Southeast Michigan Regional Climate Resilience Framework

SEMCOG | SOUTHEAST MICHIGAN COUNCIL OF GOVERNMENTS

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Mission

SEMCOG, the Southeast Michigan Council of Governments, is the only organization in Southeast Michigan that brings together all governments to develop regional solutions for both now and in the future. SEMCOG:

- Promotes informed decision making to improve Southeast Michigan and its local governments by providing insightful data analysis and direct assistance to member governments;

- Promotes the efficient use of tax dollars for infrastructure investment and governmental effectiveness;

- Develops regional solutions that go beyond the boundaries of individual local governments; and

- Advocates on behalf of Southeast Michigan in Lansing and Washington

Southeast Michigan Regional Climate Resilience Framework

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Abstract

This document presents a comprehensive framework for enhancing climate resilience in Southeast Michigan, which is already experiencing the adverse effects of climate change such as recurrent urban flooding, extreme heat, coastal erosion and flooding. The framework outlines proactive adaptation strategies for all entities in the region to pursue, distinguishing between high priority strategies for the near term and efforts to tackle over the long term. The strategies are further organized based on three primary stages of work: assessment, planning, and implementation. The framework also underscores the importance of equity-centered planning to ensure that the benefits of resilience-building efforts reach all community members. By outlining a plan to both consolidate knowledge and resources and foster cross-jurisdictional collaboration, the framework aims to equip the region to withstand and recover from climate-related shocks and ensure sustained, equitable progress in its resilience journey.

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Introduction

Over the last decade, Southeast Michigan has experienced unprecedented rain events, devastating flooding, and property damage to homeowners and businesses, resulting in billions of dollars in economic impacts across the region. With Federal Disaster Declarations for flooding or severe storm events in 2014, 2021, and 2023, it's critical for the Southeast Michigan region to understand vulnerabilities and develop strategies for more resilient communities and infrastructure. Metro Detroit saw 5-7 inches of rainfall in one weekend in June of 2021, which caused severe flooding due to widespread power outages and subsequent pump station failures (Figure 1).

This increased flooding, in addition to other environmental factors like extreme heat, and coastal erosion, is causing significant challenges to infrastructure, human health, the economy, and the environment. These hazards are not isolated incidents, but persistent threats that are projected to worsen and demand proactive adaptation strategies.

Figure 1. Flooding Impacts on I-94 in June 2021

Figure 2. Examples of Impacts from Extreme Precipitation and Flooding

To safeguard the region's economic and cultural vitality, it is imperative to build climate resilience. In this document, **"resilience" refers to the capacity of a community, business, or natural environment to prevent, withstand, respond to, and recover from a disruption**, as defined in the U.S. Climate Resilience Toolkit. Extreme precipitation and flooding can have rippling and interconnected effects across the region, disrupting transportation, emergency services, water quality, and more (Figure 2).

SEMCOG developed local rainfall projections that are summarized in the Southeast Michigan Current and Future Precipitation report to support local resilience efforts until national rainfall statistics are updated. Model projections in this report demonstrate increasing trends in both rainfall frequency and intensity into the future. The rainfall events used to design stormwater infrastructure for Southeast Michigan have the potential to double by 2050.

The region's stormwater infrastructure investment needs are over $1 billion annually. Combining those with drinking water, wastewater and transportation, Southeast Michigan infrastructure investment needs are in the billions on an annual basis. This is further exacerbated by the fact that local jurisdictions do not have a rate structure analogous to water and sewer rates to support stormwater improvements, operations, and maintenance. It is imperative for the Michigan legislature to pass legislation that enables local communities to develop stormwater utilities.

This regional framework provides an opportunity to further coordinate resilience activities across the region, identify remaining needs, demonstrate alignment with federal guidelines and requirements for resilience planning, and position the region for continued federal and State funding for critical resilience projects.

This document lays out a framework for advancing climate resilience in Southeast Michigan. It is based on an understanding of the many ongoing resilience efforts in the region, as well as how they fit into this broader framework, and clarifies the roles of key entities in driving regional resilience. The framework is consistent with federal requirements and guidance from sources including the Federal Highway Administration (FHWA), the Federal Emergency Management Agency (FEMA), the National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency (EPA). Finally, it lays out the three key steps for advancing regional resilience (Figure 3).

