposure to climate-related hazards.[9]

Temperature, precipitation, and sea level rise are described in baseline, low, and high emissions scenarios using representative concentration pathway (RCP) scenarios for 2050. The baseline data is based on historical data from 1976-2005. The low emissions scenario uses RCP 4.5, which aligns with Conference of Parties (COP) 26 goals. The high emissions scenario uses RCP 8.5, which reflects a "business as usual" approach. A higher RCP indicates higher greenhouse gas concentrations. Other indicators use historical data to help better understand current vulnerability.

Temperature

Extreme heat can result in drought, prolonged heatwaves, and wildfire. This can result in overuse of water sources, negative impacts on public health, loss of agricultural crops, and loss of life. Wildfires can cause loss of property and life, especially in the wildland-urban interface, an area where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.[10] Changes in temperature can also result in changes to the length of the construction season and higher rates of evaporation and drier soil, affecting rates of erosion and pavement degradation.[11] Extreme heat causes more deaths than any other weather-related hazards, even hurricanes and flooding, and urban areas can be 1.8-5.4˚ F warmer than their surroundings during the day and 22˚ F during the evening due to heat absorption. Many people are at higher risk to heat, including those who have a health risk, work outside or work without air conditioning, which can include those in the transportation sector.[12]

The MPO region is expected to experience a change in the annual maximum temperature five-day average is expected to increase by 3.69˚ F in 2050 in a lower emissions scenario and 4.66˚ F in a high emissions scenario. The change in total number of days a year above 95˚F with approximately 30 days in 2050 in a lower emissions scenario and 41 days in a high emissions scenario (Table X, Figure X). Values reported in the table are for the geographic area of the CORE MPO and values reported in the figure are by individual county.

Table X. Heat Indicators in the CORE MPO Region for 2050

Climate Stressor	Indicator	Baseline (1976-2005)	2050 Low Emissions Scenario (RCP 4.5)	2050 High Emissions Scenario (RCP 8.5)
Temperature	Annual Maximum Temperature 5 Day Average	96.84˚ F	100.53˚ F	101.49˚ F
Temperature	Total number of days a year above 95˚F	14.19 days	44.36 days	55.13 days

[9] https://resilience.climate.gov/pages/about

[10] HIRA (2022) pg. 34

[11] FHWA Climate Adaptation and Assessment Framework pg. 12

[12] https://www.epa.gov/sites/default/files/2016-10/documents/extreme-heat-guidebook.pdf

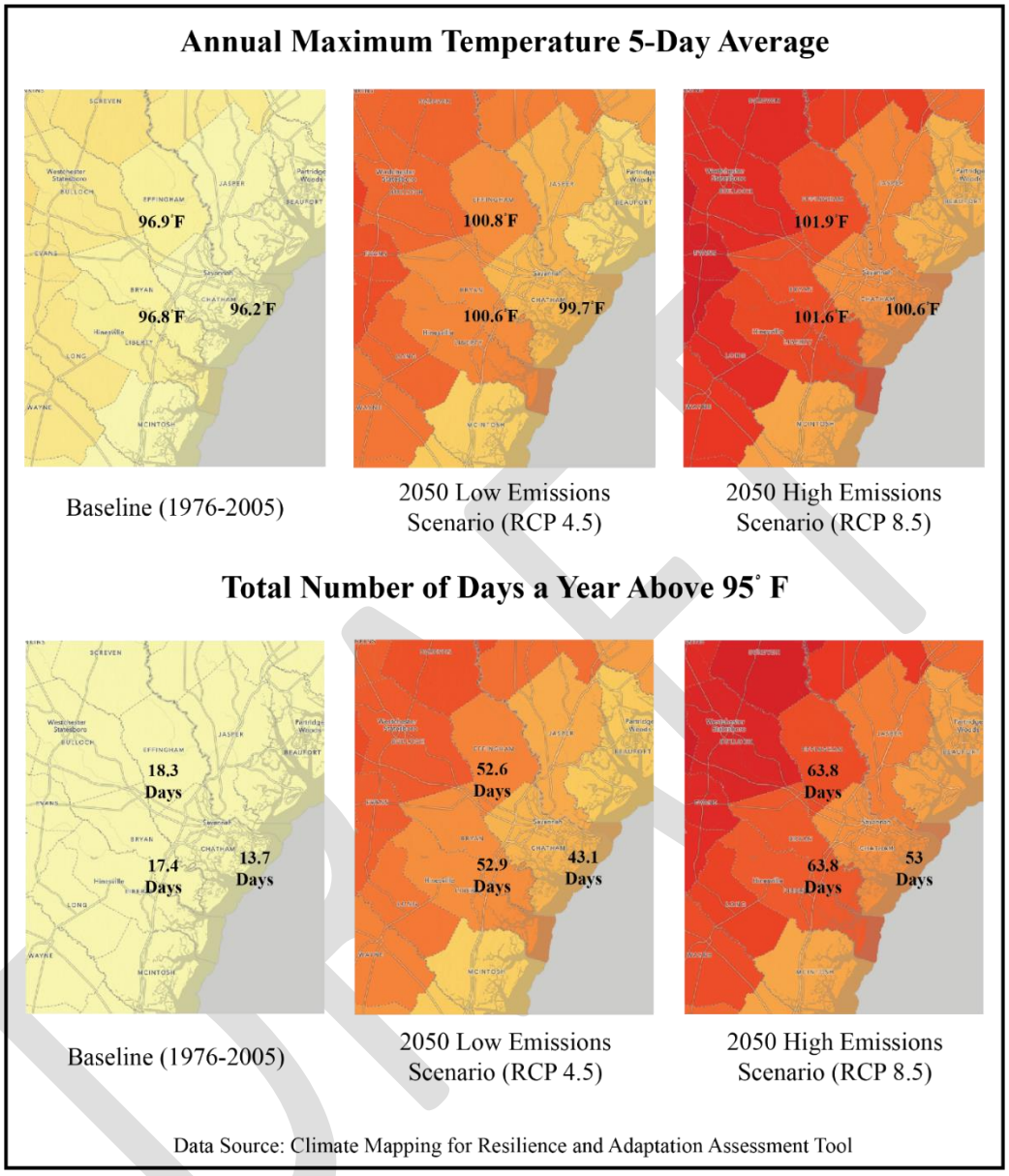


FIGURE X. Heat Indicators in the CORE MPO Region for 2050

Precipitation/Flooding

Precipitation is not expected to change as dramatically as temperature in the MPO region. There will be a change in total annual precipitation of approximately 1.7 inches in a 2050 low emissions scenario and 2.6 inches in a high emissions scenario. The number of consecutive days with precipitation is expected to increase by 0.42 days in a 2050 low emissions scenario and 0.37 days in a high emissions scenario (Table X, Figure X). Values reported in the table are for the geographic area of the CORE MPO and values reported in the figure are by individual county.

Table X. Precipitation Indicators in the CORE MPO Region for 2050

Climate Stressor	Indicator	Baseline (1976-2005)	2050 Low Emissions Scenario (RCP 4.5)	2050 High Emissions Scenario (RCP 8.5)
Precipitation	Total Annual Precipitation	49.70 inches	51.43 inches	52.28 inches
Precipitation	Number of Consecutive Days with Precipitation	14.69 days	15.11 Days	15.06 Days

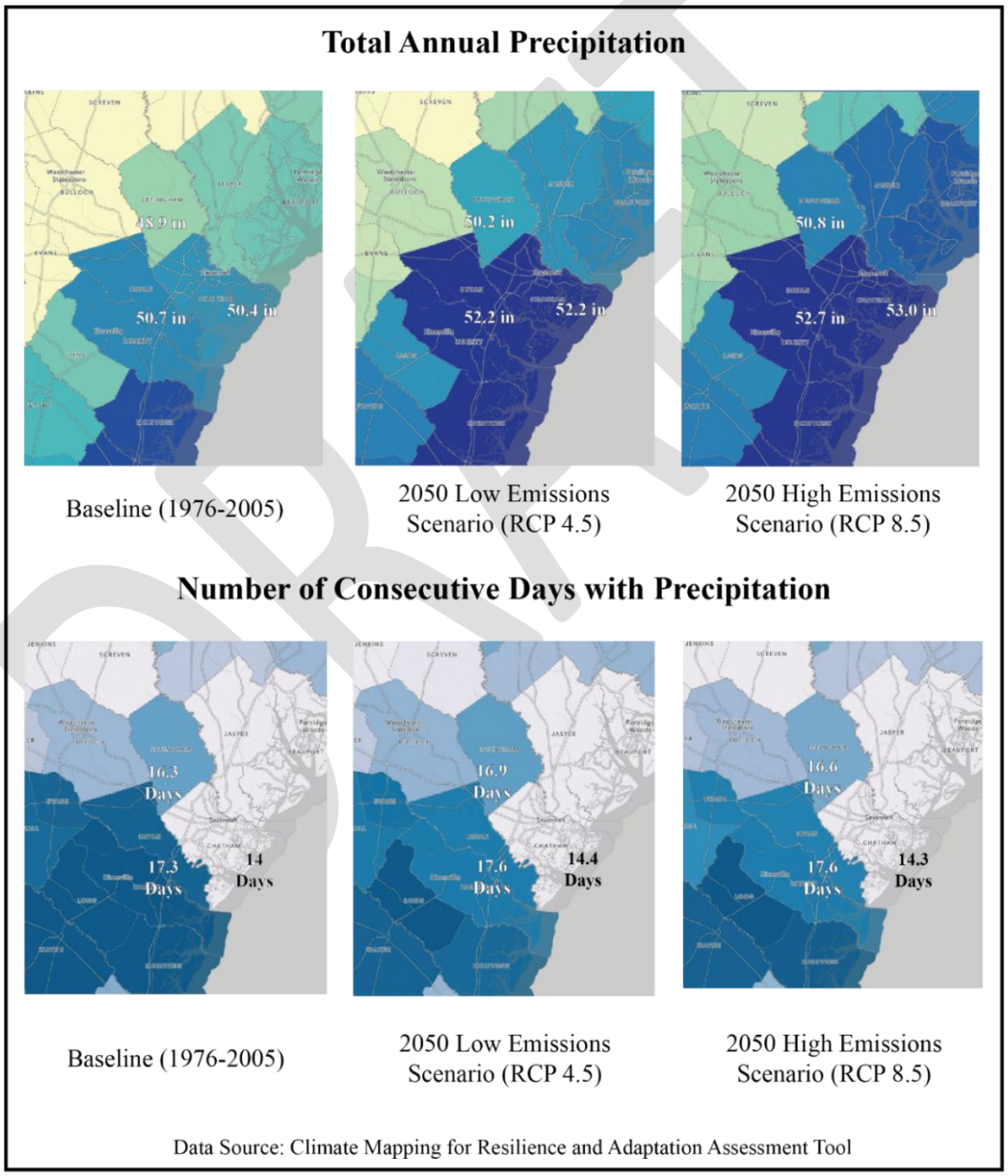


FIGURE X. Precipitation Indicators in the CORE MPO Region for 2050

Sea Level Rise

The projected sea level rise at the Fort Pulaski tide gauge *in an* intermediate scenario is 0.95 ft in 2040 and 1.64 ft in 2060. In a high scenario, projected sea level rise is 1.12 ft in 2040 and 2.4 ft in 2060. In less than 20 years, the Georgia coast is projected to experience approximately 1 ft sea level rise. Sea level rise can damage property, facilities, and infrastructure through flooding and storm surge.

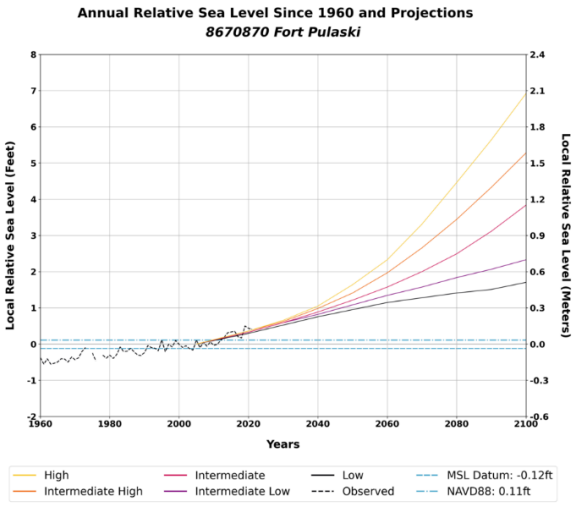
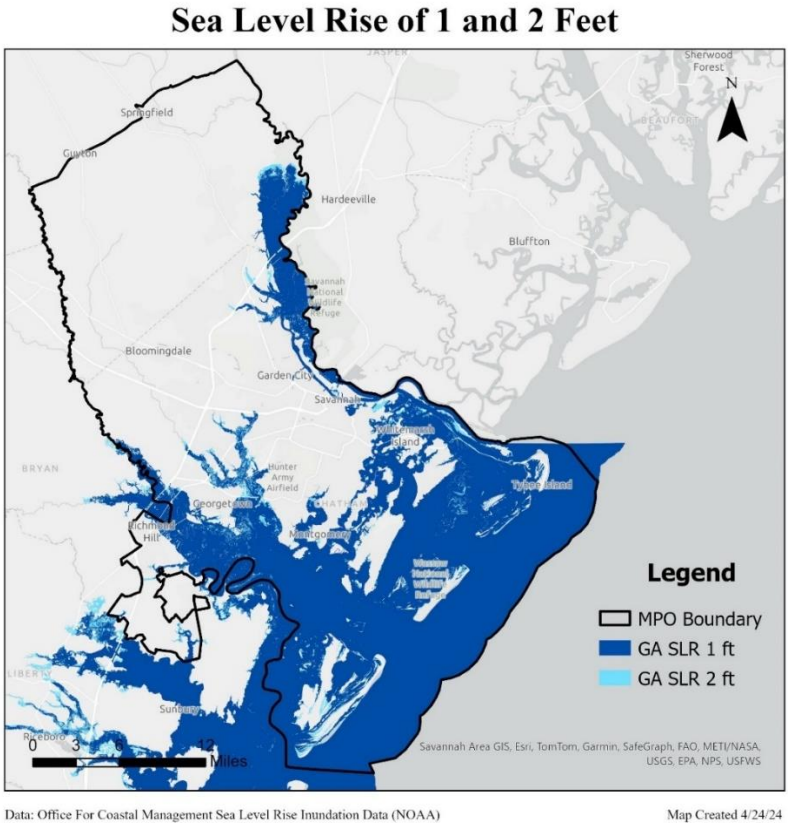


