TEXAS LBJ School

The University of Texas at Austin
Lyndon B. Johnson School of Public Affairs

Climate & Health Catalyst Program

Final Report

Client: Environmental Defense Fund

Presented by:

Alejandra Tapia
Allison Hooks
Rizwaan Lakhani
Viviana Salgado

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Acknowledgments

ATTN: **April 30, 2024**

Derek Walker
Vice President, US Region

Maia Draper
Senior Policy Manager, Environmental Health

Environmental Defense Fund
301 Congress Avenue, Suite 1300
Austin, Texas 78701

Dear Mr. Derek Walker and Ms. Maia Draper,

TOur team is pleased to present the final report for the Climate & Health Catalyst Program, representing a significant milestone in our collective efforts to address the critical intersection of climate change and public health in the United States.

Throughout our collaboration, our primary objective has been to guide the Climate & Health Catalyst Program towards becoming a fully integrated and sustainable initiative in alignment with the Environmental Defense Fund's (EDF) long-term objectives, alongside our partner cities, Grand Prairie, Texas, and St. John the Baptist, Louisiana.

Our efforts have been dedicated to crafting documents that provide local governments with actionable insights for resilience planning. By conducting thorough literature reviews, vulnerability assessments, and customized policy recommendations, we have tailored our approach to meet the specific needs of each partner city. Our ultimate goal is to empower decision-makers to proactively tackle the challenges posed by climate change.

We are confident that our report will catalyze transformative change, enabling communities to fortify their resilience and safeguard public health in the face of climate change.

Sincerely,

Alejandra Tapia   Allison Hooks   Rizwaan Lakhani   Viviana Salgado

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I.   Executive Summary

Climate change poses severe risks to human health and well-being, exacerbating existing vulnerabilities and creating new challenges. Our project aims to assist local governments in addressing climate and health challenges through data-driven tools and analysis. Our team partnered with Environmental Defense Fund (EDF) to validate the usability of its Climate Vulnerability Index (CVI) and provide resources to two partner cities, Grand Prairie, Texas, and St. John the Baptist, Louisiana.

Our project adopted two distinct frameworks to develop and tailor policy recommendations: the City Resilience Framework for Grand Prairie and the Environmental Justice Framework for St. John the Baptist. These frameworks facilitated an understanding of the factors influencing resilience and guided the identification of effective actions and investments.

Our project developed Climate and Health Vulnerability Assessments and Policy Action Recommendations for each partner city. The assessments revealed that in both cities, community baseline vulnerabilities - the long-standing inequities and injustices within a community that shape its resilience to climate impact - drive overall climate vulnerability.

For instance, while Grand Prairie faces challenges such as chronic disease prevention, poor air quality due to pollution sources and transportation, and temperature-related deaths, St. John the Baptist grapples with infrastructure issues, exposure to toxic industrial pollution, and inadequate healthcare access. Based on the Assessments, we have included recommendations aimed at addressing these climate vulnerability drivers within our partner cities.

In addition to recommendations tailored to local governments, the project includes recommendations to EDF, such as enhancing the CVI's usability through case studies, linking vulnerability drivers to funding resources, establishing local governments cohorts, fostering university partnerships, and strategically engaging with community-based organizations to amplify the impact of the Climate & Health Catalyst Program.

Overall, this project underscores the urgency of addressing climate vulnerability and its interconnection with health outcomes and social determinants of health (SDOH). By providing tailored assessments and policy recommendations, it empowers local governments to take informed actions and allocate resources effectively, ultimately enhancing community resilience and well-being.

II.   Introduction

The Challenge

Climate change poses novel health issues and exacerbates existing health issues by intensifying their severity or frequency. Health problems that are caused or intensified by climate change include respiratory, cardiovascular, and vector-borne diseases, as well as mental health conditions.[1] For example, between 2008 and 2018, the annual number of emergency department visits for heat stress increased by 102%.[2] Climate change contributes to natural disasters, which have been linked to post-traumatic stress disorder and suicide, especially for populations with risk factors such as low socioeconomic status.[3]

People can have a greater or lesser vulnerability to health risks depending on social, political, and economic factors known as social determinants of health.[4] A person's vulnerability to climate change health risks depends on three determinants: their level of exposure, their sensitivity to these risks, and their ability to respond or adapt to climate variations and changes.[5] People with high levels of vulnerability to climate may include women and girls, children, older adults, outdoor workers, and impoverished people.
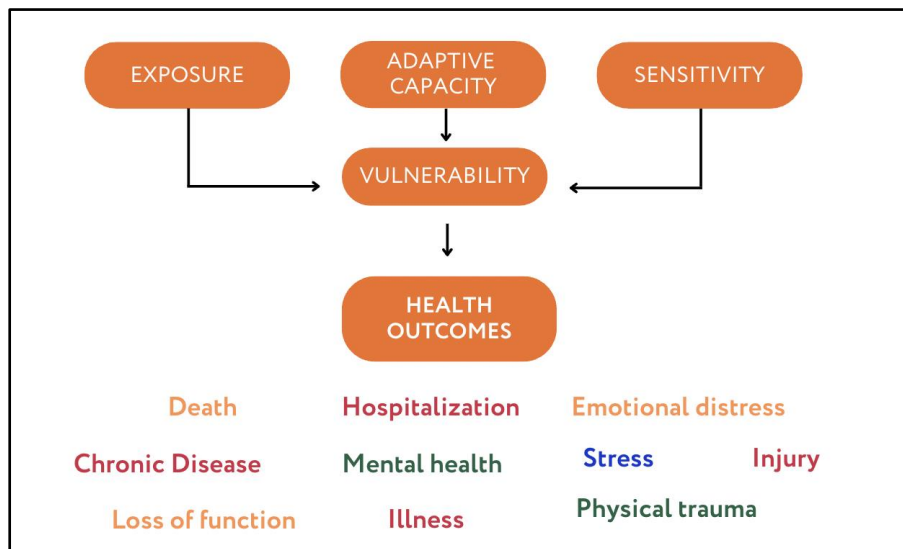
Figure 1. Climate vulnerability is driven by exposure, adaptive capacity, and sensitivity.

The impact of climate on health can differ depending on both the population's vulnerability and the location, making it critical for local governments to understand and develop policies based on climate equity. Climate equity aims to recognize and address the unequal burdens on vulnerable populations while ensuring that all people share the benefits of climate protection efforts.[6] An equitable approach to building resilience emphasizes the importance of local governments using real-time data and indexes to assess vulnerability and develop tailored policies and solutions to mitigate these effects. Our project hypothesizes that local governments lack access to climate and health intelligence tools or the capacity to properly interpret data, making them unable to take action, allocate resources effectively, and meet the growing needs of climate-vulnerable communities.

Client Partner

EDF is a nonprofit organization committed to safeguarding the environment through science-based advocacy, litigation, and partnerships. EDF has been a leading voice in addressing pressing environmental issues on a global scale. EDF's primary objectives include combating climate change, preserving natural ecosystems, and advocating for sustainable environmental policies. Their work spans from clean energy promotion to wildlife conservation.