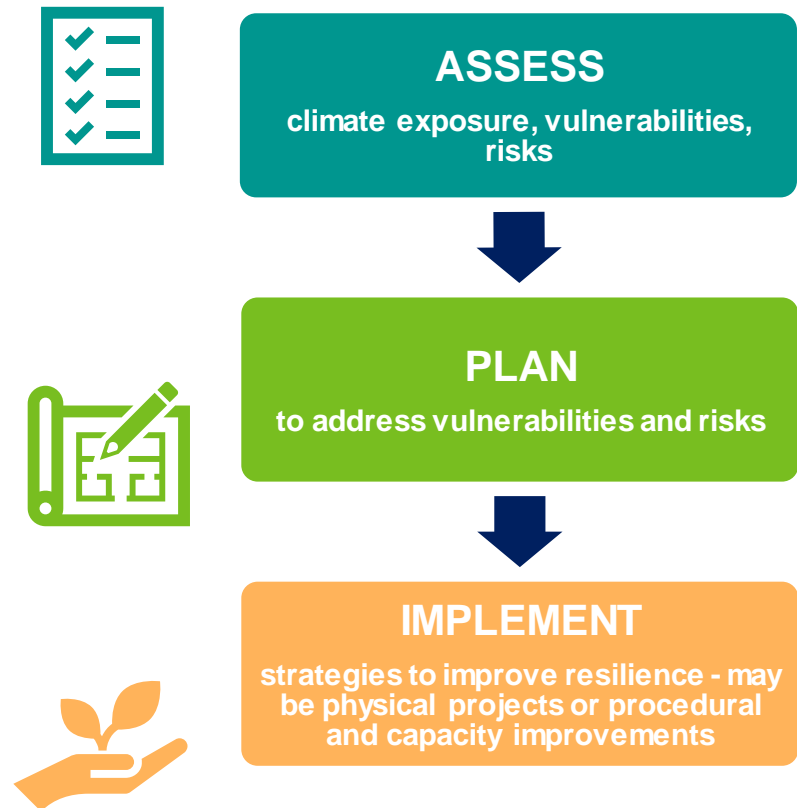**Figure 3. Regional Resilience Framework**

ASSESS
climate exposure, vulnerabilities, risks

PLAN
to address vulnerabilities and risks

IMPLEMENT
strategies to improve resilience - may be physical projects or procedural and capacity improvements

Figure 4
Resilience Across Different Scales

Equity is a fundamental pillar of this climate resilience framework. It is critical that as SEMCOG works to build regional resilience, those efforts benefit all members of the region equitably. Disasters and hazards, such as flooding, can disproportionately impact individuals and communities who experience higher social vulnerability. Social vulnerability is the likelihood of an individual, community, or group to be negatively affected by external stressors that create barriers to communitywide resilience. These external stressors may include access to transportation, socioeconomics, and housing characteristics. In addition, socially vulnerable communities typically bear the brunt of natural disasters and climate-related risks sooner and to a greater extent. These communities, often composed of minority groups and individuals facing economic hardships, face additional challenges and non-climate-related stressors.

Building effective climate resilience requires action from all levels of government and within communities (see Figure 4). It also requires a full range of project and program types, from the small scale (e.g., rain garden) to the large scale (e.g., watershed management planning). Identifying opportunities for large-scale green infrastructure, or nature-based solutions, throughout the region is important for minimizing the impacts of flooding, in addition to improving water quality and protecting transportation and public infrastructure. All existing and forthcoming resilience work in Southeast Michigan, no matter the leading entity, contributes to a broader effort that this framework aims to better coordinate at the regional level.

This framework recognizes and incorporates other large, coordinated efforts. For example, the Michigan Department of Transportation (MDOT)'s Resilience Improvement Plan considers climate hazards that impact Michigan, including flooding, extreme heat, and coastal erosion. This plan evaluates vulnerabilities, assesses the risk associated with climate hazards, and identifies strategies to improve the resilience of surface transportation facilities to climate hazards. Additionally, the Great Lakes Water Authority (GLWA)'s upcoming Southeast Michigan Flood Study with the US Army Corps of Engineers (USACE) aims to evaluate the implementation of large-scale green and gray infrastructure to address flooding concerns and long-term impacts of climate change.