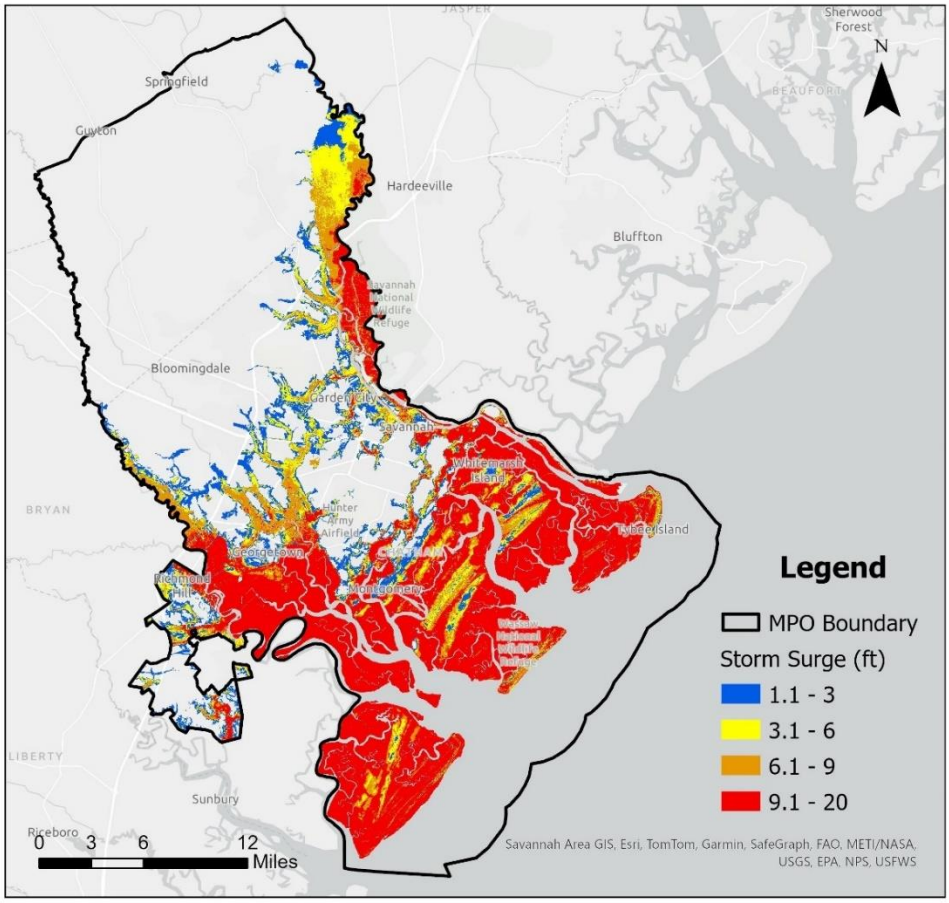
FIGURE X. Fort Pulaski Annual Relative Sea Level Since 1960 and Projections (NOAA)



Storm Surge

NOAA defines storm surge as "the abnormal rise in seawater level during a storm, measured as the height of the water above the normal predicted astronomical tide. The surge is caused primarily by a storm's winds pushing water onshore."[13] The Georgia Coastal region is vulnerable to high storm surge, with the highest potential to cause devastation in Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden counties. Storm surge ranged from 3-5 ft in past tropical cyclones of Floyd in 1999, Matthew in 2016, and Irma in 2017, but could be 10-20 ft in a worst-case scenario.[14] Hurricanes and tropical storms can impact roads, bridges, schools, and healthcare facilities by water damage from storm surge. Storm surge can cause widespread destruction to property, facilities, and infrastructure and result in high recovery costs. Further, power outages and the disruption of transportation can delay emergency response teams.[15]

Category 3 Hurricane Storm Surge



Data: National Hurricane Center Storm Surge Risk Map (NOAA)

Map Created 4/24/24

[13] https://oceanservice.noaa.gov/facts/stormsurge-stormtide.html

[14] Georgia HIRA 2022, pg. 6

[15] Georgia HIRA 2022, pg. 30

Wind

Sustained wind caused by tropical storms and hurricanes can cause extensive damage to structures, roadways, and bridges from flying debris and power loss. This can disrupt response units and may even damage or destroy first response vehicles.[16] The average windspeed recorded at the Savannah/Hilton Head International Airport (KSAV) from April 1996-February 2024 is 6.55 mph and the fastest recorded wind speed was 81 mph.[17]

Nineteen total storms have impacted Georgia at tropical storm or hurricane strength between 2001 and 2020, and only one entered Georgia as a hurricane (Hurricane Michael in 2020). Twelve occurred within state lines, seven occurred within fifty miles of state lines. Wind from Hurricane Michael (2018) and Irma (Irma) caused massive power outages, agricultural loss, damage to infrastructure, and downed trees. Hurricane Matthew (2016) caused the highest wind gusts recorded of 94-96 mph on Tybee Island, although it did not make landfall. Wind may also intensify other hazards such as tornadoes, thunder and hailstorms, and wildfires.[18]

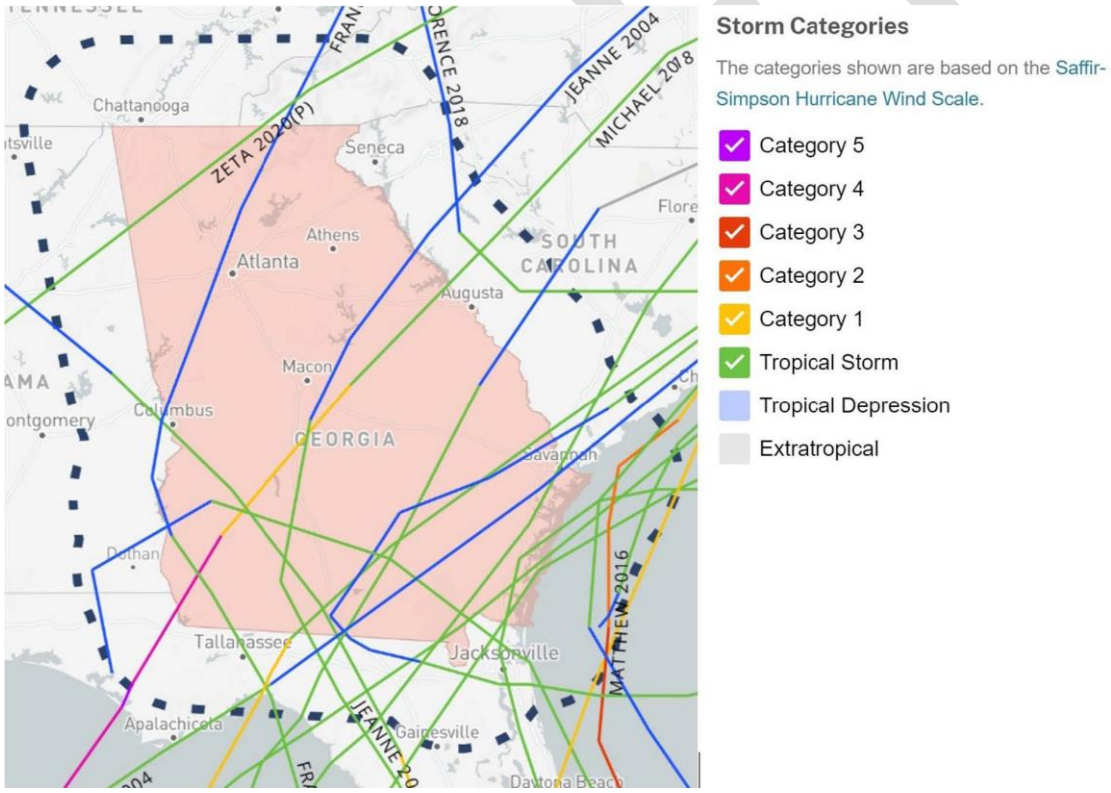


FIGURE X. Tropical Storm / Hurricane Tracks (HIRA 2022, NOAA Historical Hurricane Tracks)

[16] HIRA pg. 30
[17] https://www.ncei.noaa.gov/
[18] HIRA pg. 33 and 7

Evacuation Routes and Critical Facilities

Hurricane evacuation routes in the CORE MPO region include I-16, US 80, GA-21, and GA-144 (FIGURE X). Within Chatham County, there are three evacuation zones:

- Zone A: Areas east of the Truman Parkway and the Vernon River
- Zone B: Areas west of the Truman Parkway, but east of Interstate 95
- Zone C: Areas west of Interstate 95

An Evacuation Order is a general statement used to encourage residents to evacuate and will be issued when local officials feel it may be in your best interest to evacuate the targeted area. A Mandatory Evacuation Order is an executive directive requiring all residents, visitors, businesses, and others in the target area to evacuate.[19]

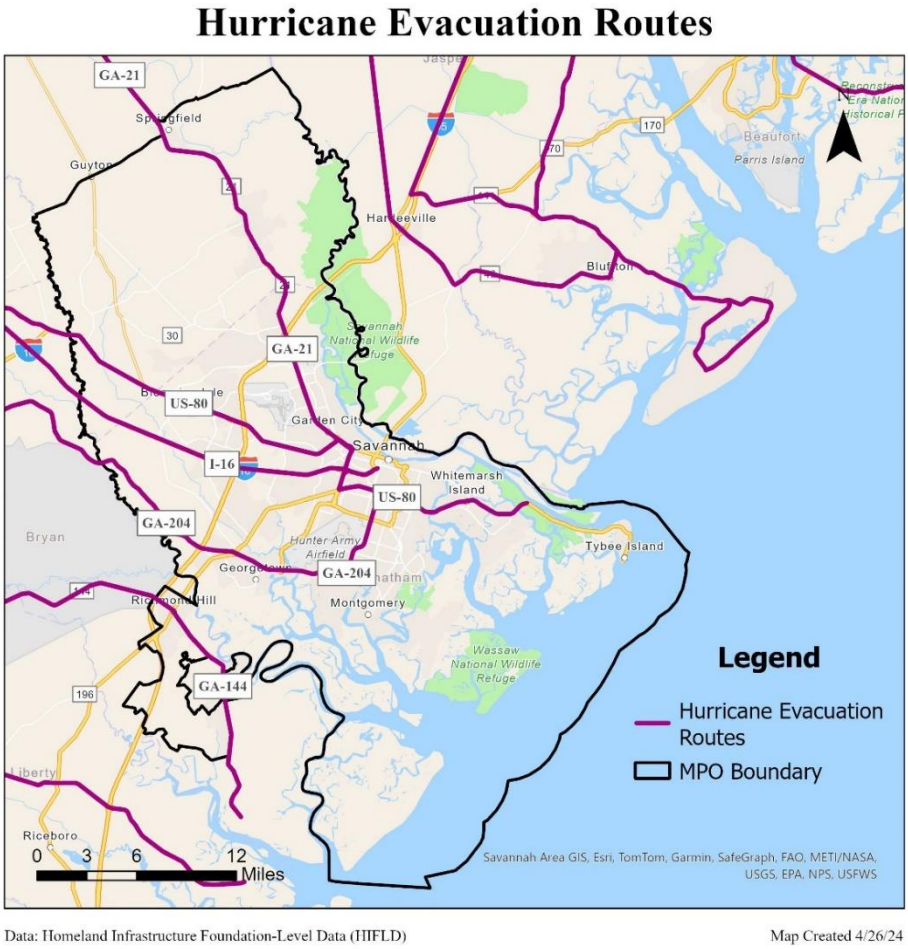


FIGURE X. Hurricane Evacuation Routes in the CORE MPO Region

[19] https://www.chathamemergency.org/PrepareNow/EvacuationZones

Critical facilities are essential services and lifelines that would result in severe consequences to public health, safety, and welfare if damaged in an emergency event.[20] These may include emergency operation centers, hospitals, fire stations, police stations, government buildings, and schools. All critical facilities are considered at risk to hurricane winds across all of Chatham County. Facilities may be more vulnerable depending on age, construction, and other factors.[21] Critical facilities can be located within individual HMPs.

Man-made Hazards

Man-made or human-caused hazard are defined as "any disastrous event caused directly and principally by one or more identifiable deliberate or negligent human actions [and] a technological hazard is a hazard originating from technological or industrial conditions, including accidents, dangerous procedures, or failures."[22] Building resilience to man-made hazards is as important as natural hazards. The following hazards will be discussed: hazardous materials incidents, cybersecurity incidents, active shooters, and infrastructure failures.

Hazardous Materials Incidents

The Chatham County Multi-Jurisdictional HMP defines a transportation hazardous materials incident as "the accidental release of chemical substances or mixtures during transport… Highway accidents involving hazardous materials pose a great potential for public exposures. Both nearby populations and motorists can be impacted and become exposed by accidents and releases. If airplanes carrying hazardous cargo crash, or otherwise leak contaminated cargo, populations and the environment in the impacted area can become exposed."[23]

Hazardous materials are routinely stored and transported throughout Georgia. Georgia's industrial capacity and network of highways, pipelines, waterways, and railways result in vulnerabilities to hazardous material releases. Storage sites as well as hazardous materials in transit could be impacted by accidental, criminal, or terrorist events. Many sites that utilize or store hazardous materials are in coastal counties where they are could be exposed to tropical cyclone winds and rains. A release of a hazardous material could result in injury, long term health problems, loss of life and damage to property and the environment. The consequences of a hazardous material release will vary greatly depending on the location, time, quantity, and material released. A hazardous materials incident can impact delivery of services by requiring roadway and bridge closures and disruption of transit services while the event is happening and during cleanup.[24]

There are many fixed facility sites and transportation routes with hazardous materials in Chatham County. The Chatham County HMP addressed this hazard and found it highly likely in the planning

[20] Chatham County Multi-Jurisdictional HMP (2020), pg. 56
[21] Chatham County Multi-Jurisdictional HMP (2020), pg. 133
[22] HIRA pg. 1
[23] Chatham County Multi-Jurisdictional HMP (2020), pg. 205
[24] HIRA (2022) pg. 51

area.[25] Previous Major Occurrences: Based on available data, there were over 900 reports of oil and hazmat releases reported to the Georgia Environmental Protection Division in 2017. Some of the major occurrences:

- Multiple tanker roll overs throughout GA releasing thousands of gallons of gasoline and diesel fuel;
- Multiple train derailments resulting in the release of thousands of gallons of oil and diesel fuel;
- Multiple sunken vessels along Georgia's coast.[26]

Cybersecurity Incidents

Most of Georgia's critical infrastructure is linked to some technology-based platform, which is a key vector of attack in a cybersecurity incident.[27] HIRA defines cybersecurity as "the methods, techniques, and practices of protecting cyberspace (internet-connected networks, devices, software applications, and the sensitive data that travels through them all) from unauthorized access that would compromise the confidentiality, integrity and/or availability of the data. Cyberspace and its underlying infrastructure are vulnerable to a wide range of risks stemming from both physical and cyber threats and hazards. Sophisticated cyber criminals, threat actors and nation-states exploit vulnerabilities to steal information and money and are developing capabilities to disrupt, destroy, or threaten the delivery of essential services."[28]

Cyberspace is particularly difficult to secure due to several factors: the ability of malicious actors to operate from anywhere in the world, the linkages between cyberspace and physical systems and the difficulty of reducing vulnerabilities and consequences in complex cyber networks. Cybersecurity attacks can disrupt services, such as supply chain capabilities and delivery of everyday goods and services.

Active shooters

HIRA describes an active killer or active shooter as the "perpetrator of a type of mass murder marked by rapidity, scale, randomness, and often suicide."[29] These attacks can impede delivery of services depending on the type of an attack, especially if explosive devices are utilized. For example, roadways or bridges may be to be closed and transit services may be disrupted. These attacks may impact access to homes and critical facilities as well.