EDF is piloting a Climate & Health Catalyst Program for local governments. The program aims to assist local governments with addressing climate and health challenges and developing a climate and health action planning toolkit through the use of data-driven tools. To support this program, EDF recently developed the CVI which enables policymakers to identify census tracts with high vulnerability to climate change based on climate, health, economic, social, infrastructural, and environmental factors that influence a community's ability to prepare, adapt, and recover from climate change impacts.

Our Project

To support the implementation of the Climate & Health Catalyst Program, EDF engaged with our team to develop a Climate and Health Vulnerability Assessment and policy action recommendations for two partner cities, Grand Prairie, Texas, and St. John the Baptist, Louisiana. Our work as the LBJ team was to validate the usability of EDF's CVI, provide important resources to partner cities, and demonstrate how the resources associated with EDF's Climate & Health Catalyst Program can assist US cities with prioritizing policy actions to combat inequitable health impacts from climate change.

III. Research Questions

Our collaborative efforts with the communities of Grand Prairie and St. John the Baptist, aimed to better understand and improve these municipalities' resilience and well-being. To guide our research project, we explored the following research questions:

RQ1: How well do local governments understand the impacts of climate vulnerability on their communities?

This question aims to gauge the degree to which local governments grasp the implications of climate vulnerability within their specific communities. Additionally, it serves as a means to pinpoint any significant knowledge gaps that could hinder the effective implementation of climate-related policies.

RQ 2: How do local governments use data to develop policies to advance community well-being?

To properly develop the Climate & Health Vulnerability Assessments and craft Policy Recommendations, we sought to gain valuable insights into how local governments leverage data to formulate policies that enhance community well-being. Understanding the role of data in the decision-making process is vital, as it can uncover challenges and opportunities for improvement in policy development.

RQ 3. What strategies are needed for local governments to enhance their communities' health, well-being, and resilience?

Our research aimed to identify strategies for local governments to enhance community health, well-being, and resilience by addressing climate and health vulnerabilities through relevant policies. Answering this research question will ultimately lead to actionable recommendations and strategies for Grand Prairie and St. John the Baptist, and similar communities to strengthen resilience.

IV. Methodology

To answer our research questions, we used mixed methods, drawing from primary and secondary sources. The mixed methods included a literature review, desk research, interviews, and the CVI. The data and insights generated from these methods together informed the project's deliverables.

Literature Review

The objective of the literature review was to contribute toward answering our research questions and synthesizing the current academic literature related to climate change and health vulnerability. It is organized by four topic areas. The first is developing an understanding for the need for local government resilience planning and adaptive governance. Second, distinguishing the multiple definitions of resilience planning by local governments. Third, frameworks and relevant policy lenses for developing and implementing resilience plans. And fourth, the need for climate vulnerability assessments to inform local governments policy actions. See Appendix 1 for the full literature review.

Desk Research

To supplement the literature review, we analyzed data and developed insights through desk research. We reviewed government documents, other primary and secondary web sources, health outcomes data, demographic data, and other relevant local data to identify vulnerable communities within each partner city.

City Interviews

To gather information and insights specific to Grand Prairie, and St. John the Baptist, we conducted five interviews for each city including government officials, community members and other experts. The interviews were semi-structured. This approach enabled us to gather in-depth qualitative information while allowing flexibility for the interviewer to ask follow-up questions about new information that emerged during the interview. The interview covered topics related to our three research questions, including 1) current understanding of climate vulnerability in the community; 2) data and tools used by each department and how they are used; and 3) existing or previously used programs and strategies implemented by the department. We conducted a thematic analysis of the interview data using MaxQDA for qualitative data analysis. See Appendix 2 for our interview protocol.

Climate Vulnerability Index

We used EDF's CVI to identify vulnerable populations and to better understand interactions between community baseline indicators, climate risks, and health outcomes. The CVI combines 184 datasets and ranks more than 70,000 US census tracks based on climate and health vulnerability. We used the tool to understand the climate and health risks in each city and to assess which communities within Grand Prairie and St. John the Baptist are most vulnerable to climate change.

V.   Frameworks and Policy Lenses

As part of the mixed methods approach in helping answer our research questions, we reviewed the literature related to climate change and health vulnerability. To address vulnerability, local governments across the US have developed and implemented resilience plans, which are guided by various frameworks based on community contexts. The concept of *resilience* is multi-faceted, drawing from market and complex systems theories. It has been adopted in different fields, reflecting a growing recognition of the interconnectedness of ecological, social, economic, and security issues. In the context of urban development, it represents a departure from traditional planning, emphasizing strategic thinking about probability and risk.[7]

As the pace of environmental and social changes accelerates, resilience planning at the local level is essential to mitigate negative social and health-related impacts. Throughout the Climate & Health Catalyst Program, the LBJ team will use **resilience planning as a strategic approach that enhances the capacity of communities and individuals to adapt and withstand climate change impacts.[8]** It represents a paradigm shift in local-level strategy implementation, moving beyond only large infrastructure development projects towards strategies that help local populations "fend for themselves" and manage climate crisis events through a systems-thinking method.[9]

Adaptive governance and public participation are critical in creating resilient cities. This concept refers to how government institutions can manage the complexity and unpredictability associated with socio-ecological systems amidst change and uncertainty. Effective resilience strategies must ensure *distributional equity* (fair distribution of resources), *procedural equity* (inclusive and representative decision-making processes), and *recognitional equity* (acknowledging and addressing underlying inequalities).[10]

Facing multiple resilience challenges, local governments require a framework to guide resilience planning and decision-making. Using a framework facilitates understanding of factors that influence resilience and identifying the most effective actions and investments.[11] For the purposes of this project, we used two different resilience frameworks to tailor our policy recommendations to the specific needs of our two city partners: City Resilience Framework and Environmental Justice.

City Resilience Framework outlines four dimensions of resilience: health and well-being, economy and society, infrastructure and environment, and leadership and strategy.[12] The framework also describes qualities of resilient cities: reflectiveness, resourcefulness, robustness, redundancy, flexibility, inclusiveness, and integration.[13] Our project proposes how the city of Grand Prairie can adapt and apply this framework to address climate and health vulnerabilities.

On the other hand, we propose that St. John the Baptist Parish, can use *Environmental Justice* as a framework for resilience planning. Environmental justice refers to all individuals' fair treatment and meaningful involvement in the development, implementation, and enforcement of environmental laws, regulations, and policies, regardless of an individual's race, color, national origin, income, tribal affiliation, or disability. Furthermore, it involves fair treatment and meaningful engagement in agency decision-making and other activities

affecting human health and the environment. The environmental justice approach is crucial in addressing the inequitable health impacts of climate change because health disparities may arise due to social inequities and environmental factors that burden the places where individuals reside, work, learn, and engage in recreational activities.[14] In the context of resilience planning, environmental justice ensures that all communities have equitable access to the resources and the capacities needed to respond to and recover from climate change impacts.[15]

VI.   Climate and Health Vulnerability Assessments

Introduction

A Climate and Health Vulnerability Assessment is necessary to identify and address significant climate and health risks affecting communities in St John the Baptist Parish and Grand Prairie. To create the St. John the Baptist and Grand Prairie Climate and Health Vulnerability Assessments, we conducted desk research, interviewed government officials, and used EDF's CVI. Its objective is to assist policymakers in making informed decisions on responding to the potential impacts of climate change in their communities.