This framework marks the beginning of more standardized regional coordination for climate resilience efforts. The process will be iterative, expanding in size and scope as it moves forward. **Under the Assess, Plan, Implement framing, the following sections include resources and potential roles for entities such as local governments or transportation agencies.**

Step 1: Assess

The first step toward developing regional resilience strategies typically involves climate vulnerability and risk assessments that can provide information to help decision-makers identify and prioritize future planning and implementation. All partners in the region have important roles to play in assessing resilience. The examples here range from day-to-day public works operations to larger studies and assessments. Every agency can reflect on current and planned activities and projects to understand how they fit into the regional resilience framework.

Local Governments (Local Communities and Counties)

- **Understand Data Availability**: Use the Southeast Michigan Climate Resiliency Data Portfolio to support local resilience studies and data collection.

- **Vulnerability Assessments**: Identify areas most at risk from climate impacts by analyzing historical data and future climate projections. Conduct stormwater infrastructure modeling and assessments as part of local stormwater planning. Consider participating in localized assessment opportunities provided by outside partners such as the GLISA FloodWise Communities Program.

- **Risk Mapping**: Develop detailed maps that highlight climate-related hazards to guide future planning and development. Map localized areas that frequently flood.

- **Asset Management**: Build an asset management approach to infrastructure, which includes detailed inventory and condition assessment of assets as well as vulnerability or risk of failure assessment. Example activities include mapping stormwater infrastructure systems including conveyance, flood control, water quality, and other best management practices.

- **Public Outreach and Education**: Continue public education initiatives, including public surveys, with an additional focus on climate hazards.

- **Economic Impact Analysis**: Assess the potential economic costs of climate impacts on the local economy, including impacts on property values, business operations, and public services. Stay abreast of the USACE / GLWA future economic analysis from the Southeast Michigan Flood Study described in this Framework.

- **Infrastructure Project Coordination**: Map ongoing and desired capital improvement projects, and share information through SEMCOG and/or Michigan Infrastructure Council's MiDig Project Portal to improve coordination during improvements. Ensure stormwater studies are conducted before scoping and project selection.

- **Nature-Based Solutions and Best Practices**: Review and provide feedback on potential opportunities for nature-based solutions, including both large-scale green infrastructure features to manage excess runoff in addition to conservation areas from SEMCOG's regional analysis.

Transportation Partners (Local Communities, Counties, Federal Aid Committees and MDOT)

Consider local government assessment opportunities with additional considerations for:

- **Vulnerability Assessments**: Update data on exposure, vulnerability, and risk associated with transportation assets.

- **Risk Mapping and Inspection:** Document and map transportation assets that frequently flood. Conduct regular inspection of infrastructure impacted by, and at risk to, extreme events.

- **Infrastructure Project Coordination**: Map desired capital improvement projects and utilize the Michigan Infrastructure Council's MiDig Project Portal to improve coordination during improvements. Ensure stormwater studies are conducted before scoping and project selection.

- **Asset Management**: Continue and expand culvert inventory and asset management programs; Track asset conditions to determine those vulnerable/damaged from extreme events; prioritize projects that reduce infrastructure damage and failure.

State and Regional Agencies

- **Flood Management Alternatives Analysis:** Develop regional assessment of potential nature-based solutions to identify and quantify potential large-scale storage opportunities that may reduce and manage flooding.

- **Flood Risk Reduction Study:** The US Army Corps of Engineers (USACE) and Great Lakes Water Authority (GLWA) are working collaboratively on a Southeast Michigan Flood Study to develop future alternatives for flood risk reduction. This study aims to evaluate the implementation of large-scale green and gray infrastructure to address flooding concerns and long-term impacts of climate change.

- **Asset Management:** Continue supporting an asset management approach to infrastructure, which includes detailed inventory and condition assessment of assets as well as vulnerability or risk of failure assessment. Encourage local participation in the Michigan Infrastructure Council Asset Management Champions Program. Collect high-priority regional asset data such as for culverts (identified as a data gap in the Flood Risk Tool methodology), which will be funded with FHWA PROTECT funds.