Infrastructure failures

Infrastructure is aging in the United States, making it more prone to failure as the average age increases. Infrastructure can include structures that improve living conditions and commerce, including schools, hospitals, roads, bridges, dams, sewers, and energy systems. Failures can lead to

[25] Chatham County Multi-Jurisdictional HMP (2020), pg. 51
[26] HIRA (2022) pg. 51
[27] HIRA pg. 4
[28] HIRA pg. 40
[29] HIRA pg. 45

heavy flooding, power loss, property damage, injury, and even death. Roadways may become obstructed or inaccessible to the public and first responders in an emergency. Delivery of food, drinking-water, and services will be impacted locally, regionally, and statewide due to problems with accessibility and transport abilities. Communications, transportation, and governmental services operations would be impacted due to power failure and accessibility challenges. Property of homes and businesses may be destroyed if situated close to the failure point.[30]

CORE MPO Resilience Studies

In 2023, two CORE MPO studies with resilience components were completed: the The Flooding Dynamic Modeling Tools for Optimized Planning of CORE MPO Transportation Infrastructure Systems (Urban Flood Model) and Freight Plan Update. This section summarizes each study.

Urban Flood Model

The Flooding Dynamic Modeling Tools for Optimized Planning of CORE MPO Transportation Infrastructure Systems project assessed the vulnerability of stormwater infrastructure and surface transportation networks in the CORE MPO area to present and future flooding. The project developed an urban stormwater management model using the Storm Water Management Model (SWMM) to analyze the performance of the stormwater network under different rainfall events and sea level rise (SLR) scenarios. The stormwater management model identified the need for backflow preventers in the stormwater drainage systems to mitigate the impact of coastal inundation during rainfall events and SLR projections. This information can be used to inform future flood studies and improve the design and planning of stormwater infrastructure.

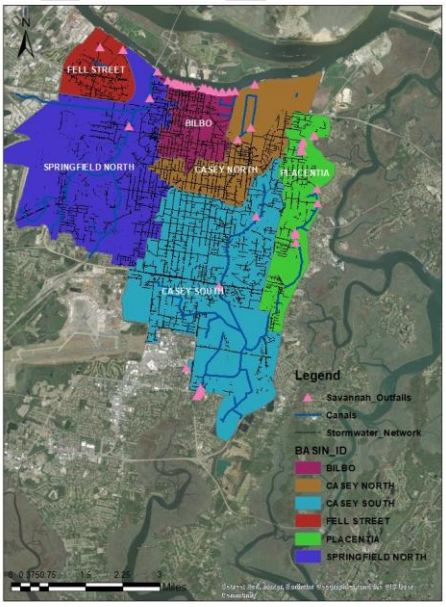


FIGURE X. Stormwater network data and their urban drainage watersheds.

[30] HIRA pg. 55

The project also conducted tidal flooding modeling using the Advanced CIRCulation (ADCIRC) code to examine the impact of astronomic tides and storm surge on the transportation network. The tidal flooding modeling provided insights into the extent of flooding due to astronomic tides and storm surge under different SLR scenarios. This information can help identify areas of the transportation network that are vulnerable to tidal flooding and guide the development of flood mitigation strategies.

Scenario	Moderate Vulnerability (miles)	High Vulnerability (miles)	Total (miles)
Present-Day Tides	50.7	91.0	141.7
Tides 2050 DNR Low (1.23 ft)	47.5	151.0	198.5
Tides 2050 DNR High (2.18 ft)	40.8	202.5	243.3
Tides 2075 DNR Low (2.14 ft)	42.0	199.4	241.4
Tides 2075 DNR High (4.08 ft)	40.3	318.5	358.9
Tides 2100 DNR Low (3.28 ft)	35.2	274.8	309.9
Tides 2100 DNR High (6.56 ft)	44.1	523.5	567.5
0.1% AEP	73.3	638.9	712.2
0.2% AEP	116.2	948.8	1,065.0

FIGURE X. Miles of effected roadway for each flooding scenario (Urban Flood Model, 2023) for 2023 CORE MPO Boundary.

The Roadway Vulnerability Assessment classified road segments based on their elevation and the depth of flooding above the road. This assessment highlighted the vulnerability of certain road segments to flooding and can support decision-making for prioritizing infrastructure improvements and resilience planning. The findings of the project were integrated into a Project Prioritization Tool and an online ESRI Dashboard to assist with planning and decision-making for resilient transportation infrastructure (FIGURE X). These tools can assist decision-makers in optimizing the planning and design of transportation infrastructure to improve resilience and address social and economic considerations.

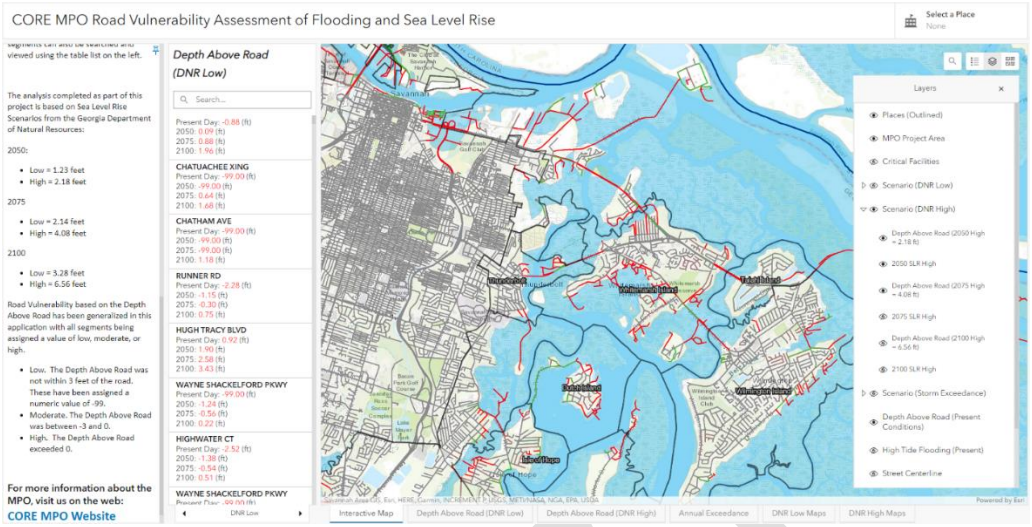


FIGURE X. CORE MPO Road Vulnerability Assessment of Flooding and Sea Level Rise Dashboard

The study also discusses the concept of social vulnerability and its relationship to transportation resilience planning. It emphasizes the importance of considering the social vulnerability of communities when planning for transportation resilience, as socially vulnerable populations are often less prepared for disasters and more likely to experience adverse effects. The study uses the Social Vulnerability Index (SVI), which is a tool used to evaluate the relative social vulnerability of different communities. The study further discusses the financial stewardship aspect of transportation resilience planning, providing a list of funding opportunities for the CORE MPO planning area. It also highlights the importance of diversifying the range of resources available to maintain necessary levels of service and mentions the relevance of nature-based infrastructure systems in resilience planning.

Freight Plan Update

Environmental and Community Impact Scan and Analysis (2023)

The Regional Freight Transportation Plan Update conducted an Environmental and Community Impact Scan and Analysis for the CORE MPO region. The analysis focused on freight equity impacts and environmental impacts of freight transportation. In terms of freight equity impacts, the analysis identified disadvantaged communities based on locally defined environmental justice areas and USDOT-defined historically disadvantaged communities. The analysis found that these communities experience higher levels of truck congestion, longer travel times, and higher levels of trucking activity compared to non-disadvantaged communities. Additionally, historically disadvantaged communities have higher rates of truck-involved crashes. The document presents potential strategies for addressing freight transportation equity and environmental challenges.

FIGURE 2.9 COMPARISON OF TRUCK ACTIVITY ACROSS COMMUNITIES

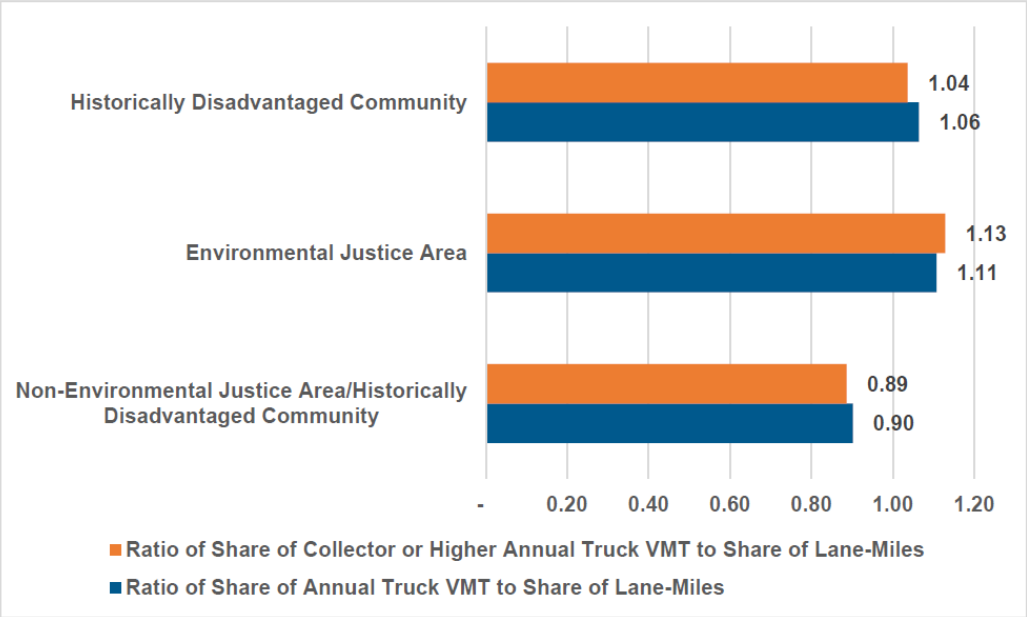


FIGURE X. Comparison of Truck Activity Across Communities (Freight Plan Update 2023)

The *CORE MPO Regional Freight Transportation Plan (RFTP) Update* provided the following analysis of freight emissions for the 2022 CORE MPO area.

"As part of its Freight Mobility Trends Report, the Federal Highway Administration (FHWA) estimates the amount of CO2 generated per mile of National Highway System (NHS) roadways for states and urbanized areas. For the Savannah urbanized area, truck traffic on NHS roadways was estimated to generate approximately 619 metric tons of CO2 per mile in 2021 as shown in Figure 3.6. The substantial decrease in CO2 emissions per mile for 2020-2021, from a peak of 968 metric tons per mile in 2018, is likely due to the nationwide decrease in traffic volumes that resulted from the COVID-19 pandemic.22 Though truck volumes largely remained consistent with pre-pandemic levels, they were operating on less congested roadways due to reduced commuter traffic. As a result, the improvement in efficiency for trucks reduced their emissions.

There are multiple regional trends indicating that truck CO2 emissions will increase over the long term unless action is taken by regional leaders and their state and federal partners. The CORE MPO region is projected to experience substantial population growth over the next 20 years and will grow at a rate that exceeds statewide and national averages. In addition, freight-related land uses throughout the region are becoming more prevalent. The region's various economic development agencies are currently developing over 15,000 acres of land for heavy industrial and logistics uses. This is in addition to privately held properties being developed by the private sector for industrial uses. Underlying both the population growth and freight land use trends is the trend of accelerated growth at the Port of Savannah. The Port of Savannah's annual containerized throughput is forecast to grow

from 5.5 million twenty-foot equivalent units (TEU) in 2021 to 9 million TEU in 2025. All of these trends point to higher levels of truck CO2 emissions over the long term."[31]

FIGURE 3.6 TRUCK CO2 EMISSIONS IN THE CORE MPO REGION, 2017-2021

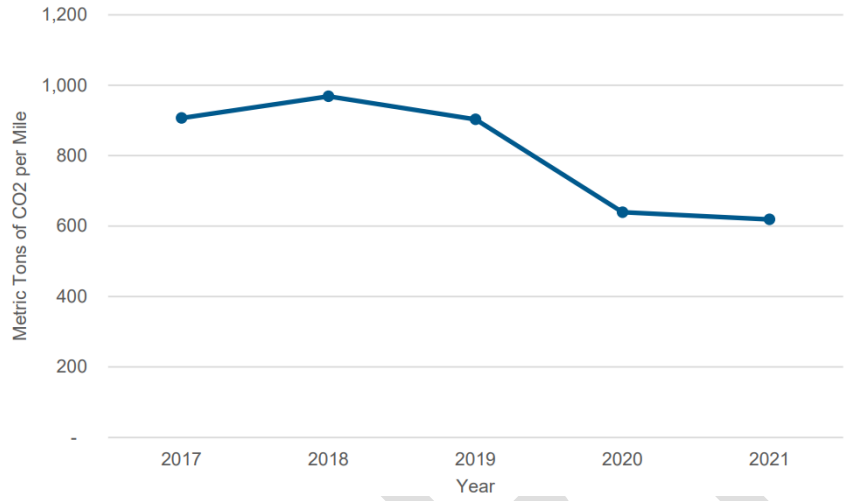


FIGURE X. Truck CO2 Emissions in the CORE MPO Region 2017-2021 (Freight Plan Update 2023)

For freight equity impacts, strategies include tracking freight equity indicators, implementing avoidance, mitigation, and offsetting enhancements strategies, focusing on economic development and local benefits, conducting outreach strategies, and implementing land use strategies. For freight environmental impacts, strategies include developing green infrastructure, implementing wildlife crossing strategies, protecting wildlife habitats and environmentally sensitive areas through land use strategies, and reducing congestion to lower emissions. The document also provides key insights, such as the locations of environmental justice areas and historically disadvantaged communities, the impacts of freight congestion, activity, and safety on these communities, and the impacts of freight on wildlife habitats and the environment. It emphasizes the need to consider both the negative externalities and positive outcomes of freight to develop effective strategies and recommendations.

In terms of environmental impacts, the analysis examined wildlife habitat impacts and emissions impacts. The region contains multiple wildlife habitats, wetlands, and critical habitats for threatened and endangered species. Freight transportation can have adverse effects on these habitats, including habitat loss and degradation. Freight-related land uses, such as logistics facilities, often result in large areas of impervious surfaces, such as concrete and asphalt, which can lead to increased stormwater runoff and flooding. This runoff can carry pollutants into wetlands, impairing their ability to support wildlife and provide clean water. Additionally, the development of industrial and logistics properties can result in the conversion or alteration of wetlands, leading to their loss or degradation. Further, these impacts include the loss of habitat, degradation of habitat quality, and population fragmentation and isolation.

[31] Freight Plan Update Environmental And Community Impact Scan And Analysis (2023) pg. 33-34

Freight activities, such as the construction of new roadways or rail corridors, can further impact wildlife habitats by encroaching on or dividing these areas. Industrial zoned properties, which are often associated with freight activity, may also be located near wildlife habitats, potentially leading to negative impacts on wildlife populations. Activities can contribute to increased stormwater runoff. This runoff can carry pollutants, such as oil, chemicals, and sediment, into waterways, including wetlands and other sensitive areas. Untreated stormwater runoff can impair water quality and harm wildlife.