Overall Climate Vulnerability

The CVI assigns an overall climate vulnerability score, which combines the environmental, social, economic, and infrastructure impacts on vulnerability. This score is presented in the form of national vulnerability percentile and is used to identify the most vulnerable communities to the impacts of climate change in the US. The *Overall Climate Vulnerability* score is composed of *Community Baseline Vulnerabilities* and *Climate Impacts*.
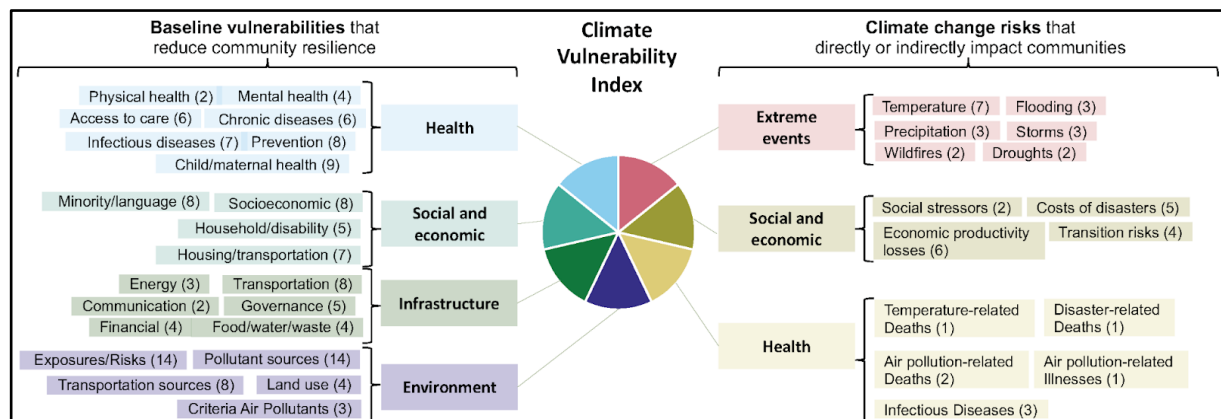
 Figure 2. The Climate Vulnerability Index comprises baseline vulnerabilities and climate change risks. Indicators (n in parentheses) are organized into components, which together create vulnerability and risk categories: health, social and economic, Infrastructure, environment, and extreme events. Figure is from CVI methodology.[16]

VII.   St. John the Baptist

City Profile

St. John the Baptist is located along the Mississippi River between New Orleans and Baton Rouge. The river divides the Parish into two regions. It is surrounded by Lake Maurepas, Lake Pontchartrain, and Lac des Allemands. These lakes connect the Parish to many waterways and marshes leading to the Gulf of Mexico.[17]

According to the latest data from the US Census Bureau, the Parish's population was 39,955 in 2022 and has shown a decline of 6.2% from 2020 to 2023.[18] The majority of people living in the Parish, about 59.3%, identify as Black or African American alone, while approximately 36.9% identify themselves as white alone. The Parish's median household income is $65,114. The labor participation rate is 50%, lower than the Louisiana state average of 60.9%. Additionally, 15.7% of the population lives below the poverty line.[19]

St. John the Baptist Parish's economy is supported by a mix of industries, including manufacturing and services such as accommodation and food, healthcare and social assistance, transportation and warehousing, and retail sales.[20] But it is predominantly driven by the industrial economy where it is home to 135 petrochemical plants, including oil refineries, chemical manufacturing facilities, including big companies such as Marathon Petroleum Corporation, Denka Performance Elastomer, Nalco Champion, and Dupont.[21] [22]

Due to its location, the Parish faces several climate impacts, including flooding, land loss, tropical storms, and heat waves. The Parish is especially susceptible to hurricanes and has been hit by significant storms such as Hurricanes Katrina and Rita in 2005 and Hurricane Isaac in 2012.[23]

Regarding health, the Parish faces challenges related to overall environmental degradation, particularly air quality and industrial pollution, affecting the risks of cancer, cardiovascular, and respiratory illnesses. The Environmental Protection Agency has identified several census tracts in St. John the Baptist with a high concentration of petrochemical facilities and elevated cancer risk.[24] The area's health concerns are also related to income, poverty, lack of insurance affordability, and an aging population. Older adults, for example, face challenges when preparing for and recovering from disasters, particularly when combined with poverty, lack of insurance, and other factors.[25]

City Progress

In response to climate-related risks, Louisiana State and St. John the Baptist Parish have developed various strategies, plans, and projects to foster resilience and adaptation, including the Louisiana Comprehensive Master Plan for Sustainable Coast, Louisiana's Strategic Adaptations for Future Environments (LA SAFE) and the Hazard Mitigation Plan:

1. *Louisiana's Comprehensive Master Plan for a Sustainable Coast*

In 2005, the Louisiana Legislature created the Coastal Protection and Restoration Authority (CPRA) to develop a comprehensive master plan to protect and restore the state's coastal

areas. This plan is a scientifically-based framework that focuses on coastal restoration and protection and provides context for evaluating other activities within the coastal zone, such as transportation, navigation, port projects, oil and gas development, groundwater management, and land use planning.[26]

2. *LA SAFE, Regional, and Local Adaptation Strategies*

LA SAFE is the Adaptation Strategy developed by the state, particularly in the face of floods, to take a holistic approach to addressing climate impacts on communities. In 2019, the Louisiana Office of Community Development (OCD) and the Foundation for Louisiana (FFL) launched the LA SAFE initiative comprising multidisciplinary experts, residents, and stakeholders to develop a plan that integrates structural risk reduction systems and ecological restoration efforts with a forward-thinking approach to urban planning and development.[27]

The local plan for St. John the Baptist Parish includes five main adaptation goals: 1) Manage flood water/stormwater and subsidence; 2) Direct growth to low-risk areas; 3) Improve mobility throughout the Parish and region; 4) Protect and promote historical and cultural assets; and 5) Strengthen and diversify the local economy by enhancing coordination among schools and local industry. It outlines specific projects and actions, such as improving drainage infrastructure, elevating homes, and creating wetland buffers to help the Parish adapt to coastal land loss and flooding impacts:[28]

3. *Hazard Mitigation Plan 2021*

The Hazard Mitigation Plan Update (HMPU) was developed as "the first of the four phases of risk management. It is followed by preparedness, response, and recovery".[29] The HMPU proposes strategies that utilize long-term risk assessment, climate modeling, and relocation approaches for land loss areas. The hazards identified include drought, expansive soils, flooding, thunderstorms, tornadoes, tropical cyclones, and winter storms. The potential destructive power of tropical cyclones has been determined to be the most common hazard to the Parish, making hurricanes the primary focus of the mitigation planning process.[30]

St. John the Baptist Parish defines **resilience** as "*the ability to anticipate, prepare for, and adapt our community to changing environmental conditions in order to lessen the impact of future hazards.*"[31] To plan for resilience and mitigate hazards, "communities can prepare for future hazards, implement adaptation strategies that make the Parish more suitable to changing environmental and economic conditions, and develop response and recovery procedures to be implemented immediately after a disaster strikes."[32] The Parish's path to achieving resilience is outlined in the ordinance of the plans previously described, and five Resilience Projects are currently underway.[33]

Figure 3. St John the Baptist's on-going Resilience Projects.[34]

1. **Airline and Main Complete Streets**—The Project aims to transform Airline Highway and Main Street in LaPlace by providing green infrastructure and transportation improvements.