- **Risk Mapping:** Purchase Risk Factor Flood Model data for the seven-county region for use in enhancing the vulnerability assessment of the region. This data can be used to supplement FEMA flood maps, which are often outdated.

- **Data Collection:** Pursue regional data collection efforts to support resilience studies. Examples include updated aerial photography, LiDAR, and Hydro Enforced Digital Elevation models.

- **Funding**: Continue SEMCOG's subaward grant opportunities as funding is available, including the Planning Assistance and EPA Great Lakes Environmental Justice Grant Programs. Continue to seek out funding resources to support regional and local priorities. Work collaboratively with funders to ensure regional priorities are reflected in federal and State programs.

- **Programming**: Continue to lead and collaborate on assessment efforts and provide data and supporting resources to Southeast Michigan partners.

- **Collaboration**: Coordinate and participate in efforts with other regional partners, such as utility providers, research institutions, and State agencies. Review regional studies

from other partners, like Erb Family Foundation's Watershed Report Cards that provide an overall socio-environmental assessment of Southeast Michigan watersheds.

Regional Stakeholders and Partners

Watershed organizations, land conservancies, foundations, academic institutions, community-based organizations, and others are valuable partners in leading and supporting resilience efforts. Each of these organizations plays an important role in the categories listed below. Examples are provided for reference based on known projects and initiatives.

- **Equity**: Include perspectives from the public that incorporate equity. Use tools like SEMCOG's Equity Emphasis Areas Application and United Way's Asset-Limited, Income-Constrained, Employed (ALICE) data to understand more nuanced characteristics of equity within communities.

- **Public Outreach and Education**: Provide education, outreach, and engagement opportunities for the public. Understand public priorities related to climate hazards. Watershed and community-based organizations are positioned to educate, understand, and work collaboratively with the public and at a local scale. Examples include initiatives to connect the public to the region's water resources. As watershed councils, the Friends of the Rouge, Clinton River Watershed Council, Huron River Watershed Council, Friends of the Detroit River, and Friends of the St. Clair River play a valuable role in regional resilience.

- **Data Collection**: Collect data to help quantify environmental benefits of various conservation and preservation efforts. Examples include the Great Lakes Stream Crossing Inventory managed by the Michigan Department of Natural Resources, but often implemented at the local level by watershed councils. Additionally, several watershed councils

collect chemistry and flow data, habitat data and information about wildlife populations (macroinvertebrate, frog and toad, fish) to support local planning efforts.

- **Needs Assessment**: Lead watershed-level planning efforts; identify and communicate environmental preservation needs. Land conservancies are a key partner in identifying preservation opportunities and securing funding for conservation. Examples include the Six Rivers Land Conservancy and The Nature Conservancy, which work within Southeast Michigan.

- **Research**: Perform research on new techniques and data related to resilience. Local universities, including University of Michigan, Wayne State University, Michigan State University, and Central Michigan University are keyed in regarding future resilience research opportunities. For example, U-M and Wayne State are working on elements of nature-based solutions from the social, economic, and design aspects. Central Michigan University received funding from the Department of Energy to downscale climate models to simulate future precipitation and flood inundation.

Step 2: Plan

Planning for climate resilience encompasses a range of tactics, including development of formal planning documents, coordination of regional resilience efforts, integration of resilience into existing planning and decision-making processes, and engagement with communities to build adaptive capacity. Examples here represent various approaches for different stakeholders to apply in current efforts or consider in future plans. To build resilience, communities must be engaged in broader resilience efforts so that they can voice local needs and contribute local knowledge.

Local Governments (Local Communities and Counties)

- **Asset Management**: Using an asset management approach previously described, develop short- and long-term asset management plans that guide decisions making for infrastructure investments, including capital projects and operations and maintenance strategies. Develop stormwater infrastructure asset management plans.

- **Capital Improvement Planning**: Identify key projects from past planning efforts, including watershed management plans. Identify potential flood mitigation and water quality improvement opportunities. Update capital improvement plans regularly to reflect resilience priorities.

- **Climate Action Plan**: Develop comprehensive strategies that outline goals, targets, and actions for reducing emissions and increasing resilience to climate impacts.

- **Land Use and Master Planning**: Integrate climate resilience into master plans, zoning codes, building standards, and land use plans to prevent development in high-risk areas and encourage sustainable practices.