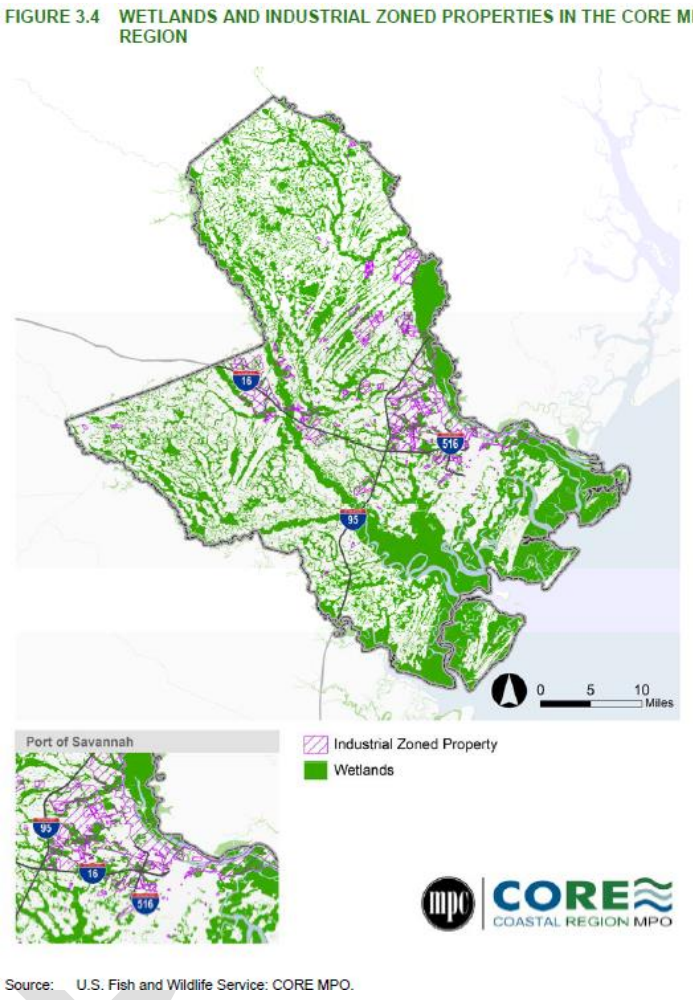


FIGURE X. Wetlands and Industrial Zoned Properties in the CORE MPO Region (Freight Plan Update 2023)

The document outlines strategies for addressing freight transportation equity and environmental challenges. These strategies include tracking freight equity indicators, implementing avoidance, mitigation, and offsetting enhancements strategies, focusing on economic development and local benefits, conducting outreach strategies, implementing land use strategies, developing green infrastructure, implementing wildlife crossing strategies, protecting wildlife habitats and

environmentally sensitive areas, and reducing congestion to lower emissions. The document highlights key insights regarding the impacts of freight on environmental justice areas and historically disadvantaged communities, as well as the impacts on wildlife habitats and the environment. It emphasizes the importance of considering both the negative impacts and positive outcomes of freight to develop comprehensive strategies and recommendations.

Freight Plan Update: Resiliency Task 2.7 (2023)

The Regional Freight Transportation Plan for the CORE MPO region focuses on assessing the resilience of the freight network and identifying potential risks and hazards. The plan recognizes the importance of the region's multimodal freight network, which includes the Port of Savannah, major highways, freight railroads, and cargo-serving airports. The document discusses various risks and disruptors that can impact supply chains and transportation systems in the CORE MPO region, including natural hazards such as sea level rise, coastal flooding, riverine flooding, hurricanes, and tornadoes, as well as supply chain disruptions caused by extreme weather events, labor shortages, pandemics, cyberattacks, and infrastructure failures. The plan aims to enhance the resiliency of the freight transportation system by identifying vulnerable assets and developing strategies to mitigate risks. These strategies may involve planning, operations, and capital investments, such as relocating and rerouting freight assets, hardening infrastructure, increasing network redundancy, developing protective barriers, and improving information sharing and coordination. By addressing these risks, the plan aims to ensure the smooth flow of goods and maintain the functionality of the supply chain in the CORE MPO region.

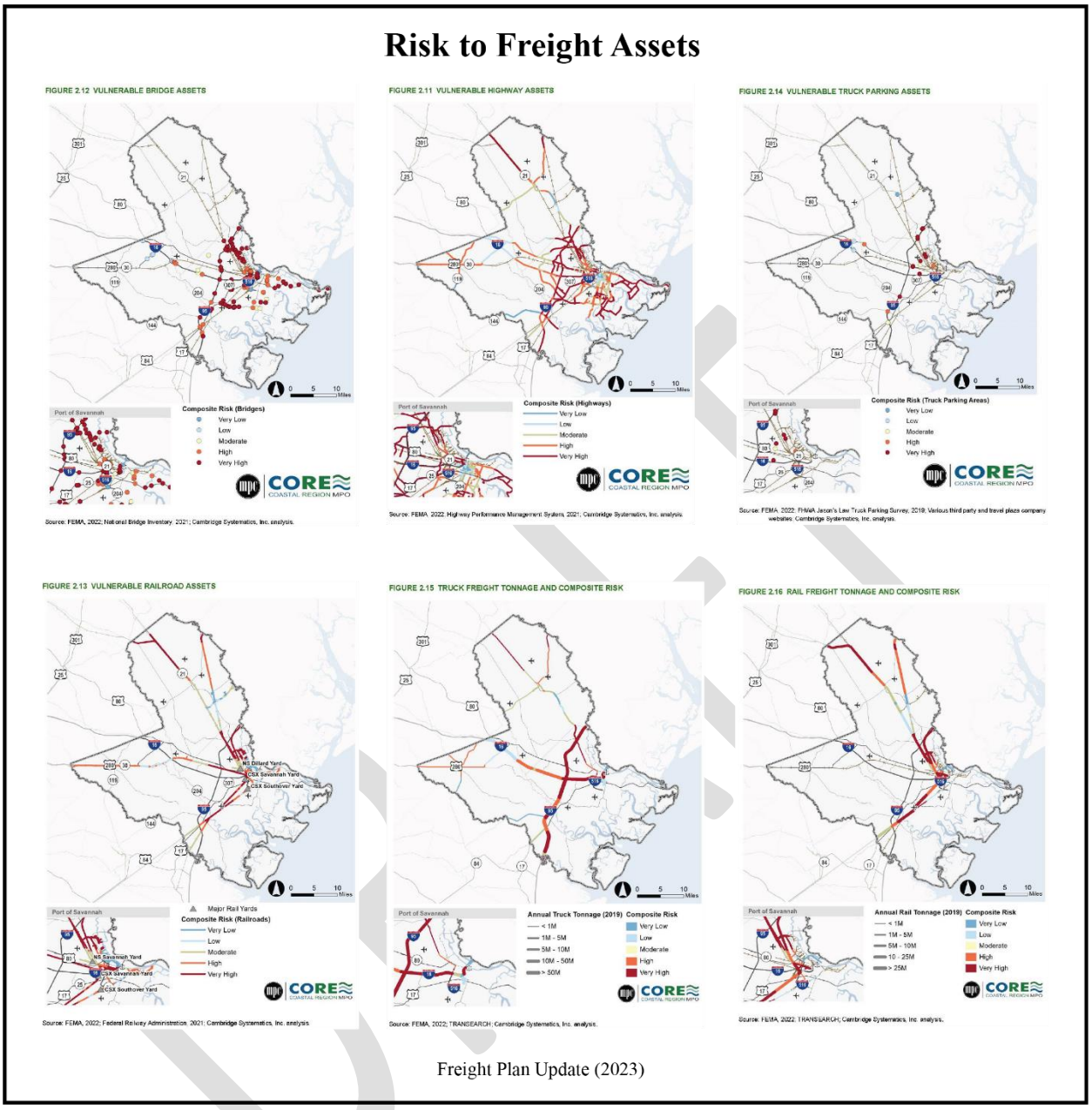


FIGURE X. Freight assets at risk identified by the Freight Plan Update

Plan 2040 Natural Resources & Transportation

Natural Resources

Chatham County and the City of Savannah face several challenges and opportunities related to natural resource management and climate change. Some of the key challenges include climate change impacts such as extreme heat, changes in rainfall patterns, rising sea levels, and increased flooding. Loss of agricultural and forest land to development, solid waste management issues, and

the need to protect natural resources are also challenges. However, there are opportunities to address these challenges. These include implementing mitigation and adaptation measures, collaborating with neighboring counties, protecting and expanding parks and conservation lands, and increasing public education and awareness. By addressing these challenges and capitalizing on these opportunities, Chatham County can work towards a more sustainable and resilient future.

The natural resource goals outlined in Plan 2040 are as follows:

1. Protect the public health, safety, and welfare of residents from flood hazards.
2. Improve public education and outreach efforts related to water, flooding, and hazards.
3. Implement plans, policies, and property protection to reduce potential damages from climate change.
4. Conserve and protect potable water sources to ensure adequate drinking water supplies for existing and future residents.
5. Preserve and enhance scenic views.
6. Conserve existing tree canopy and require planting of additional native trees during the development process to mitigate negative impacts of stormwater runoff, heat islands, reduced air quality, and loss of tree species from rising ambient temperatures.
7. Improve the ability of our community to adapt to changing natural and built environments.
8. Manage the impacts of climate change as it relates to land use and development through mitigation and adaptation measures.
9. Plan for the mitigation and redevelopment of brownfields for productive uses.
10. Proactively manage stormwater runoff.
11. Implement a municipal clean energy action plan.

Transportation

Transportation plays a role in the overall planning and development strategies to mitigate and adapt to climate change. The focus is on promoting alternative modes of transportation, reducing vehicle trips, and incorporating sustainable transportation practices into land use decisions. There is a need to coordinate land use and transportation infrastructure decisions and incorporate climate change projections into these decisions. One strategy for reducing greenhouse gas emissions from development is to put homes, jobs, stores, parks, schools, and other destinations close to each other so that people can easily walk, bike, use public transit, or drive shorter distances. Furthermore, there is a goal to review and amend policies and regulations as necessary to remove barriers to mixed uses within close proximity of each other in order to reduce vehicle trips. Plan 2040 also mentions the need

to evaluate existing policies, plans, and regulations to ensure that they are consistent with best management practices regarding smart growth, energy efficiency, and reduction of emissions.

Energy and Emissions

Emissions

The Inventory of US Greenhouse Gas Emissions and Sinks reported the transportation sector was the largest emitter of greenhouse gas (GHG) emissions (28.5%) in the United States in 2021.[32] According to the *US National Blueprint for Transportation Decarbonization*, emissions from transportation are the result of system design and land use, vehicle and engine efficiency, and high-GHG fuels and can be reduced by increasing convenience, improving efficiency, and transitioning to clean vehicles and fuels.[33] Understanding the link between emissions and transportation can result in co-benefits such as safety and quality of life, equity, air quality, economic growth, and energy security.

Greenhouse gases absorb heat in the atmosphere near the Earth's surface, preventing it from escaping into space. If the atmospheric concentrations of these gases rise, the average temperature of the lower atmosphere will gradually increase, a phenomenon known as the greenhouse effect. Greenhouse gases include carbon dioxide, water vapor, and methane.[34] The greenhouse effect is caused by GHGs such as water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases absorbing radiation leaving the earth and trapping heat in the atmosphere.

The *Fifth National Climate Assessment* describes the changing climate conditions as “rapid and unprecedented.” The present-day levels of GHGs in the atmosphere are higher than at any time in the past 800,000 years, with most emissions occurring since 1970, and global temperature has increased faster in the last 50 years than at any time in the past 2,000 years.[35] Working to decrease emissions needs to become a top priority in the transportation sector.

Carbon dioxide is the primary GHG emitted from human activities and the transportation sector, primarily due to fossil fuel combustion.[36] Many factors influence CO_2 emissions from fossil fuel combustion, such as changes in population growth, energy prices, technology, and behavior.[37] In 2021, CO_2 accounted for 35% of all transportation emissions. Light-duty vehicles, including passenger cars, SUVs, pickup trucks, and motorcycles, were the largest contributors to U.S. transportation GHG

[32] https://www.epa.gov/system/files/documents/2023-04/US-GHG-Inventory-2023-Main-Text.pdf
[33] https://www.transportation.gov/priorities/climate-and-sustainability/us-national-blueprint-transportation-decarbonization
[34] https://www.transportation.gov/priorities/climate-and-sustainability/definitions
[35] https://nca2023.globalchange.gov/#overview
[36] https://www.epa.gov/ghgemissions/overview-greenhouse-gases
[37] https://www.dot.ga.gov/GDOT/Pages/CarbonReduction.aspx

emissions, and medium- and heavy-duty vehicles (MHDVs) were the second-largest contributor (FIGURE X).[38]

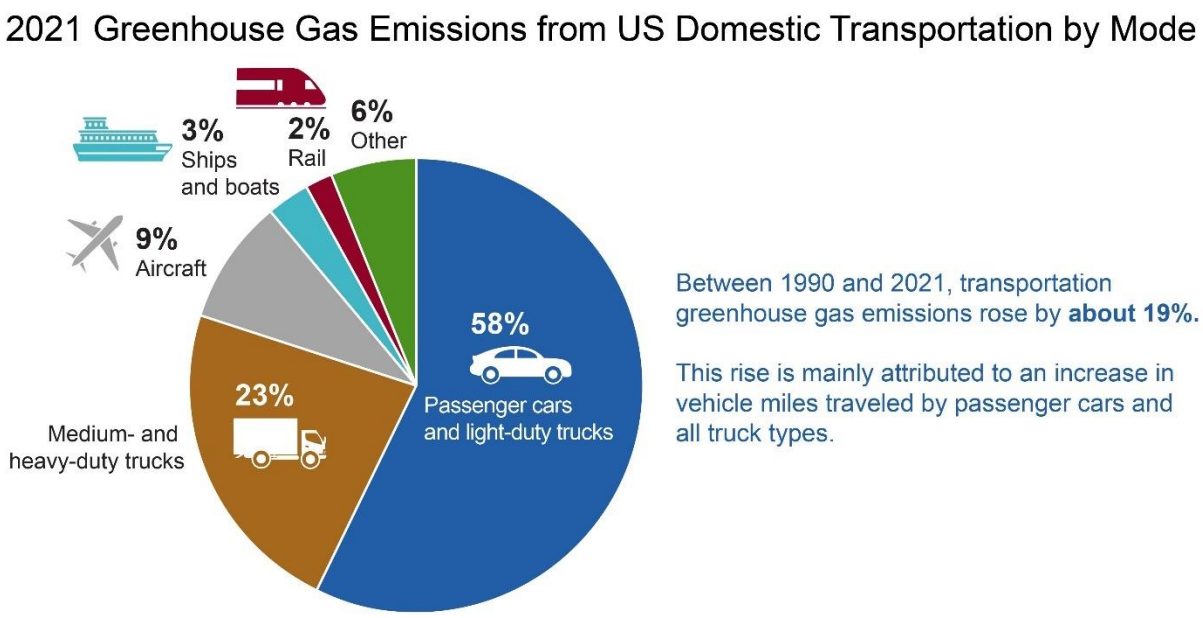
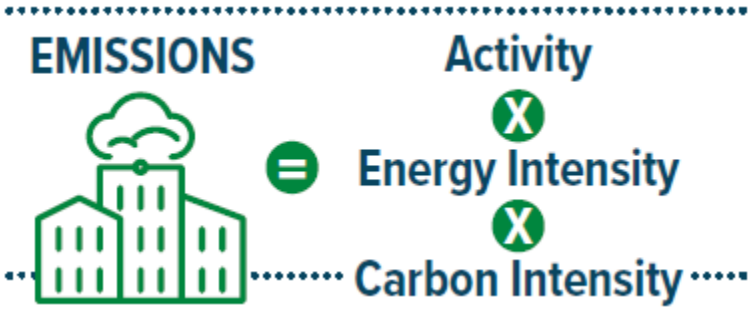