2. **Lake Pontchartrain Shoreline Protection**—The Project will use breakwaters to create a resilient shoreline, reducing erosion, stabilizing the shoreline, and building up sediment.

3. **Belle Terre Streetscape and Stormwater Enhancements**—The Project will enhance a major Parish corridor by incorporating green infrastructure to alleviate localized flooding within the Lake Pontchartrain Basin, improve clean mobility, and alleviate local drainage.

4. **Resilient Housing Plan**— This Plan aims to reduce damage and loss to current housing, improve disaster recovery funding processes, and enhance planning and building standards for new/renovated housing to withstand future storms.

5. **Sunset Park Restoration**— The restoration will include shoreline protection measures like rip rap, backfill bank stabilization, and planting of native marshland plants, trees, grasses, and flowering species to stabilize the area.

Climate and Health Vulnerability Analysis

We used the CVI to analyze the top drivers causing overall climate vulnerability within St. John the Baptist. This section highlights the top drivers causing such vulnerability with

scores greater than or equal to the 75th national vulnerability percentile. For additional detail about drivers and indicators, see Appendix 4.

According to the CVI, St. John the Baptist is the most vulnerable Parish in Louisiana and ranks in the 100th national percentile for overall climate vulnerability when weighting environmental, social, economic, and infrastructure factors. Closer examination reveals intersecting drivers and harsh realities demanding action.

Transportation infrastructure deficits, including limited road access, public transit, and road flooding risks place it in the 99th national percentile vulnerability. Access to financial services fares no better, with a 99th percentile ranking reflecting many unbanked households, prevalence of predatory lending, and housing affordability. Gaps in governance further compound matters, as the 96th percentile reflects low tax revenues constraining the provision of vital public services like housing.

The environmental ramifications prove just as staggering and inextricably linked to the proliferation of industrial facilities. At the 96th percentile for exposures and risks, residents face health hazards from toxic air pollutants known to cause cancer, respiratory, thyroid, neurological, kidney, and immunological diseases. This toxic onslaught is compounded by the 91st percentile density of polluting chemical plants, manufacturers and facilities with environmental violations.

Unsurprisingly these community baseline drivers have devastated community health and wellbeing in multiple ways. The Parish ranks in the 98th percentile for mental health burdens like depression and drug overdose deaths. Infectious disease vulnerabilities are also at a dire 97th percentile level, with elevated rates of HIV, chlamydia and syphilis. The 96th percentile ranking for child and maternal health illustrates the intergenerational toll, with inadequate ADHD treatment, high prevalence rates, and preterm births jeopardizing the youngest residents' futures.

Conclusion

The CVI data reveals a harsh truth, St. John the Baptist's climate vulnerability is inextricably linked to and exacerbated by entrenched environmental and health injustices that have long festered. Current resilience plans take positive steps in certain areas like stormwater management, housing, and economic diversification. However, they overlook the critical threats of toxic industrial pollution and poor community health outcomes.

Enhancing environmental justice by reining in toxic exposures and stringently regulating polluting facilities must become a top priority, as St. John's percentile rankings demonstrate a public health emergency. Concerted efforts to improve healthcare access, youth services, and disease prevention are also urgently needed to alleviate the burdens of mental illness, infectious diseases, and inadequate child and maternal care. Most critically, resilience can only be realized by prioritizing robust community engagement and accountability to directly confront these injustices in a meaningful way alongside adapting to climate impacts.

While the challenges are daunting, St. John the Baptist represents an opportunity to learn from past injustices and chart a new path towards holistic resilience and environmental

justice. By centering the lived experiences of overburdened residents and directly addressing the cumulative impact of pollution and systemic disadvantages, the Parish can become a model for building genuine resilience that leaves no community behind. Moving forward will require an unwavering commitment to remediating environmental health hazards, improving healthcare access, prioritizing youth support services, and ensuring robust community engagement. Through this inclusive approach, St. John the Baptist can transform from a vulnerable zone into a resilient community where no resident's wellbeing and human rights are compromised.

Policy Recommendations

To address the vulnerabilities identified after conducting the Climate and Health Vulnerability Assessment on St John the Baptist Parish, we developed a set of policy recommendations for policymakers in areas particularly overlooked. This table can assist the local government of St. John the Baptist in enhancing its resilience plans by addressing the community's urgent needs regarding climate and health vulnerabilities. Additionally, we have included a list of funding options that can support the recommended actions.

Table 1: Policy recommendations for St. John the Baptist

Policy Name	Description	Timeframe	Funding options	Theme	CVI Driver
Develop a comprehensive Public Transit Plan	Create a long-term public transit plan that identifies the current and future needs of the community's vulnerable population and outlines strategies for improving service frequency, coverage, and reliability.	Mid term (1-5 years)	PROTECT Grant Program, DOT Mobility of Seniors & Individuals with Disabilities	Infrastructure	Transportation
Financial literacy campaigns and/or Financial empowerment centers	Implement community-wide financial education initiatives. These may include workshops, online resources, and collaboration with local education organizations. Topics can cover budgeting, saving, credit/lending management, and financial planning.	Short term (<1 year)	U.S. Department of Housing and Urban Development, Partnerships with financial institutions	Infrastructure	Financial Services
Increase the access to financial services for low-income populations	Partner with local Financial Institutions/Community Development Financial Institutions (CDFIs) to support underserved communities by offering affordable micro-loans, small business loans, and housing assistance to help residents build credit.	Short term (<1 year)	Partnerships with financial institutions	Infrastructure	Financial Services and Governance