- **Green Infrastructure**: Conduct a green infrastructure code audit and update codes and ordinances that reflect best practices in green infrastructure planning. Also assess optimal areas for complete and green streets.

- **Emergency Preparedness**: Create or update disaster response plans to ensure quick and effective responses to extreme weather events, including evacuation routes and communication strategies; improve warning systems such as for basement backups.

- **Resilience Hubs**: Identify local resilience hubs (e.g., fire stations, libraries, and schools) needed beyond those that have been/are being created, considering specific locations in terms of environmental justice and ensuring that communities are aware of them.

- **Financial Planning**: Develop funding mechanisms, such as bonds or public-private partnerships, to finance climate resilience projects and infrastructure upgrades. Identify funding alternatives for stormwater resilience projects, utilizing the Southeast Michigan Climate Funding Strategies.

- **Infrastructure Project Coordination**: Map ongoing and desired capital improvement projects and share through SEMCOG and/or Michigan Infrastructure Council's MiDig Project Portal to improve coordination during improvements. Work strategically to seek out opportunities to efficiently align projects in time and space.

- **Public Outreach and Education**: Conduct outreach and education with the public to raise awareness of individual-level emergency response actions (e.g., how to manage a home during a storm) and as part of local planning efforts.

Transportation Partners (Local Communities, Counties, Federal Aid Committees and MDOT)

- **Project Selection**: Develop a checklist for project selection process and project scoping to embed resilience and climate related planning; use the Southeast Michigan Flood Risk Tool as an indicator to support selection of projects.

- **Transportation Improvement Program**: Identify locations and priorities for resilience and stormwater management practices and incorporate as part of the regional transportation planning project selection process.

- **Regional Transportation Plan**: The Vision 2050 RTP includes elements of infrastructure coordination and resiliency priorities to support the transportation system.

- **Resilience Improvement Plan**: MDOT's recently completed Resilience Improvement Plan considers climate hazards that impact Michigan, including flooding, extreme heat, and coastal erosion. Evaluate and select actions that support local transportation planning.

- **Asset Management Plans:** MDOT's Transportation Asset Management Plan (TAMP) is completed every three years to guide the transportation-related program and project decisions across the state. Previous iterations of the TAMP include thoroughly integrating resilience into transportation planning as a goal.

- **Design Guidance**: Work collaboratively to evaluate and determine how projections for future rainfall may be considered in transportation project designs. Update

engineering design standards to reflect resiliency considerations.

- **Disaster Response Planning**: Develop evacuation routes and redundant routes to access critical facilities and communities.

- **Resilience Planning:** Evaluate use of resilience and stormwater best management practices for the transportation system.

- **Infrastructure Project Coordination**: Investigate infrastructure coordination opportunities with a focus on reconstruction projects that could address flooding and resilience in the region and across infrastructure sectors.

State and Regional Agencies

- **Resilience Improvement Plan:** Develop a Regional Resilience Improvement Plan (RIP) for Southeast Michigan, including a regional risk-based vulnerability assessment, collecting culvert data for increased accuracy, and identifying specific priority resilience projects for the region. The RIP will also include conceptual plans for large-scale green infrastructure and a feasibility analysis of diverting runoff from upcoming capital projects to large-scale, nature-based solutions.

- **Green Infrastructure:** The Green Infrastructure Assessments in Environmental Justice Areas project will identify high-priority, publicly owned properties that are feasible for green infrastructure. SEMCOG, in partnership with the Center for Watershed Protection, will develop conceptual green infrastructure plans for six underserved communities.

- **Climate Action Plan:** Develop the Comprehensive Climate Action Plan for Southeast Michigan that reflects actions that support resilience priorities.

- **Funding**: Provide funding for high-priority activities. Incentivize climate resilience measures in development and redevelopment projects, including opportunities for brownfield redevelopment.

- **Programming**: Continue to lead planning efforts and provide data and supporting resources to Southeast Michigan region.

- **Collaboration**: Coordinate efforts with other regional partners, such as utility providers, research institutions, and State agencies.

Regional Stakeholders and Partners

Watershed organizations, land conservancies, foundations, academic institutions, community-based organizations, and others are valuable partners in leading and supporting resilience efforts. Each of these organizations plays an important role in the categories listed below. Examples are provided for reference based on known projects and initiatives.