FIGURE X: 2021 Greenhouse Gas Emissions from US Domestic Transportation by Mode (5th National Climate Assessment, 2023)[39]

The *US National Blueprint for Transportation Decarbonization* describes transportation use-phase emissions as, "the result of three main drivers or categories: the total amount of activity, (i.e., the distance and volume of passenger and goods travel); the energy intensity of the transportation options used to meet the activity demand, (i.e., the energy used per mile traveled); and the carbon intensity of the fuels used to provide that energy, specifically the amount of GHG emitted per unit of energy consumed."[40]



[38] https://www.transportation.gov/priorities/climate-and-sustainability/us-national-blueprint-transportation-decarbonization
[39] https://nca2023.globalchange.gov/chapter/13#section-1
[40] https://www.transportation.gov/priorities/climate-and-sustainability/us-national-blueprint-transportation-decarbonization

FIGURE X: Three Primary Drivers of Emissions (US National Blueprint for Transportation Decarbonization)[41]

In Georgia, the transportation sector was the highest emitter of GHGs, primarily CO_2, in 2021.[42] Georgia has reduced overall statewide emissions by 12.2% between 1990 and 2020 due to reductions in electricity-generating and industrial sectors (FIGURE X).[43]

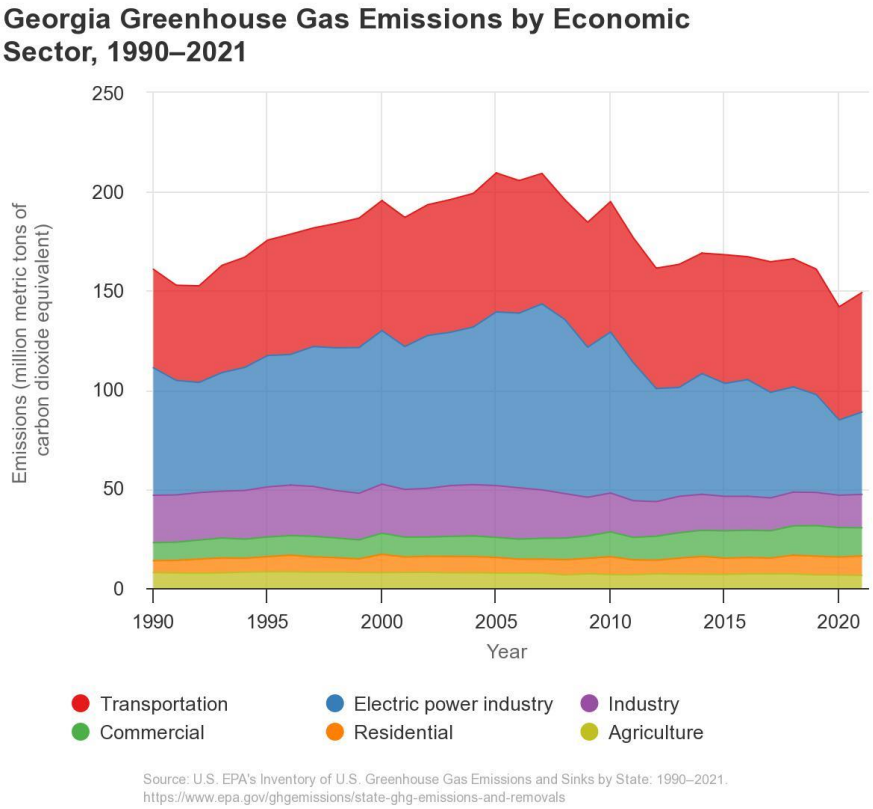


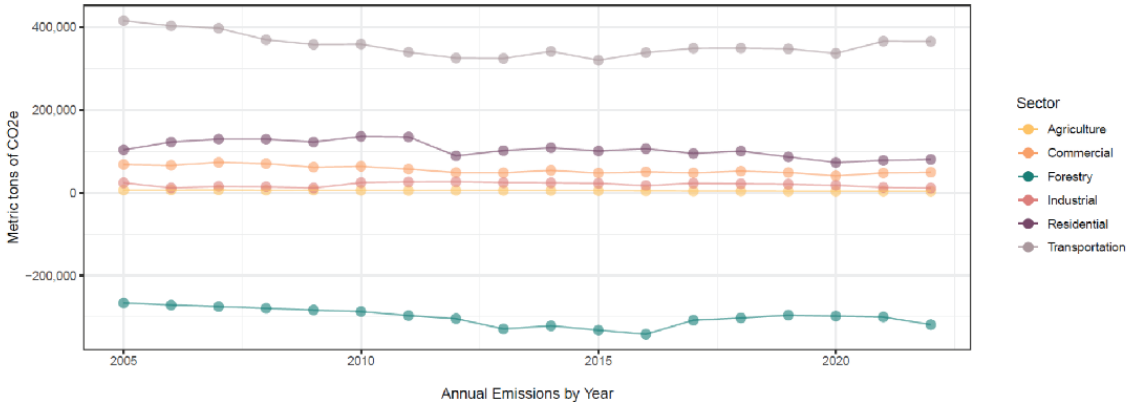
FIGURE X. Greenhouse Gas Emissions by Economic Industry 1990-2021 (EPA, 2023)[44]

Within the CORE MPO region of Bryan, Chatham, and Effingham Counties, transportation contributed to the most emissions in Bryan County, and the second most emissions in Chatham and Effingham counties behind the industrial sector for the years 2005-2022.[45] The year 2020 is considered an anomaly due to the COVID-19 Pandemic when less people were driving. By 2022, transportation emissions were at or above pre-pandemic levels in each county.

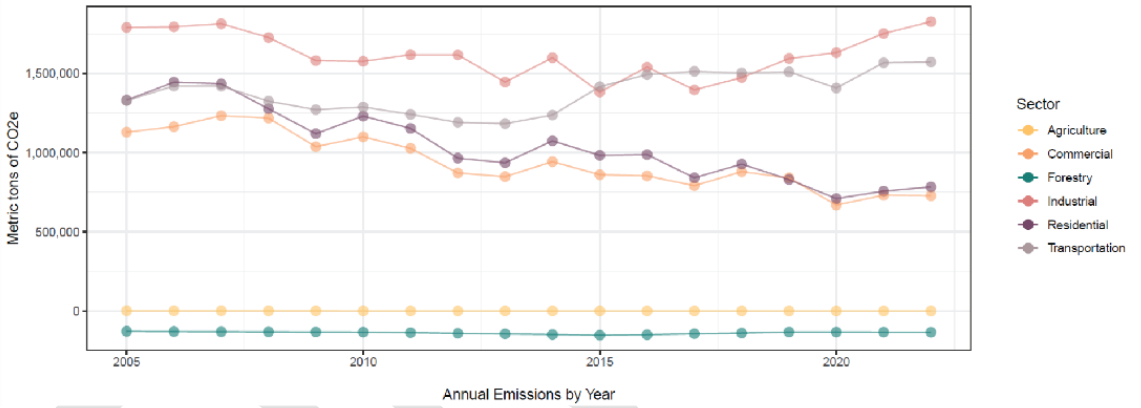
[41] https://www.transportation.gov/priorities/climate-and-sustainability/us-national-blueprint-transportation-decarbonization
[42] https://cfpub.epa.gov/ghgdata/inventoryexplorer/#allsectors/allsectors/allgas/econsect/all
[43] https://www.dot.ga.gov/GDOT/Pages/CarbonReduction.aspx
[44] https://cfpub.epa.gov/ghgdata/inventoryexplorer/#allsectors/allsectors/allgas/econsect/all
[45] https://www.drawdownga.org/ghg-emissions-tracker/

Yearly Emissions from 2005-2022

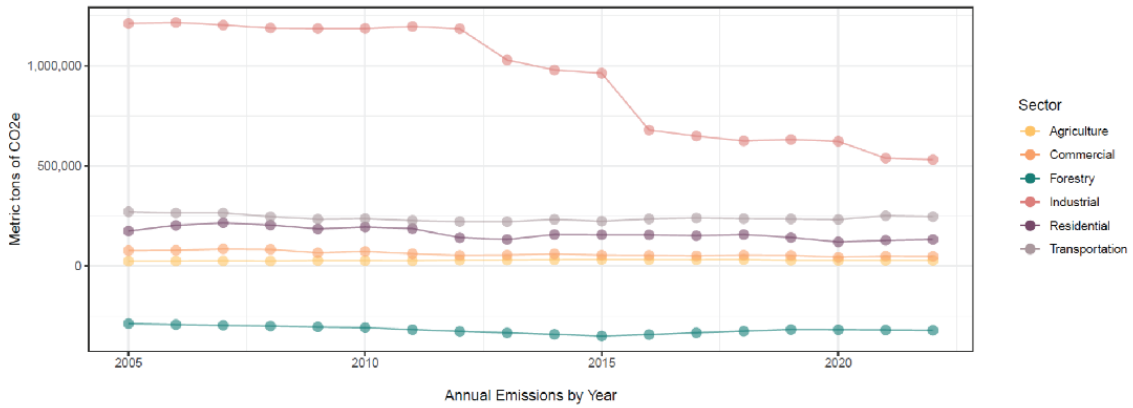
Bryan County



Chatham County



Effingham County



Source: Drawdown Georgia Emissions Tracker

Co-Benefits of Emissions Reduction

The *US National Blueprint for Transportation Decarbonization* described co-benefits of decarbonization:

Safety and Quality of Life – Investments in active transportation infrastructure can ensure that those walking, biking, and rolling can travel safely and improve access to public transportation. In addition to reducing air pollution, these investments will generate health benefits by encouraging people to exercise in the course of their daily lives and avoid the stress of driving in traffic. Transportation systems that rely more on walking, biking, and transit require a smaller physical footprint, which reduces impacts on the natural and human environment, frees up space used for parking, and lowers noise and pollution in communities, greatly improving quality of life in our neighborhoods.

Equity – Today's transportation system does not serve all communities equitably. For example, 20% of American families below the poverty line do not have access to a car, with a disproportionate percentage of those families being Black (33%) and Latino (25%). Limited transportation options mean limited access to jobs, culture, recreation, and even friends and family. Investments in reliable, frequent, and affordable transit service, along with safe sidewalks and bike lanes, provide much-needed mobility for households without access to personal vehicles and offer outsized benefit for people of color, residents of low-income communities, and Americans with limited mobility. Increasing access to low-carbon travel infrastructure by improving bicycle and pedestrian safety will benefit all roadway users and bring significant benefits to vulnerable roadway users, including seniors, people with disabilities, and people in lower income communities. In addition, investments in infrastructure can increase wealth creation opportunities for underserved communities. DOT's Disadvantaged Business Enterprise program is helping ensure that small businesses owned by people of color and women get a fair chance to compete for infrastructure contracts.

Air Quality – Decarbonizing the transportation sector will reduce air pollutants that are harmful to the environment and to public health, such as NOx, volatile organic compounds, particulate matter, sulfur dioxide, and others.

Economic Growth – Investment in public transportation, rail, and active transportation infrastructure generates large economic returns. Every $1 invested in public transportation generates an estimated $5 in long-term annual economic returns, and every $1 billion invested in public transportation supports about 20,000 jobs. Fuel savings from walking and biking instead of driving are estimated to be $3.3 billion annually in the U.S. A study on Georgia's Silver Comet Trail expansion found that people gain an estimated $4.64 in direct and indirect economic benefits from every $1 invested in the expansion. In 2017, Class I railroads alone generated $219 billion in economic activity and yielded around $26 billion in tax revenues, while supporting 1.1 million jobs across the nation. Additionally, the compact, mixed-use development patterns that support a cleaner transportation system also generate greater revenue per acre of land, spur more economic productivity, and support job creation.

Energy Security – Transportation is currently heavily dependent on petroleum fuels, and the sector accounts for over 70% of all petroleum used in the United States. Improving mobility options and the efficiency of the transportation sector will reduce our dependence on petroleum, limit the impacts of petroleum price volatility and inflation, and lower our total energy use. Lower and more diversified energy demand—when accompanied by enhanced domestic supply chains or clean technologies—will improve the nation's security, decrease vulnerability to supply interruptions or price changes, and increase the reliability and affordability of mobility for all Americans. Incentives in the BIL and IRA combined with other federal investments and the National Blueprint for Lithium-Batteries are actively expanding sources of battery components, increasing diversification and energy security.[46]

Plans and Programs

FHWA GHG Performance Measure

In December 2023 FHWA issued the final rule, "National Performance Management Measures; Assessing Performance of the National Highway System, Greenhouse Gas Emissions Measure," which requires State DOTs and MPOs to establish declining CO2 targets for the GHG measure and report progress. States and MPOs will have the flexibility to set their own targets if emissions decline over time.[47] However, twenty-two States filed two lawsuits challenging FHWA's greenhouse gas (GHG) emissions Final Rule. Pursuant to negotiations in these cases, FHWA agreed to temporarily not seek to enforce the February 1, 2024, deadline for States to submit initial targets and reports through March 29, 2024. On March 27, the U.S. District Court for the Northern District of Texas vacated and remanded the Final Rule to DOT, in effect nullifying the rule Nationwide. Consistent with the Court's decision, States and MPOs are not required to submit initial targets and reports at this time, and FHWA will provide more information at a later date. Despite the ruling on the GHG Performance Rule, the CORE MPO can begin to incorporate strategies from decarbonization plans at the federal, state, and local level.

100% Savannah Plan

Within the MPO, the City of Savannah has clean energy goals. 100% Savannah is a commitment to 100% safe, clean, and renewable electricity by 2035 and 100% safe, clean, and renewable energy for all other uses (e.g. transportation, heating, and industry) by 2050. The city is committed to using the clean energy transition as an opportunity to redress historical inequities through investments in workforce training, renewable energy installations, energy efficiency, and clean transportation.