Policy Name	Description	Timeframe	Funding options	Theme	CVI Driver
Review and update the Parish's Real Estate Tax policies	Assess the current real estate tax structure and identify areas for improvement. This may involve conducting a comprehensive review of tax exemptions, incentives, and assessment practices to ensure that the system is fair, equitable, and responsive to the needs of the community.	Mid term (1-5 years)	N/A	Infrastructure	Governance
Build a Sustainability Team	Funding to build a team of sustainability staff to develop a plan addressing the connection between climate change and health in the Parish. The team will then implement policy actions and fundraise for the plan.	Mid term (1-5 years)	EPA Climate Pollution Reduction Grants, Barr Foundation	Infrastructure	Governance
Strengthen partnerships with non-profit organizations and community-based groups	Collaborate with local non-profit organizations and community groups aiming to expand access to affordable housing and support services for low-income residents. This can involve funding, technical assistance, or other resources.	Short term (<1 year)	Barr Foundation, Community Development Block Grants (CDBG), in-kind contributions from stakeholders within the Paris	Infrastructure	Governance
Build a Community Advisory Board	Create a Community Advisory Board to promote better communication and collaboration between communities and local government, and to develop feasible implementation plans in the Parish.	Short term (<1 year)	Barr Foundation, Community Development Block Grants (CDBG), in-kind contributions from stakeholders within the Paris	Infrastructure	Governance
Environmental Regulation Enforcement	Enforce environmental regulations on industrial facilities related to climate and health impacts and strengthen local enforcement and penalties for facilities violating EPA regulations under TSCA or other environmental laws.	Short term (<1 year)	EPA Climate Pollution Reduction Grants	Environment	Exposure & Risks/Pollution sources
Clean Ports initiative	Collaborate with port authorities and industry stakeholders to develop a comprehensive plan for reducing air pollution and greenhouse gas emissions resulting from port operations. This plan could include implementing shore power systems for docked ships, promoting the use of alternative fuels and electric vehicles for cargo handling equipment, and investing in infrastructure improvements to reduce congestion and idling time.	Mid term (1-5 years)	EPA's Clean Ports Program (IRA)	Environment	Transportation pollution sources

Policy Name	Description	Timeframe	Funding options	Theme	CVI Driver
Increase healthcare access to child, maternal and mental health services	By fostering collaboration with state-level health institutions, expand community health centers, partner with telehealth providers, and implement mobile treatment units focusing on underserved communities.	Short term (<1 year)	CDC's Overdose Data to Action program, Health Resources and Service Administration Grants	Community Health	Mental health & deaths of despair
Mobile health program for HIV, Chlamydia, and Syphilis prevention	Develop an "Mobile health" program to increase healthcare access and prevention, especially for infectious diseases in underserved communities, utilizing accessible phone technologies.	Mid term (1-5 years)	HHS Environmental Justice Community Innovator Challenge; Partnership with healthcare providers, insurance, and Medicaid	Community Health	Infectious diseases
Heat illness prevention program for outdoor workers	Develop a comprehensive program that may include mandatory rest breaks, access to shade and water, and heat safety training for workers and supervisors; policies that require employers to monitor heat conditions and adjust work schedules or tasks as needed; and provision of appropriate protective equipment like cooling vests and breathable fabrics.	Mid term (1-5 years)	HHS Mitigating Heat Stress in Vulnerable Populations Program	Social & Economic	Economic & productivity losses
Sustainability plan for GHG reduction and community health	Develop a Sustainability Plan with industrial companies in the Parish to reduce GHG emissions and improve community health.	Short term (<1 year)	EPA Climate Pollution Reduction Grants; EPA Environmental and Climate Justice (ECJ) Grant Program , Barr Foundation, Partnerships with private sector	Social & Economic	Transition risks
Resilience HUBs (Cooling Centers & Warming and Disaster Shelters)	Resilience hubs could provide services day-to-day and during disasters and weather events (i.e. heat waves). St John the Baptist resilience hubs should be equipped as cooling and warming centers. Hubs should be near the homeless population/senior living facilities and easily accessible by those who do not own a vehicle.	Mid term (1-5 years)	Emergency Food and Shelter Program (future funding rounds); EPA Environmental and Climate Justice (ECJ) Grant Program	Climate Health	Temperature and disaster-related deaths

VIII. Grand Prairie

City Profile

Centrally located in the Dallas-Fort Worth-Arlington Metropolitan Statistical Area, the city of Grand Prairie is home to over 197,000 residents, as of 2022. Since 2012, the City's population has grown by 13 percent, with a compound annual growth rate of 1.1 percent. The Hispanic population makes up 48 percent of its population, followed by 20 percent White, 23 percent Black or African American, and 7 percent Asian. With its growth, the City is becoming more racially diverse. Between 2012 and 2022, the share of Hispanic, Black or African American, and Asian population increased, while the share of White population decreased. Grand Prairie is relatively young, with the median age being 33.7 years compared to 38.5 years nationally.

The median household income of Grand Prairie is over $76,000. Aerospace, education, and manufacturing industries make up a significant portion of its economy. Top employers include Lockheed Martin Missiles and Fire Control HQ, Grand Prairie Independent School District, and Poly-America Inc. Grand Prairie faces environmental and social risks as it continues to grow. Environmental and physical risks include poor air quality, extreme heat and winter, and flooding and drought. Social and health risks consist of lack of English fluency, old housing stock, and low access to healthcare and quality foods.

City Progress

A key area of focus for Grand Prairie has been in improving air quality. The Environmental Protection Agency (EPA) has designated severe ozone nonattainment areas in the city, where air pollution levels persistently exceed the national ambient air quality standards. Poor air quality has health implications, such as coughing, asthma attacks, and chest pain. To address this, the city has been conducting data collection activities pertaining to greenhouse gas emissions. The city has also been involved in various emission reduction efforts through various policies and city-wide initiatives.

Climate and Health Vulnerability Analysis

In this analysis, we examined overall climate vulnerability at the census tract level because the higher resolution enables a more granular understanding of communities that are most vulnerable. We identified census tracts with overall climate vulnerability scores greater than or equal to the 75th national vulnerability percentile. We found that nine census tracts within Grand Prairie met this criterion, representing the areas of the community most vulnerable to climate change impacts.

These census tracts are concentrated in northern Grand Prairie, reflecting the reality that vulnerability is not geographically evenly distributed across the city. Some communities in Northern Grand Prairie are more vulnerable and require intentional policy responses to reduce climate vulnerability.

Community baseline vulnerability was much higher than climate impact vulnerability in these census tracts, suggesting that efforts to reduce vulnerability should focus on addressing long-standing inequities and injustices within Grand Prairie. The drivers of community baseline vulnerability include Chronic Disease Prevention, Pollution Sources, Transportation, Financial Services, Communications, Socioeconomic Stressors, Governance, Access to Care, Food, Water, and Waste Management, and Housing Type and Transportation. Of these community baseline vulnerability drivers, we focus our discussion here on the most common drivers among the most vulnerable census tracts. For further detail on all drivers and indicators, see Appendix 6.

Of the nine census tracts with high climate vulnerability, all have Chronic Disease Prevention as one of their top three drivers of community baseline vulnerability. Within the Chronic Disease Prevention driver, the low percentage of colonoscopy exams for adults was a top indicator for eight census tracts. Our interviews with government officials noted that air quality, water quality, and food desserts/access to nutritional foods also contribute to prevalence of chronic diseases. These findings indicate that there is a need to increase participation in disease prevention measures, especially increasing the rate of colonoscopy screenings in adults.