- **Public Outreach and Engagement**: Conduct outreach involve the public in local and regional resilience-related planning initiatives. Consider hosting listening sessions in areas most vulnerable to climate impacts.

- **Watershed Planning**: Incorporate resilience at all levels with consideration for large scale nature-based solutions in the optimum watershed areas to minimize flooding.

- **Climate Action Plan**: These plans include comprehensive strategies that outline goals, targets, and actions for reducing emissions and increasing resilience to climate impacts. As an example, the Huron-Clinton Metroparks Authority Climate Action Plan includes resilience topics.

Step 3: Implement

This section covers activities to implement resilience strategies, encompassing programming, physical mechanisms, and procedural improvements. Priority implementation activities build on the strength of existing stormwater management and related efforts underway in the region. The examples represent various approaches for different regional stakeholders to apply in their current efforts or consider in their future work.

Local Governments (Local Communities and Counties)

- **Natural Solutions**: Implement nature-based solutions, such as restoring wetlands, planting trees, and creating green roofs, to absorb floodwaters, reduce heat, and enhance biodiversity.

- **Project Planning:** Incorporate resilience and stormwater improvements in transportation projects. Look for existing opportunities to maximize storage.

- **Infrastructure Upgrades**: Retrofit and strengthen critical infrastructure, like bridges, roads, and water systems, to withstand extreme weather conditions.

- **Building Codes**: Enforce stricter building codes that require new construction to be resilient to climate risks, such as elevated structures in flood-prone areas and heat-resistant materials.

- **Design Guidance**: Work collaboratively with transportation and regional partners to evaluate and revise existing design guidelines and standards for infrastructure projects to consider projected climate changes to help ensure that structures remain resilient and sustainable.

- **Public Outreach and Education**: Launch programs to educate the public about climate risks and resilience strategies, encouraging personal preparedness and community involvement. Complete local projects to demonstrate benefits of resilience projects.

- **Early Warning Systems**: Develop or enhance early warning systems for extreme weather events, including real-time monitoring and communication networks to alert residents.

- **Collaboration and Partnerships**: Partner with regional governments, NGOs, and private sector organizations to leverage resources, share knowledge, and coordinate climate resilience efforts across jurisdictions. Align stormwater infrastructure projects with other project partners.

- **Operation and Maintenance:** Conduct routine maintenance of the collection and conveyance system (culverts, catch basins, etc.). Clear catch basins before forecasted heavy rain events. Prioritize maintenance schedules that include consideration of asset vulnerabilities and risks.

Transportation Partners (Local Communities, Counties, Federal Aid Committees, and MDOT)

- **Natural Solutions**: Implement nature-based solutions, such as restoring wetlands, planting trees, and creating green

roofs to absorb floodwaters, reduce heat, and enhance biodiversity.

- **Project Planning:** Incorporate resilience and stormwater improvements in transportation projects. Look for existing opportunities to maximize storage.

- **Design Guidance:** Develop resilience design guidance for all project types, working collaboratively to evaluate and revise existing design guidelines and standards for infrastructure projects to consider projected climate changes.

- **Collaborate**: Coordinate across resilience programs for project implementation. Align hazard mitigation, emergency response, and transportation programs with water infrastructure improvement needs.

- **Structural Resilience:** Upgrade pump stations; install backup generators; raise bridges; stabilize slopes; and remove, relocate, or elevate assets in the flood plain.

- **Stormwater Management:** Increase stormwater infrastructure capacity, install retention basins or drainage systems, and implement tunnel sewers. Install stormwater best practices.

- **Culvert Management**: Enlarge culverts and catchment devices upstream of culverts or replace culverts with bridges.

- **Operation and Maintenance:** Conduct routine maintenance of the collection and conveyance system (culverts, catch basins, etc.).

- **Monitoring**: Utilize sensors along or within assets to monitor water levels and changing climate conditions.

State and Regional Agencies

- **Pursue Funding**: SEMCOG to monitor and pursue relevant federal and State funding resources (e.g., low-interest loans,

rebates, dedicated funds, technical assistance), which can be leveraged for local climate resilience efforts.

- **Provide Funding**: Provide funding for high-priority project implementation; incentivize implementation of climate resilient measures for nature-based solutions.