[46] https://www.transportation.gov/priorities/climate-and-sustainability/us-national-blueprint-transportation-decarbonization

[47] https://www.federalregister.gov/documents/2023/12/07/2023-26019/national-performance-management-measures-assessing-performance-of-the-national-highway-system

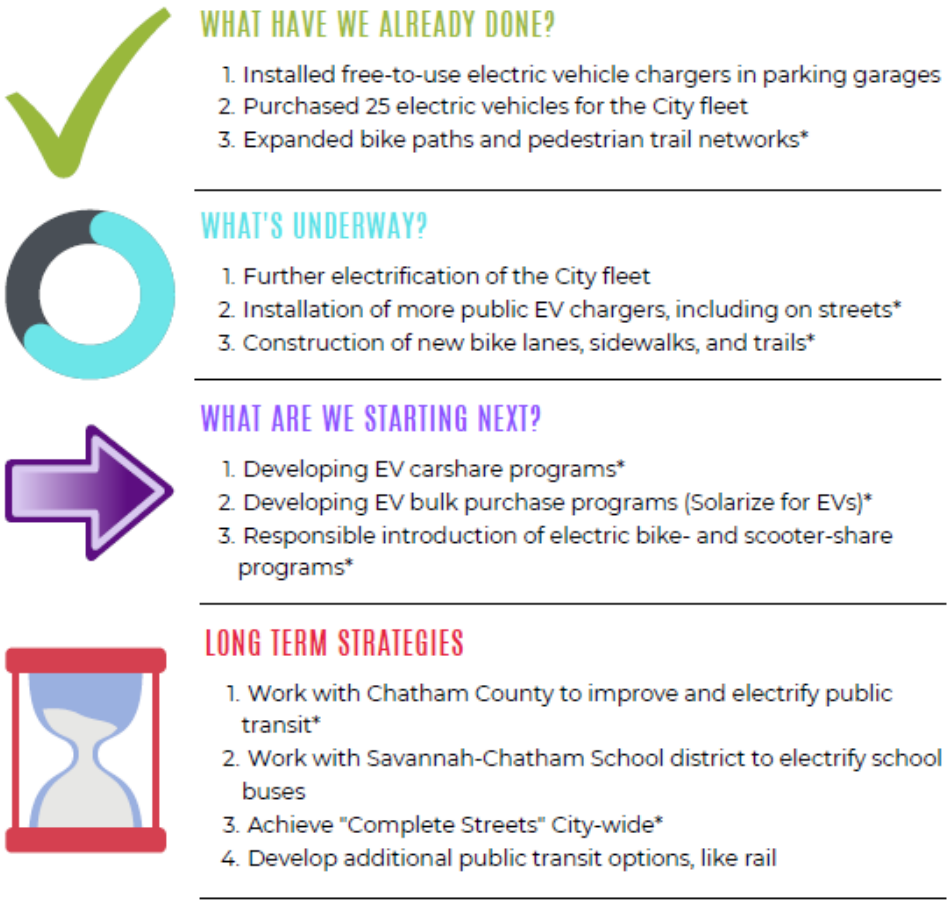


FIGURE X. 100% Savannah Transportation and Mobility Report Card[48]

100% Savannah lists several strategies for decarbonization of the transportation sector:

Improve and expand pedestrian transportation options: For residents who can't afford a car, pedestrian transportation options like sidewalks and bike lanes are crucial for getting to work, getting groceries, and visiting loved ones. These modes of transportation are also beneficial for human health and the environment.

Improve and expand public transit options: Compared to individual vehicles, public transit is environmentally preferable because it can move a large number of people with less fuel. However, these benefits cannot be realized if public transit is perceived to be slow or difficult to use.

Electrify City vehicles: As with energy efficiency and solar, the City has an important role to play in leading the way on electric vehicles (EVs). If trusted local leaders drive electric vehicles, residents may feel more comfortable driving EVs themselves.

[48] https://www.savannahga.gov/2931/100-Savannah

Electrify community transit options: Though public transit provides climate benefits in any form, the benefit is far greater when that transit is electric. We plan to work with the Chatham Area Transit Authority (CAT) to encourage the transition to electric. We also plan to explore ways to shift the Downtowner program and other rideshares toward EVs.

Introduce new mobility options: To increase familiarity with electrification, it would be beneficial to introduce new electric mobility options.[49]

Carbon Reduction Strategy (CRS) and Program (CRP)

The Carbon Reduction Program was established by the Bipartisan Infrastructure Law (BIL) in 2021 and will provide an estimated $211 million to Georgia for the 5-year period, 2022–2026. The purpose is to "reduce transportation emissions through the development of state carbon reduction strategies and by funding projects designed to reduce transportation emissions," where, "transportation emissions means carbon dioxide emissions from on-road highway sources of those emissions within a State." Funds will be distributed throughout the state and Metropolitan Planning Organization (MPO) partners. The Georgia Department of Transportation (GDOT) developed the Carbon Reduction Strategy to highlight available funding and provide information on strategies consistent with the goals of the CRP. The CORE MPO should seek to take advantage of these funds by consulting the CRS and coordinating with GDOT to determine which projects may qualify for funding.

The CRS is a document that will guide GDOT and Georgia's MPOs as they select strategies to include in their planning process and leverage available federal funds. The GDOT CRS includes a menu of strategies and projects which are eligible for CRP funds and are consistent with state priorities. The plan will be updated every 4 years after USDOT approval. The strategies/projects fall into 3 broad categories:

1. Sustainable Infrastructure: This set of strategies addresses infrastructure-based reductions, such as sustainable pavements, alternative construction, and maintenance practices.
2. Operational Efficiency Improvements: Efforts to manage transportation operations, optimize system performance, reduce delay, and smooth traffic flow to reduce vehicle exhaust.
3. Alternative Technologies and Modes: Strategies addressing consumer choice, including choices related to vehicle purchases and travel choices.

Multi-Modal Transportation Electrification and Supporting Infrastructure

National Electric Vehicle Infrastructure (NEVI) Deployment Program

The CORE MPO does not have a plan for electric vehicles and follows guidance from GDOT's National Electric Vehicle Infrastructure (NEVI) Deployment Program, derived from the 2021 Bipartisan Infrastructure Law enacted as the Infrastructure Investment and Jobs Act (IIJA). According to GDOT, the goal of the Georgia NEVI Program is to deploy a national network of electric vehicle (EV) charging stations that provide a convenient, reliable, affordable, and equitable experience for all users. The

[49] https://www.savannahga.gov/2931/100-Savannah

program provides nearly $5 billion nationally over five years beginning in the fall of 2022. Georgia's allotment from the formula program is approximately $135 million to develop its portion of the national network.[50]

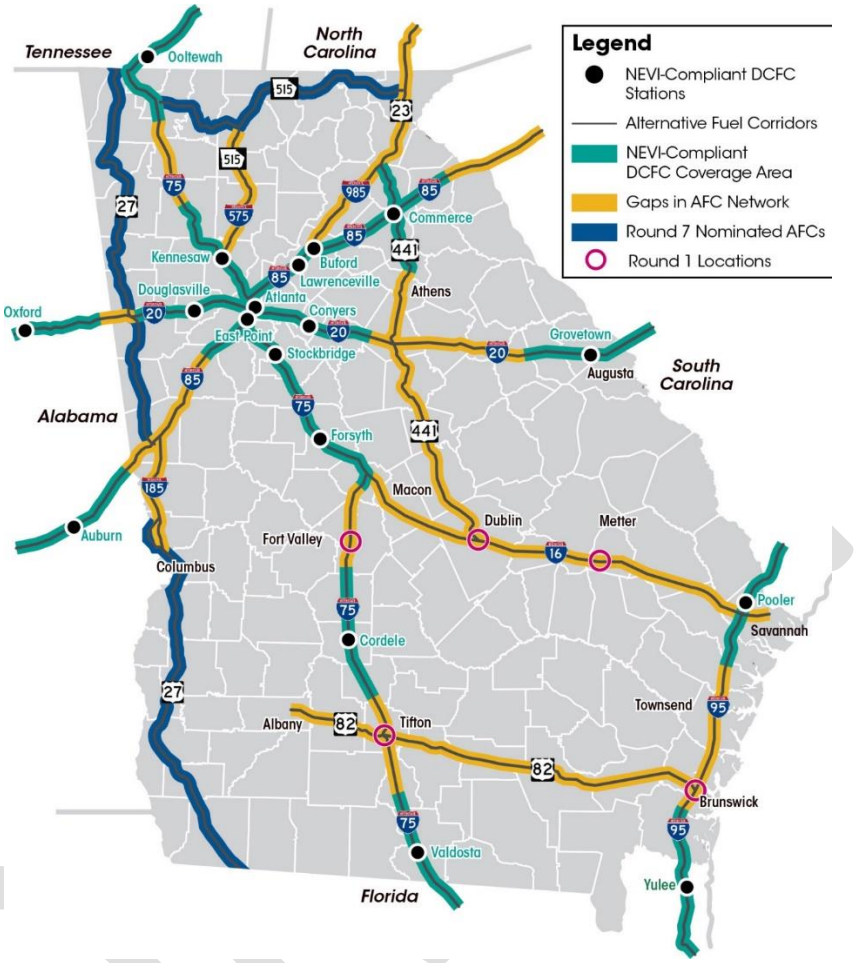


FIGURE X. Alternative Fuel Corridors where NEVI-funded EV charging stations are required to be installed (GDOT, 2023)[51]

[50] https://nevi-gdot.hub.arcgis.com/

[51] https://nevi-gdot.hub.arcgis.com/

NEVI-funded EV charging stations must be:

- Open to the public or to authorized commercial vehicle operators from more than one company
- Located first on Georgia's AFC network such that stations are installed
- No more than 50 miles apart
- Less than one mile from the AFC
- Direct Current (DC) Fast Chargers with at least four Combined Charging System (CCS) ports capable of delivering a minimum of150 kilowatts (kW) of power per port simultaneously for a total of at least 600 kW per station.

Federal NEVI Requirements

- Program must deliver 40% of the overall benefits to federally defined Disadvantaged Communities which includes rural and underserved populations.
- Once the AFC network is built out to NEVI standards and certified by the Secretary of Transportation, Georgia DOT may use any remaining funds for EV charging infrastructure on any public road or publicly accessible location.[52]

Georgia is considered a leader in the automotive and manufacturing space with 186 companies making $2.9 billion in investments and supporting 10,500 jobs in the state in Fiscal Year 2021; and it continues to welcome investment in the electric mobility ecosystem and its substantial Tier 1, 2, and 3 suppliers. GDOT's efforts to use NEVI funds to bridge gaps and provide public charging will help maintain Georgia's leadership in this electric mobility ecosystem. Georgia is already the Southeast's leader with 4.4 EV registrations per 1,000 registered automobiles and offers more EV charging outlets per capita than any other state in the Southeast. Georgia attracted Rivian, an EV truck manufacturer, and Hyundai Motor Group to build multibillion-dollar EV manufacturing plants in Georgia.[53]

More information can be found in the GDOT Georgia Electric Vehicle Infrastructure Deployment Plan (2023).

Charging Stations in the CORE MPO Region

As of April 2024, there are 73 electric vehicle charging stations in the CORE MPO region (FIGURE X). Stations are typically located in clusters, such as in the Savannah downtown area and Tanger Outlet shopping center, or along highways and interstates. Interstates 16 and 95 are both Alternative Fuel Corridors where NEVI-funded EV charging stations are required to be installed. There are no charging stations in the CORE MPO portion of Effingham County and three stations in the Bryan County portion. Locations of charging stations can be accessed the Department of Energy Alternative Fuels Data Center.[54]

[52] https://nevi-gdot.hub.arcgis.com/
[53] GDOT NEVI Plan pg. 21
[54] https://afdc.energy.gov/

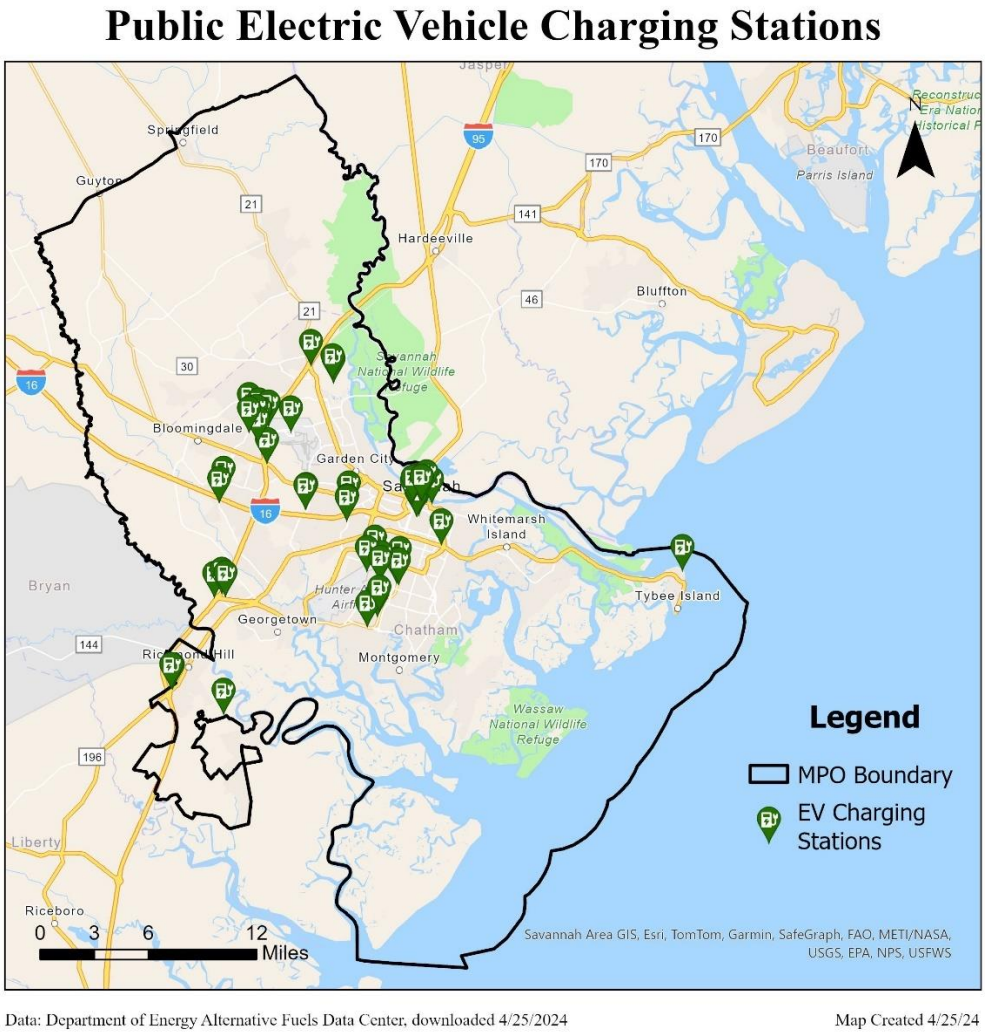


FIGURE X. Public Electric Vehicles Charging Stations in the CORE MPO Region

Chatham Area Transit Zero Emission Transportation Plan

The Chatham Area Transit (CAT) Zero Emission Transportation Plan for electric fleet transition includes fixed-route transit and trolley service and will be comprised of only Battery Electric Buses (BEBs). CAT is currently transitioning to a battery electric fleet and will continue with the purchase of additional vehicles and the installation of on-route charging infrastructure in 2025; the next procurement of 40-foot BEBs will occur in 2026 and the first procurement of battery electric trolleys will occur the following year in 2027. CAT's trolley fleet will be 100% zero emissions in 2030 and the 35-foot and 40-foot bus fleet will be 100% zero emissions in 2034.