Pollution Sources are a top driver of vulnerability in high vulnerability census tracts in Grand Prairie. Pollution sources are in the top three drivers of vulnerability for half of the vulnerable census tracts. Nine counties in North Texas, including Dallas County and Tarrant County which are located in Grand Prairie, exceed the national ambient air quality standards, according to the EPA. In response to this issue, Grand Prairie is conducting a greenhouse gas inventory for its municipal operations in order to identify baseline emissions levels and sources and activities generating emissions. This points to the need to mitigate and manage sources of pollution within these communities.

In addition, Transportation is a top driver in one-third of the high vulnerability census tracts and was a consistent theme throughout our interviews. Addressed in our interviews as well as the 2018 Comprehensive Plan update, the lack of public transportation creates difficulties for residents, such as accessing healthcare services.

In terms of climate impacts, important drivers of vulnerability are transition risks, disaster-related deaths, Temperature-related deaths, and Economic & Productivity Losses. Specifically, transition risks are a top driver for all vulnerable census tracts in Grand Prairie. Methane emissions and the state energy-related carbon dioxide emissions are top indicators associated with transition risk. These indicators signal a need to reduce greenhouse gas emissions to reduce vulnerability in these communities.

Disaster-related deaths drive climate vulnerability in 8 of the 9 most vulnerable census tracts in Grand Prairie. In addition, temperature-related deaths drive climate vulnerability in half of the most vulnerable census tracts. With disaster and temperature-related deaths as drivers of climate vulnerability, it is important for the City of Grand Prairie to design policy interventions that reduce mortality from extreme heat, extreme cold, and natural disaster events.

Furthermore, with Economic & Productivity Losses as an important driver for half of the most vulnerable census tracts, Grand Prairie must create economic development strategies and labor policies to mitigate the impact of lower productivity in jobs with high climate risk and to protect outdoor workers.

Conclusion

Climate vulnerability in Grand Prairie is geographically concentrated in the northern areas of the city and is primarily driven by community baseline characteristics. Drivers such as the chronic disease prevention efforts, pollution sources, and transportation options are particularly important across the majority of the most vulnerable census tracts in the city. The geographic concentration of vulnerability and the specific drivers of vulnerability demonstrate the need for policy responses focused on the most vulnerable communities as well as policy responses that support preventative healthcare, the mitigation of exposure to pollution sources, and an increase in access and quality of transportation.

Within regards to climate impacts, transition risks and disaster and temperature-related deaths are primary drivers of vulnerability in Grand Prairie. Reducing GHG emissions can help reduce transition risks. While Grand Prairie has started with its municipal GHG inventory, additional actions and policies will be needed to further reduce vulnerability. Policy interventions focused on reducing mortality associated with extreme temperatures and disaster events are likely to be overlapping and will improve overall resilience.

While there are various drivers of climate vulnerability in Grand Prairie, this vulnerability assessment offers guidance to facilitate focus on the most vulnerable areas and the most significant sources of vulnerability. Using this information to develop climate and health policies, the City of Grand Prairie can enhance community health, well-being, and resilience.

Policy Recommendations

After conducting a Climate and Health Vulnerability Assessment and analysis of the strengths, weaknesses, opportunities, and threats (SWOT) in Grand Prairie, we developed a set of 25 policy recommendations (Table 2). This table can assist the City of Grand Prairie in enhancing their resilience plans by addressing the urgent needs of the community regarding climate and health vulnerabilities. Additionally, we have included a list of funding options that can support the recommended actions.

Table 2. Policy recommendations for Grand Prairie

Policy Name	Description	Timeframe	Funding options	Theme	CVI Driver
Education and Public Awareness for preventative screenings	Promote of preventative screenings including colonoscopy screenings, dental exams, high blood pressure screenings, older women and men preventative screenings, and routine doctor and dental visits.	Mid term (1-5 years)	Partnership with healthcare providers, insurance, and Medicaid	Community Health	Chronic Disease Prevention
Increase healthcare access by supporting existing health clinics in becoming Federally Qualified Health Centers	Engage Texas Association of Community Health Centers (TACHC) to expand capacity of existing clinics to apply to become FQHCs.	Mid term (1-5 years)	Bureau of Primary Health Care Grants; Support from Texas Association of Community Health Centers; Texas Health and Human Services FQHC Incubator Program	Community Health	Chronic Disease Prevention
Mobile & Pop-up healthcare clinics	Partner with healthcare providers to create mobile healthcare clinics and/or pop-up clinics. Explore partnership with University of North Texas Health Science Center at Fort Worth/Texas College of Osteopathic Medicine.	Short term (<1 year)	HHS Environmental Justice Community Innovator Challenge; Partnership with healthcare providers, insurance, and Medicaid	Community Health	Chronic Disease Prevention
Partner with banks to serve unbanked population	Engage with banks to educate residents about opening a bank account and to provide banking services to underserved populations.	short term (<1 year)	Funding from banks' customer acquisition budgets	Social & Economic	Financial Services
Increase access to quality foods	Provide tax incentives to attract grocery stores to food deserts; explore pilot programs to expand access to locally grown produce.	Mid term (1-5 years)	Specific incentive(s) created by Economic Development Department specifically for grocery stores; Senior Farmers Market Nutrition Program; Gus Schumacher Nutrition Incentive Program	Community Health	Food, Water, and Waste Management
Food desert strategy	Partner with COG members to develop strategies to combat food deserts, such as community gardens, tax incentives, etc.	Short term (<1 year)	Healthy Food Financing Initiative's Local and Regional Healthy Food Financing Partnerships Grant Program	Community Health	Food, Water, and Waste Management

Policy Name	Description	Timeframe	Funding options	Theme	CVI Driver
Build City Sustainability Team	Build a team of sustainability staff to develop a sustainability plan, assist with city wide initiatives, and identify and apply for federal funding.	Mid term (1-5 years)	EPA Climate Pollution Reduction Grants	Environment	Governance / Transition Risks
Ozone Action Day Alerts	Partner with Air North Texas to send alerts on high ozone level days to encourage residents to take action to reduce ozone levels through telecommuting, carpooling, reducing driving, avoiding use of lawn mowers, and other actions.	Short term (<1 year)	General Fund; Partnership with Air North Texas	Environment	Pollution Sources
Explore establishing Community Advisory Panels for chemical manufacturing facilities	Establish Community Advisory Panels for chemical manufacturers in the community would facilitate community engagement and add accountability mechanisms to prevent and respond to pollution.	Short term (<1 year)	Chemical manufacturers	Community Health	Pollution Sources
Develop Heat Action Plan	Develop a heat action plan to identify populations most at risk during heat waves and provide solutions and responses to extreme heat and heat waves.	Short term (<1 year)	HHS Environmental Justice Community Innovator Challenge	Community Health	Temperature-related deaths
Heat Mapping	Identify areas (at the block level) that have high temperatures to target heat reduction interventions.	Short term (<1 year)	HHS Environmental Justice Community Innovator Challenge	Community Health	Temperature-related deaths
Cool Roofs	Cover roofs in light and reflective material or paint to prevent absorption of heat and to encourage thermal emittance.	Mid term (1-5 years)	HHS Environmental Justice Community Innovator Challenge	Infrastructure	Temperature-related deaths
Cool Pavements	Pass ordinance to allow the city to choose cool pavements in city projects, even if it is more costly upfront.	Mid term (1-5 years)	HHS Environmental Justice Community Innovator Challenge	Infrastructure	Temperature-related deaths
Green Infrastructure, Trees, & Vegetation	Plant trees and vegetation to increase shade and cooling effects from transpiration.	Mid term (1-5 years)	HHS Environmental Justice Community Innovator Challenge	Infrastructure	Temperature-related deaths
Heat-Resilient Building Materials	Use naturally insulating materials in construction.	Short term (<1 year)	HHS Environmental Justice Community Innovator Challenge	Infrastructure	Temperature-related deaths
Heat Alerts	Use existing emergency communication channels to notify community of dangerous heat conditions.	Short term (<1 year)	HHS Environmental Justice Community Innovator Challenge	Community Health	Temperature-related deaths / Communications