- **Programming**: Incorporate climate changes into State and regional hazard mitigation activities.

- **Collaboration**: Coordinate efforts with other regional partners, such as utility providers, research institutions, and State agencies.

- **Design Guidance**: Work collaboratively with local and transportation partners to evaluate and revise existing design guidelines and standards for infrastructure projects to consider projected climate changes.

- **Monitoring**: Establish monitoring and evaluation mechanisms to track the implementation progress and effectiveness of adaptation measures.

Regional Stakeholders and Partners

- **Natural Solutions**: Implement nature-based solutions, such as restoring wetlands, planting trees, and creating green roofs, to absorb floodwaters, reduce heat, and enhance biodiversity.

- **Maintenance:** Conduct routine maintenance of installed nature-based solutions.

- **Public Outreach and Education**: Launch programs to educate the public about climate risks and resilience strategies, encouraging personal preparedness and community involvement. Complete local projects to demonstrate benefits of resilience projects. Simultaneously, increase public awareness of the importance of land

conservation and the value of ecosystem function and services.

- **Collaboration and Partnerships**: Partner with regional governments, NGOs, and private sector organizations to leverage resources, share knowledge, and coordinate climate resilience efforts across jurisdictions. Align stormwater infrastructure projects with other project partners.

- **Listening Sessions**: Host engagement and listening sessions in collaboration with community leaders and organizations, prioritizing communities that are most vulnerable to climate change impacts due to their location (e.g., within a flood-prone area or an urban heat island) or exacerbating conditions (e.g., low income, poor housing quality, preexisting health conditions).

Regional Priorities

Near-Term Plans

- Facilitate collaborative efforts to evaluate and revise existing design guidelines and standards for infrastructure projects through considering historical weather and climate projections data, identifying gaps, and proposing potential standards-related options to protect critical infrastructure.

- Align GREEN initiative priorities with future capital improvement projects and ensure coordination across partners to protect and restore natural systems. This is achieved by improving the quantity, quality, and connectivity of the region's tree canopy, wetlands, conservation land, and access to nature for residents.

- Implement green infrastructure projects that both build resilience by helping to address both flooding and extreme heat issues and confer co-benefits for community health, such as improved air quality as well as mental and physical health.

Long-Term Goals

As a region, Southeast Michigan has long-term opportunities to enhance resilience of built and natural infrastructure, strategically fund and finance resilience investments, and continuously monitor, evaluate, and adapt these approaches:

- Encourage infrastructure that provides multiple benefits (e.g., complete and green streets).

- Ensure proactive and sufficient infrastructure assessment and maintenance to promote infrastructure effectiveness and longevity.

- Encourage reduced insurance premiums for taking steps to reduce climate risks.

- Support and utilize creative financing mechanisms, including public-private partnerships, infrastructure banks and resilience funds, climate or green bonds, special assessment/taxing districts, and/or stormwater fees.

- Establish monitoring and evaluation mechanisms to track the progress and effectiveness of adaptation measures.

SEMCOG Resources for Resilience Assessments, Planning, and Implementation

With a primary focus on flooding, SEMCOG has developed resources that support local decision-making. Existing efforts have focused on understanding vulnerabilities in these networks and encouraging effective coordination among entities that manage the relevant infrastructure.

- The **Resilience Data Portfolio** compiles relevant data and resources to inform vulnerability and resilience analyses for the region. This consolidates a wide array of data sources and tools that are critical for assessing vulnerabilities, planning interventions, and building resilient communities. The portfolio includes interactive maps, downloadable datasets, and reports from State and federal government sources, all tailored to the specific needs of Southeast Michigan.

- The **Southeast Michigan Climate Resiliency Funding Strategies** guide provides detailed information and guidance on a wide selection of funding programs that support diverse activities and initiatives such as nature-based solutions, equity, climate change, stormwater management, and risk reduction.

- **SEMCOG Data and Maps** feature local and regional data to support local decision-making.

- The **Flood Risk Tool** assesses flood risks to regional transportation infrastructure. SEMCOG partnered with the Michigan Department of Transportation (MDOT) to complete an assessment of flooding risk for roads, bridges, culverts, and pump stations. This tool calculates flood risk scores for roads, bridges, culverts, and pump stations in the SEMCOG region using exposure, sensitivity, and criticality indicators.