CAT's fleet transition plan is a phased approach, with milestones through 2034 (FIGURE X) and detailed action items planned out through 2027 (FIGURE X).

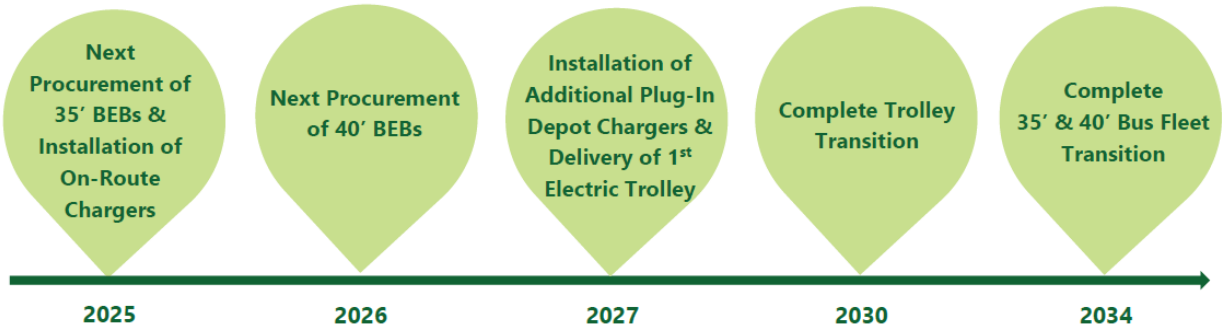


Figure 1. CAT Zero Emission Milestones

FIGURE X. Chatham Area Transit Zero Emission Milestones

Table 1. CAT 5-Year Zero Emission Transition Action Items

Year	Actions
2023	– Decision to do on-route charging or only depot charging – If on-route charging, decision to do pantograph charging or inductive charging at JMR Transit Center and Oglethorpe Mall – Decision to do inductive charging or continue plug-in charging at Gwinnett Street Garage – Begin working with property owner of Oglethorpe Mall to get approval for installation of utility and charging infrastructure
2024	– Begin working with Georgia Power to coordinate utility infrastructure upgrades required to support charging infrastructure at JMR Transit Center and Oglethorpe Mall – Apply for grant funding to purchase (6) additional buses and (4) on-route chargers to be delivered in 2025 – Retrofit existing plug-in chargers to have (3) dispensers each – Retrofit existing buses to support inductive and/or pantograph charging needed
2025	– Apply for grant funding to purchase (6) additional buses for delivery in 2026 – Install on-route charging infrastructure
2026	– Begin working with Georgia Power to coordinate facility infrastructure upgrades to support additional charging infrastructure at Gwinnett Street Garage – Apply for grant funding to purchase (2) additional depot chargers for installation in 2027 – Apply for grant funding to purchase (4) additional buses and (2) trolleys for delivery in 2027 – Select and purchase charge management software
2027	– Apply for grant funding to purchase (2) additional depot chargers for installation in 2028 – Apply for grant funding to purchase (6) additional buses for delivery in 2028 – Install (2) additional depot chargers with (3) dispensers each – Re-assess availability of hydrogen and advancements in hydrogen refueling to see if that technology should be included going forward

FIGURE X. Chatham Area Transit 5-Year Zero Emission Transition Action Items

In addition to fixed-route transit and trolley services, CAT operates a complimentary water ferry system, linking Savannah's historic River Street with the Savannah International Trade & Convention Center on Hutchinson Island. The ferry serves more than 600,000 passengers annually. CAT recently purchased two hybrid electric ferries and has issued an invitation for bids for a third.

Electric Bikes

Electric bikes (e-bikes) are like conventional bikes and have a small electric motor and battery. E-bikes are growing in popularity across the nation and provide benefits to health, accessibility, and tourism. E-bikes are classified by the following:

- Class 1: pedal assist, max assisted speed of 20 mph
- Class 2: throttle assist, max assisted speed of 20 mph
- Class 3: pedal assist, max assisted speed of 28 mph[55]

Strava Metro Data collects self-reported data on the share of bike trips that are completed with e-bikes. In the CORE MPO region, the share of e-bikes grew from 2019 to 2023 by 0.70% (TABLE X and FIGURE X). While the share of e-bikes is small, e-bike usage has consistently grown every year. The actual percentage of e-bike usage may be even higher.

TABLE X. Strava Metro Self-Reported E-Bike Usage from 2019-May 2023

	2019	2020	2021	2022	2023
Regular Bike	99.00%	98.90%	98.70%	98.60%	98.30%
E-Bike	1.00%	1.10%	1.30%	1.40%	1.70%

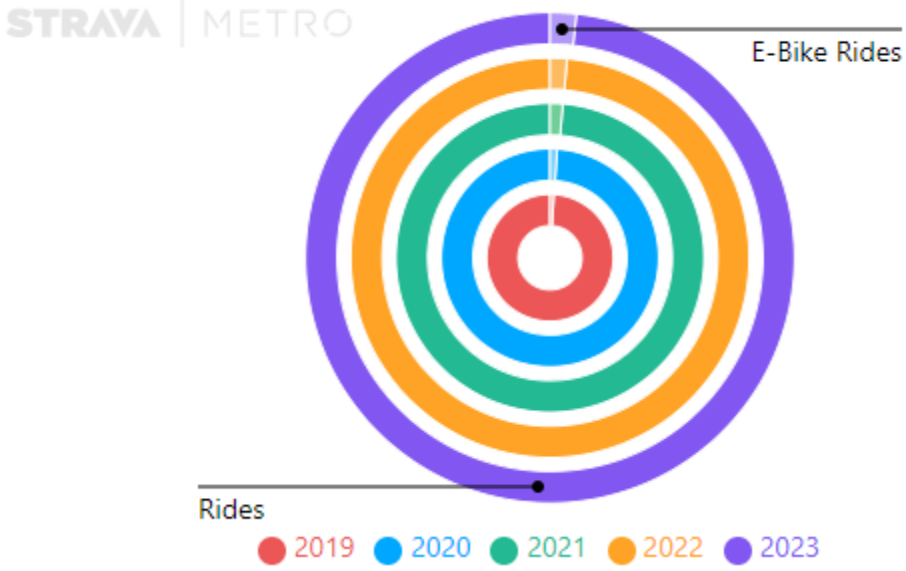


FIGURE X. Strava Metro Self-Reported E-Bike Usage from 2019-May 2023

Reduction of Truck Emissions at Port Facilities Grant Program

The Reduction of Truck Emissions at Port Facilities Grant Program, which was created by the President's Bipartisan Infrastructure Law (BIL), invests in port electrification and efficiency improvements. This program aims to reduce pollution from idling trucks at our nation's ports while modernizing infrastructure and strengthening supply chains. Georgia is receiving $15.3 million toward improvements at the Port of Savannah, including to build large-scale charging project near the port,

[55] https://www.fhwa.dot.gov/environment/bicycle_pedestrian/resources/e-bikes/

replace diesel-powered trucks, and expand the use of low-emission and zero-emission equipment.[56] The Georgia Ports Authority will receive $7.5 million to conduct a four-year pilot program at the Port of Savannah that will expand the use of low-emission and zero-emission equipment to carry out daily port activities and reduce port-related emissions from idling trucks. The project will replace petroleum diesel fuel used by 621 trucks with renewable, low-emission diesel fuel. Voltera Power, a zero-emissions refueling infrastructure provider, will receive $7.8 million to build a large-scale charging project near the Port of Savannah. The project will reduce emissions from port-related traffic by providing parking and charging services for medium- and heavy-duty electric vehicle (EV) fleets.[57]

Biodiversity and Wildlife Conservation

Ecological biodiversity and wildlife conservation should be a key component of all transportation projects. Implementing best management practices that consider the landscape, and the flora and fauna which inhabit it, in addition to complying with local, state, and federal regulations, will promote more sustainable practices that benefit surrounding communities. Practitioners can consult the *Georgia State Wildlife Action Plan* for a comprehensive list of southern coastal plain high priority animals and plants, prioritized conservation goals, and strategies.[58]

Wildlife Corridors and Crossings

Incorporating native plants, pollinator habitat, and wildlife crossings into project planning and design can reduce long-term costs from wildlife vehicle collisions, crashes caused by drivers avoiding wildlife, habitat fragmentation, genetic isolation of wildlife populations, and decreases in wildlife population. A FHWA study estimated Georgia had an annual average of 14,489 animal-vehicle crashes (3.77% of total crashes) that resulted in a societal cost of $851,731,800 using the state's crash cost methodology. Mitigation actions may include a wildlife-vehicle crash data hotspot analysis, collaboration with wildlife agencies, integration into the long-term planning process, dedicated funding, and environmental stewardship education.[59] The US Fish and Wildlife Service published *Roadway Design Guidelines* for National Wildlife Refuges. This can help to better understand wildlife considerations for planning and design.

Pollinator Habitat

Transportation project design should seek to include best management practices for pollinators. Pollinator species, such as bees, wasps, flies, beetles, butterflies, and moths, hummingbirds, and nectar-feeding bat species, are at risk due to habitat loss, insecticide exposure, and disease. Roadsides can provide an extensive linear network of habitat for pollinators with the correct management practices such as adjusting, enhancing, and restoring vegetation to meet pollinator resource needs and habitat. The *FHWA Roadside Best Management Practices that Benefit Pollinators:*

[56] https://highways.dot.gov/newsroom/grants-help-reduce-truck-air-pollution-ports
[57] https://ops.fhwa.dot.gov/bipartisan-infrastructure-law/RTEPF/2022-23/awards/index.htm?_gl=1*hr6esc*_ga*OTI4MTk0MDUyLjE2ODQ3NzUyNDg.*_ga_VW1SFWJKBB*MTcxNDY1NDM3Ny40NjMuMS4xNzE0NjU2OTM3LjAuMC4w
[58] https://georgiawildlife.com/WildlifeActionPlan#explore
[59] https://highways.dot.gov/public-roads/winter-2023/04

Handbook for Supporting Pollinators through Roadside Maintenance and Landscape Design is a helpful tool to reference to promote pollinators habitat and wellbeing.[60]

Tools and Resources

Several resources for identifying wildlife and plant species, wildlife corridors, and conservation areas include:

GDNR Georgia State Wildlife Action Plan: https://georgiawildlife.com/WildlifeActionPlan#explore

GDNR Georgia Rare Species and Natural Community Data: https://georgiawildlife.com/conservation/species-of-concern

Southeast Conservation Adaptation Strategy Blueprint: https://secassoutheast.org/blueprint

USFWS Information for Planning and Consultation (IPaC): https://ipac.ecosphere.fws.gov/

Stormwater Management & Green Infrastructure

Stormwater Management

AASHTO The Practitioner's Handbook: Developing and Implementing a Stormwater Management Program in a Transportation Agency

American Association of State Highway and Transportation Officials (AASHTO) Practitioner's Handbook is a comprehensive guide for transportation agencies in developing and implementing effective stormwater management programs. The handbook provides recommendations and practical tips for compliance with the Clean Water Act (CWA) and National Pollutant Discharge Elimination System (NPDES) regulations. It covers various topics including program development, clean water regulations, public education and outreach, construction site compliance, roadway maintenance practices, and special requirements such as Total Maximum Daily Loads (TMDLs).

The handbook emphasizes the importance of compliance with stormwater NPDES permits and highlights the benefits of a well-designed stormwater management program, such as reduced infrastructure costs and improved water quality. It also provides guidance on managing the National Environmental Policy Act (NEPA) process and complying with other environmental regulations and policies relevant to transportation projects. Overall, the Practitioner's Handbook serves as a valuable resource for transportation agencies seeking to enhance their stormwater management practices and ensure the protection of water quality.

The NPDES program was developed to implement the requirements of the Clean Water Act (CWA). The 1987 amendments to the CWA required that municipal separate storm sewer systems (MS4s), including those owned by transportation agencies (i.e., DOTs and transit agencies), obtain stormwater permits, effectively designating them as "point source" discharges. Under the federal stormwater

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60 https://www.environment.fhwa.dot.gov/env_topics/ecosystems/Pollinators_Roadsides/BMPs_pollinators_landscapes.aspx

regulations, a transportation agency's properties, facilities, and activities fall under the jurisdiction of NPDES stormwater regulations for two primary reasons:

1. Highways, highway-related properties, transit facilities, and activities are served by storm drain systems, which are often connected to, and are considered comparable to, urban MS4s covered explicitly in the federal stormwater regulations.
2. Construction of highways and transit and related facilities often results in soil disturbance of areas greater than one acre, for which specific requirements are prescribed by the federal stormwater regulations.[61]

Georgia DOT was issued a Municipal Separate Storm Sewer System (MS4) permit in January 2012 by the Georgia Environmental Protection Division (EPD). This permit was re-issued in January 2017 and again in January 2022; future renewals are anticipated every 5 years. The MS4 permit provides guidelines for agencies to prevent excessive stormwater discharges, dumping, spills, erosion and pollutants from contaminating nearby waterways. The MS4 permit program regulates the discharge of stormwater from Georgia DOT roadways and properties designated by the EPD as "MS4 Permitted Areas." The MS4 permit activities are an integral part of Georgia DOT's commitment to be a good environmental steward.[62]

[61] AASHTO Practitioner Handbook: Developing and Implementing a Stormwater Management Program in a Transportation Agency (2009, pg. 3)

[62] https://www.dot.ga.gov/GDOT/Pages/StormWater.aspx

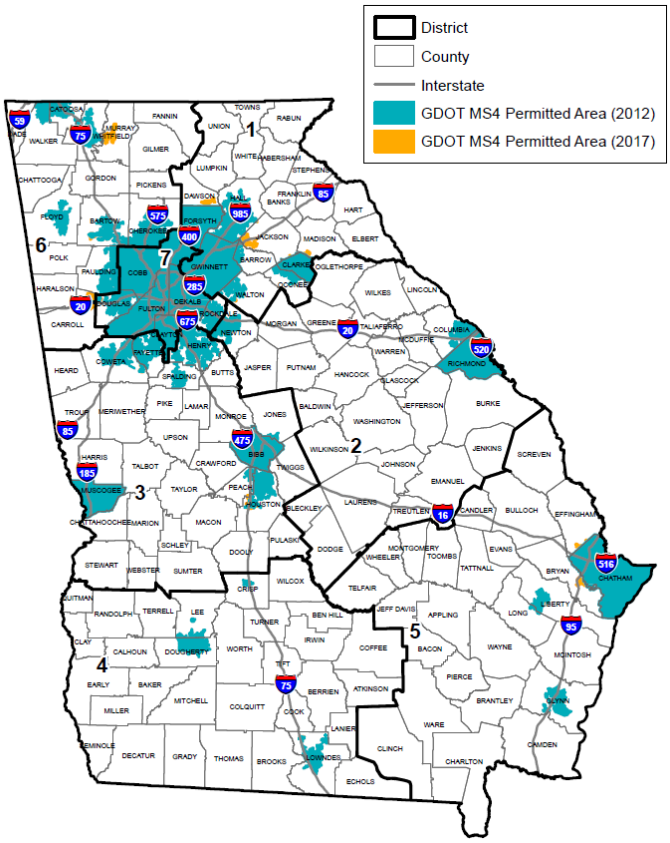

FIGURE X. GDOT MS4 Permitted Areas (GDOT)

Compliance with stormwater NPDES permits is a requirement under federal law, but a well-designed stormwater management program also benefits a state highway system by supporting sustainability goals and reducing infrastructure costs:

- Use of vegetated conveyances can reduce capital as well as operation and maintenance (O&M) costs.
- Open-graded friction course overlays may improve water quality and safety; future permeable pavement systems could
- enhance these benefits further.
- Programs such as sweeping and trash pickup provide program benefits for safety and aesthetics, as well as NPDES
- program compliance.
- Reduction of pesticide use reduces chemical, training, and personnel costs.