Policy Name	Description	Timeframe	Funding options	Theme	CVI Driver
Resilience HUBs (Cooling Centers & Warming Shelters)	Resilience hubs provide services day-to-day and during disasters. Grand Prairie resilience hubs should be equipped as both cooling and warming centers. Hubs should be near homeless population/senior living facilities and easily accessible by all, regardless of socioeconomic status.	Mid term (1-5 years)	Emergency Food and Shelter Program (future funding rounds); EPA Environmental and Climate Justice (ECJ) Grant Program	Community Health	Temperature-related deaths / Disaster-related deaths
Promote Residential Energy Efficiency Retrofits	Provide information and guidance about residential energy efficiency actions and provide information about available federal tax credits.	Short term (<1 year)	Federal Income Tax Credits and Incentives for Energy Efficiency (for homeowners); Residential PACE Financing	Infrastructure	Transition Risks
Develop sustainability plan	Develop sustainability plan that incorporates community health and GHG reduction activities.	Short term (<1 year)	EPA Climate Pollution Reduction Grants; EPA Environmental and Climate Justice (ECJ) Grant Program	Environment	Transition Risks
Heat-resilient & energy efficient building materials in new commercial developments	Identify and incentivize use in heat-resilient & energy efficient building materials in new commercial developments.	Short term (<1 year)	HUD Green Resilient Retrofit Program; Energy-Efficient New Homes Tax Credit for Home Builders; Commercial PACE Financing	Infrastructure	Transition Risks
Campaign to accelerate EV infrastructure construction	Coordinate with local cities and Oncor to accelerate EV infrastructure construction.	Mid term (1-5 years)	DOE Grid Innovation Program; FTA Low or no Emission Vehicle Program	Infrastructure	Transportation
Expand Via Grand Prairie Rideshare app	Increase public awareness of the app and increase levels of service by increasing number of drivers.	Short term (<1 year)	DOT Neighborhood Access and Equity Grant Program; DOT Enhanced Mobility of Seniors with Disabilities Formula Funding	Infrastructure	Transportation
Expand clean transportation options through private partnerships	Partner with commuting private companies (uber, lime, etc) to promote clean transportation options.	Short term (<1 year)	DOT Neighborhood Access and Equity Grant Program	Infrastructure	Transportation

Policy Name	Description	Timeframe	Funding options	Theme	CVI Driver
Electrify Via Grand Prairie Fleet	Engage Via to electrify Via Grand Prairie fleet.	Mid term (1-5 years)	Via; DOT Neighborhood Access and Equity Grant Program; DOT Enhanced Mobility of Seniors with Disabilities Formula Funding; Qualified Commercial Clean Vehicle Tax Credit	Infrastructure	Transportation
Investigate public transportation system options	Conduct preliminary studies to assess the need and feasibility of developing a public transportation system in Grand Prairie..	Long term (5+ years)	General Fund	Infrastructure	Transportation

IX. Lessons Learned

Throughout our project, we found several learnings related to urban resilience policymaking that are relevant to other communities across the US. Informed by our experience in the project and engagement with local governments and EDF staff, we developed recommendations to increase the impact and reach of EDF's CVI and its Climate & Health Catalyst Program.

Implications of Policy Research Project

This Policy Research Project demonstrates how EDF's Climate & Health Catalyst Program can engage specific communities to develop policies to enhance resilience. It presents an approach to localize and apply analysis based on the CVI to identify and prioritize climate and health policies. The project proves that climate vulnerability must be assessed at the local level and that recommended policies should be customized to reflect each community's unique challenges, assets, and values. This approach can be replicated across US communities.

The engagement with St. John the Baptist Parish provides a case study for how to develop a Climate and Health Vulnerability Assessment and develop relevant policies for a small community with significant climate and health vulnerabilities and the presence of high-polluting industries.

The approach and findings for Grand Prairie provide a model for mid-sized, suburban communities. While climate vulnerability and resilience have been important areas for local governments, much of the literature and funding has been focused on large and high-profile cities, leaving an unaddressed gap for smaller communities that have access to fewer resources. The project demonstrates how policies could be adapted for communities like Grand Prairie.

Recommendations for the EDF Climate & Health Catalyst Program

To continue to advance the impact of EDF's Climate & Health Catalyst Program, we present several recommendations related to stakeholder engagement and specific improvements to the CVI.

Strategically engage stakeholders to accelerate climate and health policy development

A critical component to advancing climate and health policies in cities is educating stakeholders about how climate change is interconnected with health outcomes and how social determinants of health influence climate vulnerability at the community level. We recommend that EDF invests in an on-going education campaign targeting key decision-makers in local and state governments to raise awareness and understanding about how climate and health impact community vulnerability to climate change and overall community resilience. Increased awareness of this issue will position decisionmakers to create policies that address climate change impacts and health as well as invest in the programs and infrastructure to enhance resilience.

As part of this campaign, EDF should build upon its "train the trainers" approach to quickly increase local government capability to use the CVI. The "train the trainer" approach would equip trainers within organizations to teach others within their respective organizations how to use the CVI. Training could be focused on using the CVI to understand community climate vulnerability, to support advocacy, to support grant applications, and to develop climate and health policies. Partnering with Metropolitan Planning Organizations and community-based organizations would enable EDF to reach key local government and community stakeholders at scale.

EDF should create cohorts of local governments to address specific climate impacts or social determinants of health. These cohorts would provide support and knowledge sharing among local governments. Through these cohorts, EDF could share best practices and examples of local governments implementing vulnerability assessments and resilience plans.

In addition to engaging local governments, EDF should strategically engage with universities in order to provide additional support to local governments. EDF should engage universities to encourage the use of CVI data in master's and doctoral theses. EDF could establish research partnerships between the local governments and local educational institutions to support the local government's use of the CVI in developing Climate and Health vulnerability assessments and to develop policies based on priorities identified through the vulnerability assessment.