- The **Flood Risk and Equity Analysis** was developed in partnership with NOAA to understand how flooding impacts the ability of people to reach key destinations (such as work, school, or health care facilities) safely, affordably, and efficiently. SEMCOG's Access to Core Services analysis is coupled with the assets at high risk of flooding in the Flood Risk Tool, to understand how a flood event may impact access for underserved and disadvantaged populations.

- The **GREEN Dashboard** identifies regional metrics and targets for the region's green infrastructure network, including tree canopy, wetlands, conservation land, recreation access, and potential sites for large-scale green infrastructure, along with other resources like existing plans or ordinances related to resilience.

- The **Wetland Storage Capacity Assessment** was developed in partnership with SEMCOG and Michigan Technological University (MTU) to assess coastal and inland wetlands of flood storage capacity

- The **Environment and Ecosystem Services Tool** is designed to highlight key environmental and ecosystem service effects of land use change and the economic value of mitigation. The tool can be utilized by planners, developers, conservation organizations, transportation agencies, and engineers to understand environmental impacts of a project in the early stages of development.

- The **Water Quality Tool** was designed to estimate how development, redevelopment and conservation opportunities impact or benefit water quality. The tool is designed to perform the calculations of EPA's Spreadsheet Tool for Estimating Pollutant Loads (STEPL) to help communities understand the impacts a project will have on pollutant loading and water quality

- The **Southeast Michigan Current and Future Precipitation** report forecasts future rainfall, from small rain events to the 100-year event. Its key findings highlight that regardless of the climate model chosen, the trend for future rainfall is increasing at a time when the area's aging and sometimes undersized stormwater management system is increasingly inadequate to handle projected runoff.

- The **Engineering Guidance for Changing Rainfall** includes a historical perspective of the approaches and data sources along with changes projected into the future. The guidance is intended as a resource to augment professional judgement with regard to adaptive design for changing rainfall. It includes recommendations for designing resilience infrastructure projects that incorporate future rainfall projections in line with the expected service life.

- The **Water Infrastructure Planning Guide** provides communities, partner agencies, and stakeholders with access to key information and resources about the region's water infrastructure. It includes specific policies and actions addressing climate resilience, many of which align with transportation planning priorities.

- The **Green Infrastructure Assessments for Coastal Resilience** project identified high-priority, publicly owned properties that were feasible for green infrastructure (GI). SEMCOG coordinated with local communities and partners to develop conceptual plans for 48 green infrastructure projects at 45 distinct sites within the region's coastal communities.

- The **Southeast Michigan Healthy Climate Plan** prioritizes policies, projects, and measures that will reduce greenhouse gas emissions and enhance natural areas that capture climate pollution. All measures aim to improve quality of life and resilience to climate change, particularly in areas where addressing equity and environmental justice is a priority.

- The **Vision 2050: Long-Range Regional Transportation Plan** includes guiding principles and planning solutions for the transportation system to achieve greater public health and environmental benefits.

- The **Infrastructure Coordination Framework** guides the numerous agencies that are tasked with constructing and maintaining infrastructure systems including transportation, water systems, and private utilities. Collaboration between owners can better support enhancing infrastructure, reducing project costs, and minimizing disruptions to the system. Leveraging limited funding across agencies and coordinating planning cycles can optimize resources, improve resilience, and maximize investments.

- Coordinating with implementing agencies through the **Partners for Clean Water** meetings and the **GREEN Implementation Team**, a regional resilience community of practice.

- Leading regional task forces, including the **Healthy Climate Task Force** and Justice40 Communities Task Force.

- The **Southeast Michigan Climate Resiliency Funding Strategies** includes a selection of funding programs that support diverse activities and initiatives such as nature-based solutions, equity, climate change, stormwater management, and risk reduction.

- The **Transportation Improvement Plan (TIP)** is a schedule of road and transit projects selected as priorities for funding by cities, villages, county road commissions, transit agencies, and the Michigan Department of Transportation. The TIP is an implementation tool of the Regional Transportation Plan (RTP).

- Administering regional grant programs that implement green infrastructure, including the Great Lakes Restoration Initiative and Transportation Alternatives Program.