Environmental benefits of highway stormwater quality enhancement include:

- Maintenance of beneficial uses of receiving waters;
- Maintenance or improvement of riparian habitat;

- Aesthetic improvements of waterways by reducing trash;
- Recharge of local aquifers through increased infiltration; and
- Reduced flood potential in conveyances.

Structural BMPs are facilities or devices engineered and built to capture and treat stormwater runoff (also called "treatment" BMPs), while non-structural BMPs include a variety of non-constructed measures or activities to reduce the generation of pollutants from highways and related facilities. A transportation agency may develop an approval process for BMPs that are shown to be effective for the constituents of concern in its runoff, and compatible with its facility operations and maintenance practices. This approval process could also apply to construction site BMPs. The selection of structural BMPs for highways is different from that for municipal systems since there is generally less right-of-way, and maintenance access is more difficult. Controls that can operate passively and where deferred maintenance is not a problem are preferred.

Examples of structural BMPs include:

- **Stormwater Retention/Detention BMPs:** Retention or detention BMPs control stormwater by gathering runoff in wet ponds, dry basins, or multi-chamber catch basins and slowly releasing it to receiving waters or drainage systems. These practices can be designed to both control stormwater volume and settle out particulates (i.e., separate them from the water by causing them to sink to the bottom) for pollutant removal.
- **Infiltration BMPs:** Infiltration BMPs are designed to facilitate the percolation of runoff through the soil to ground water, thereby resulting in reduced stormwater runoff quantity, flows, and mobilization of pollutants. Examples include infiltration basins/trenches, dry wells, and porous pavement.
- **Vegetated BMPs:** Vegetated BMPs are landscaping features that, with optimal design and go soil conditions, remove pollutants and facilitate percolation of runoff, thereby maintaining natural site hydrology, promoting healthier habitats and increasing aesthetic appeal. Examples include grassy swales, filter strips, artificial wetlands, and rain gardens.

Examples of non-structural BMPs include:

- **Implement street sweeping:** Curb systems act as traps for particulates and other pollutants. If they are properly maintained via regular vacuum street sweeping, then they are less likely to become sources of pollutants.
- **Consider alternatives to curbs:** As a design alternative, eliminating curbs from roads and highways allows runoff to be filtered through vegetated shoulders or medians and infiltrate to the ground. Where curbs are necessary for traffic control, guardrails, or other reasons, curb breaks can be incorporated to disconnect the impervious surface and direct runoff to pervious areas. This may not be feasible for streets with high traffic volume and/or on street parking demand.
- **Control litter and debris on roadsides:** Roadside litter control practices that have traditionally been implemented to address health and aesthetic concerns can also improve

runoff quality by limiting trash in runoff conveyance and treatment systems and receiving water bodies.

- **Manage pesticide use**: Over-application of pesticides may cause excess chemicals to leach to ground waters or flow into surface waters. Pesticides have the same toxic effect on aquatic plants and organisms as they do on the terrestrial plants and organisms to which they were applied.
- **Reduce fertilizer use:** Improper application of fertilizers along roadsides can result in excess nutrients being transported to surface waters or leaching to ground water.

Both structural and non-structural BMPs are important components of a comprehensive stormwater management program. They work together to reduce the quantity and improve the quality of stormwater runoff, protecting water resources and promoting environmental sustainability. Highways that incorporate stormwater quality features for conveyance may be better able to adapt to climate change. For example, vegetated channels may be able to convey surface flows while surcharged, with less flooding on adjacent facilities, and they can be modified with less cost compared to underground and open channel systems with rigid linings.[63]

Green Infrastructure

US DOT defines natural or green infrastructure as "infrastructure that uses, restores, or emulates natural ecological processes and— (A) is created through the action of natural physical, geological, biological, and chemical processes over time; (B) is created by human design, engineering, and construction to emulate or act in concert with natural processes; or (C) involves the use of plants, soils, and other natural features, including through the creation, restoration, or preservation of vegetated areas using materials appropriate to the region to manage stormwater and runoff, to attenuate flooding and storm surges, and for other related purposes." Nature-based solutions are defined as "sustainable planning, design, environmental management and engineering practices that weave natural features or processes into the built environment to promote adaptation and resilience. (Often used synonymously with natural infrastructure.)"[64]

Several reports summarize the benefits of green infrastructure and NBS in the transportation system and stormwater management.

Enhancing Coastal Resilience with Green Infrastructure

The value of natural and nature-based features in communities is increasingly represented in the concept of green infrastructure, which provide numerous benefits to communities and the environment. These include:

- Increased property values

[63] AASHTO Practitioner Handbook: Developing and Implementing a Stormwater Management Program in a Transportation Agency (2009, pg. 14-15)

[64] https://www.transportation.gov/priorities/climate-and-sustainability/definitions

- Increased water supply
- Lower ambient temperatures
- More walkable communities
- Reduced water treatment costs
- Cost savings
- Improved air quality
- Increased community resilience
- Increased biodiversity
- Habitat improvement and connectivity
- Healthier communities
- Improved water quality
- Reduced flooding

Limiting Impervious Cover as a BMP: Impervious surfaces such as pavement, asphalt, and rooftops contribute to increasing runoff from rain events, which causes flash flooding and increases the height of other downstream flood events. Limiting the amount of ground in a watershed that is covered by impervious surfaces will reduce potential damages from flooding. In addition, limiting impervious cover has been shown to have positive impacts on downstream water quality. Limiting impervious cover is a valuable design policy that should be implemented in suburban and rural settings, and in any area except the urban core where urban density is the overriding consideration. Examples include:

- Mandate or promote Green Streets practices.
- Mandate or promote practices that result in less area covered by impervious surfaces.
- Include pre-application meetings in the community design review process.
- Require green infrastructure practices to offset impervious areas that exceed that maximum.

The following resources are recommended for further information:

- Green Streets
    - US EPA: Managing Wet Weather with Green Infrastructure Municipal Hand Book: Green Streets
    - National Association of City Transportation Officials: Urban Street Stormwater Guide
    - Environmental Law Institute: Giving Green Streets the Green Light: Improving Water Quality Through Capital Improvement Policies
- Infiltration and Evapotranspiration Practices
    - Coastal Supplement to the Georgia Stormwater Management Manual
    - Coastal Resources Division of the Georgia Department of Natural Resources, Green Growth Guidelines
- Better Site Design Techniques
    - Coastal Supplement to the Georgia Stormwater Management Manual:
        - Reduce lengths and widths of roadways, driveways, and sidewalks
        - Use fewer or alternative cul-de-sacs

- Reduce parking lot footprints
- Create landscaped areas in parking lots
- Reduce building footprints[65]

FHWA Nature-Based Solutions for Coastal Highway Resilience: An Implementation Guide
Nature-based solutions use natural materials and processes to reduce erosion, wave damage, and flood risks, serving as alternatives to, or ecological enhancements of, traditional shoreline stabilization and infrastructure protection techniques. Examples include conservation, restoration, or construction of beaches, dunes, marsh, mangroves, maritime forests, and reefs.

Nature-based solutions can serve as a first line of defense and improve the resilience of coastal highways. FHWA developed Nature-Based Solutions for Coastal Highway Resilience: An Implementation Guide to help transportation professionals understand when, where, and which nature-based solutions may work for them. The guide follows the project implementation process from planning all the way through construction and maintenance.

Provides technical factsheets for select nature-based solutions can be helpful to practitioners considering implementing one of these strategies. The factsheets cover the following solutions:

- Marsh Vegetation
- Marsh Breakwater
- Marsh Sill
- Beach Nourishment
- Pocket Beach
- Dune Restoration

Incorporating nature-based solutions into transportation planning enables systematic consideration across a planning area or state and allows for identification of opportunities at an early stage. Transportation planners can facilitate coordination and collaboration with key stakeholders to mobilize larger projects, which increases the project benefits and can reduce costs. Potential partners include state coastal zone management programs, natural resource agencies, national estuarine research reserves, U.S. Army Corps of Engineers District Offices, and non-profit organizations. Coordination includes early engagement with the public as well as appropriate regulatory professionals. Transportation agencies can leverage Eco-Logical, an ecosystem-based approach to transportation planning developed by FHWA and stakeholders, to pre-identify locations where nature-based solutions may be appropriate given existing natural resources and ecological priorities.

Planners can align the Eco-Logical framework with the transportation planning process to help identify locations for consideration of nature-based solutions. This integration encourages consideration of both large-scale projects, and smaller projects that can be used to reduce erosion or

[65] Enhancing Coastal Resilience with Green Infrastructure (pg. 46-47)

increase storm resilience at a particular transportation project site. The transportation planning process consists of nine major steps that repeat as a (frequently non-linear) cycle (FIGURE X). Stakeholder engagement occurs at every stage of the planning process. Although integrating nature-based solutions into each step of the transportation planning process is not required, this guide provides options that transportation agencies may consider, if appropriate.

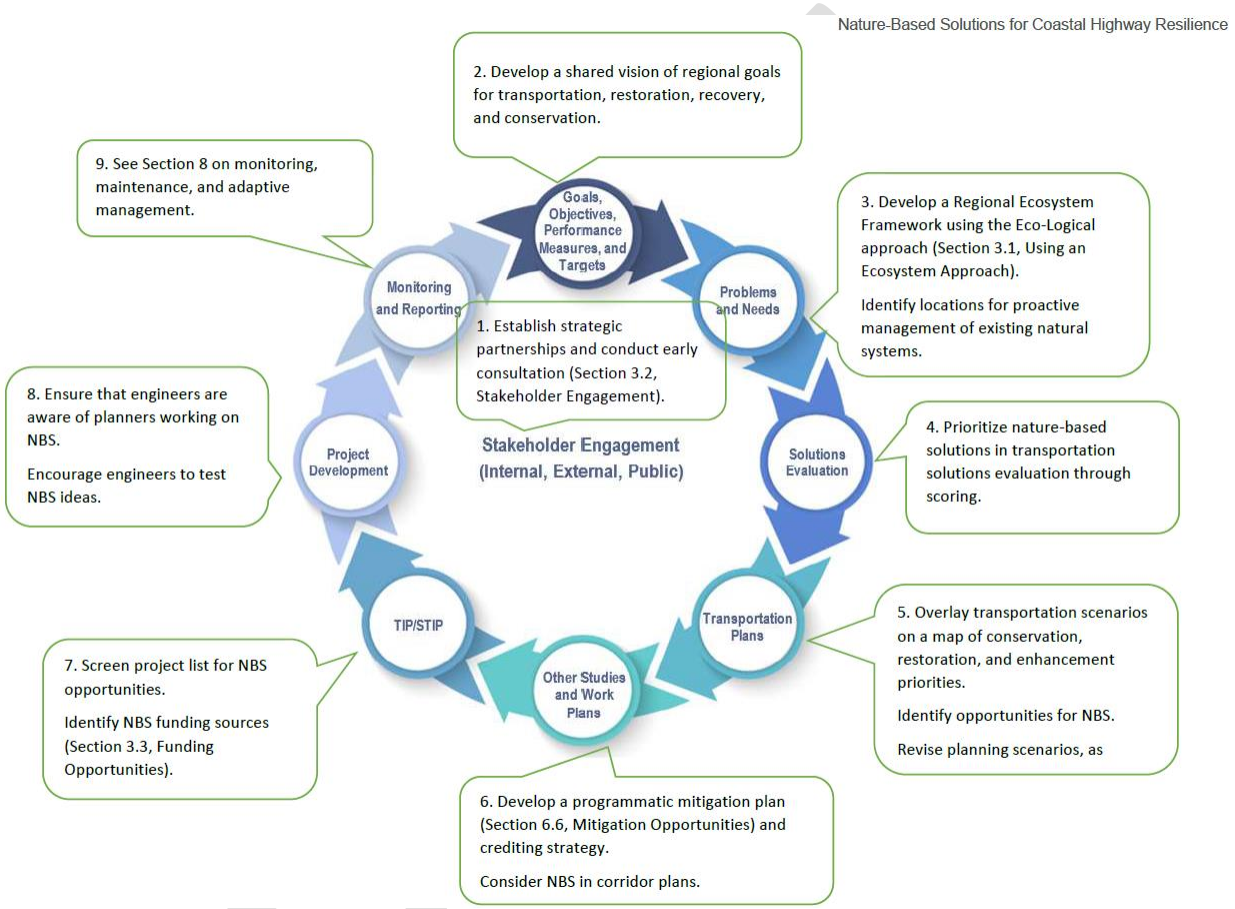

FIGURE X. Approaches for considering nature-based solutions in the transportation planning process (FHWA Nature-Based Solutions for Coastal Highway Resilience, 2019, pg. 49)

FHWA Case Studies in Realizing Co-Benefits of Multimodal Roadway Design and Gray and Green Infrastructure

This report provides information to encourage agencies interested in making improvements to their pedestrian and bicycle networks that also provide gray and green infrastructure and resiliency benefits. The discussion of stormwater and mobility benefits will help communities better understand the variety of goals and outcomes they can achieve through their projects. FHWA identified and

evaluated projects that focused on mitigating flood risk. Flood mitigation involves the management and control of floodwater movement, such as redirecting flood run-off through the use of floodwalls and flood gates, rather than trying to prevent floods altogether. These projects were implemented to address local flooding and minimize future flood damage.[66]

Examples of projects include:

- Implementation of permeable pavers to transform a street into a bicycle- and pedestrian-friendly green street and address the flooding risk and addressed compliance with the City's stormwater mandate.
- Green street that included a day-lit channel and underlying infiltration trench in the median supported by deepened curbs, impermeable liners, trench dams installed adjacent to bioretention areas in the bulbouts and sidewalk borders, striped, on-road bicycle lanes, ADA-compliant sidewalks, two pedestrian-activated flashing yellow lights at the highest volume intersections, seating, 81 street trees, high-efficiency lighting, bicycle racks, and informational signage about the transformation.
- A public-private partnership downtown eight-mile trail as a loop with shared space for bicyclists and pedestrians and 25,000 square feet of bioswales, adding eight acres of green space and 500 trees.

Green infrastructure and NBS can be employed at multiple levels in varying forms to address stormwater management and mobility, while also building a more resilient transportation network.

[66] FHWA Case Studies in Realizing Co-Benefits of Multimodal Roadway Design and Gray and Green Infrastructure (2018)