Improve the CVI to enhance usability and utility for local governments and key stakeholders. The CVI is a robust tool to understand climate vulnerability within communities, but users of the tool could benefit from improvements focused on applying the tool to local contexts. For example, case studies that demonstrate how to use the tool for specific purposes, such as grant applications or to support the development of a Heat Action Plan, would help users better understand its capabilities and to leverage it better.

Directly linking drivers of vulnerability to available resources, such as funding resources identified at EDF's and Columbia Law School's Sabin Center for Climate Change Law's Inflation Reduction Act Tracker (iratracker.org), would also further enhance the tool's value. In addition, the overlay of more data types beyond CSV files could enable local governments to analyze climate vulnerability data alongside local data such as roads, evacuation routes, heat maps, and other continuous datasets. Enabling the upload of shapefiles would also greatly enhance the CVI's usability.

X. Conclusion

Climate change poses an existential threat to human health and well-being, with far-reaching consequences that disproportionately impact vulnerable communities. Addressing this complex challenge requires a multifaceted approach that integrates robust stakeholder engagement and data-driven decision making.

This project demonstrated the power of localized climate vulnerability assessments and tailored policy recommendations in empowering communities to build resilience. By partnering with Grand Prairie and St. John the Baptist, the EDF's Climate & Health Catalyst Program exemplified the importance of understanding each community's unique challenges, assets and values.

Moving forward, sustained commitment and collaboration are crucial. Local governments must prioritize capacity-building initiatives, foster partnerships with community-based organizations and engage all stakeholders to raise awareness and drive policy change. Simultaneously, the EDF should refine and enhance tools like the CVI, making them more accessible and user-friendly for local decision-makers.

Ultimately, the path to resilience lies in recognizing the inextricable link between climate change, health outcomes, and SDOH. By addressing systemic inequities, mitigating environmental hazards, and investing in proactive adaptation strategies, communities can safeguard the well-being of present and future generations.

This project represents a significant step towards climate resilience, but the journey ahead remains long and arduous. Through collective action, unwavering dedication, and a shared vision of a sustainable, equitable future, we can overcome the challenges posed by climate change and build a world where every community can thrive.

XI. The LBJ School of Public Affairs and the Policy Research Project

As part of the core curriculum for the Master of Public Affairs and Master of Global Policy Studies programs, students at the LBJ School of Public Affairs are required to complete a two-semester long policy research project (PRP). Designed for gaining hands-on experience in policymaking, the PRP connects teams of students with external clients to address a complex policy issue in a real-world context. In this particular PRP model, teams select the clients based on their organization, policy issue, and proposed projects. After an agreement is reached on project proposal and work plan, teams begin project work with continuous client engagement. By the end of the academic year, student teams complete and submit a comprehensive policy report and present deliverable findings at the PRP Open House.

XII. The Team

Alejandra Tapia, Master in Global Policy, LBJ School

Alejandra has 12 years of experience in the social and private sectors. She received her undergraduate degree in Sociology from the National Autonomous University of Mexico in 2012 and is currently pursuing a Master's Degree in Global Policy Studies, specializing in sustainability at the University of Texas at Austin. Alejandra's professional journey has focused on research, applied strategy, and business development. Prior to her graduate studies, Alejandra was an impact and sustainability independent consultant. She embarked on her professional journey in the non-profit sector and public policy consulting, gaining invaluable insights into the world of social impact. After a few experiences collaborating with the private sector, she realized that business could also be a powerful tool for solving social and environmental problems. This led her to focus her career on social entrepreneurship, small business development, and impact investing. She has worked for organizations such as New Ventures, FUNDES, and BFA Global and collaborated with leaders from different sectors across Latin America. This has given her a unique perspective on key players in the region and how to leverage strategic alliances to create a positive impact.

Viviana Salgado, Master in Global Policy, LBJ School

Viviana holds a bachelor's in Trade and International Business and is pursuing a Master's Degree in Global Policy Studies from the LBJ School of Public Affairs at the University of Texas at Austin with specialization on Sustainable Development. During her 7-year career at Mexico's Ministry of Economy, she negotiated and oversaw compliance of international agreements, as well as developed regulations aimed at addressing market vulnerabilities. Viviana has experience in research, policy analysis and the formulation of strategies engaging diverse national and international stakeholders. She represented Mexico on committees within the World Trade Organization and other international organizations. In her most recent role at BanQu, Inc, Viviana developed a tailored strategy aimed at boosting stakeholder engagement in Mexico with blockchain solutions designed to streamline compliance, procurement, and ESG data collection and reporting for companies. Her work is driven by her passion for international development, social impact, sustainability, and the pursuit of equity.

Allison Hooks, Master of Public Affairs, LBJ School and MBA, McCombs School of Business

Allison earned her BA in Environmental Science with a minor in Political Science from Columbia University. She is pursuing an MBA from the McCombs School of Business and a Masters of Public Affairs from the LBJ School of Public Affairs at the University of Texas at Austin. Prior to her graduate studies, Allison was a manager at CDP, an environmental nonprofit, working with local governments to advance investment in sustainable infrastructure projects. She began her work with local governments as a Climate Corps AmeriCorps Sustainability Fellow with the City of Oakland, CA where she analyzed the city's climate action plan's funding sources. She also worked as a research assistant at Lamont-

Doherty Earth Observatory in New York. Allison is interested in urban sustainability; climate mitigation, adaptation, and resilience; subnational climate finance; and ESG topics.

Rizwaan Lakhani, Master of Public Affairs, LBJ School

Rizwaan graduated with a BS in Economics from the University of Houston. He is currently pursuing a Masters of Public Affairs from the LBJ School of Public Affairs at the University of Texas at Austin. He previously interned for Texas Area Health Education Centers and the Aga Khan Foundation–International Scholarship Program initiative before joining RTI International, where he worked as an Economist in their Health Care Financing and Payment program. Rizwaan contributed to various implementation and evaluation of health care initiatives, particularly for the Center for Medicare & Medicaid Innovation. He later transitioned into the Center for Applied Economics and Strategy program, where he provided research and analytic support in the areas of innovation policy, economic growth and competitiveness, and workforce development. He has experience in collecting and analyzing data from federal sources, conducting literature reviews, designing quality control processes, and contributing to state-level strategic plans and technical reports.

XIII. Appendices

Appendix 1: Literature Review

Introduction

Climate change poses novel risks and exacerbates existing vulnerabilities, presenting growing challenges to human well-being, including health and safety, as well as quality of life and the pace of economic development.[35] The health issues attributed to or exacerbated by climate change encompass respiratory and cardiovascular diseases, injuries, and premature fatalities associated with extreme weather events. Additionally, climate change can harm global and domestic food security by jeopardizing food safety, disrupting food distribution and availability, reducing access to food, and raising food prices.[36] Moreover, climate change heightens the risk of waterborne illnesses and other infectious diseases and poses threats to mental health by triggering post-traumatic stress and increasing suicide risk, especially among vulnerable groups such as those with a low socioeconomic status.[37,38]

Not everyone is equally at risk. Vulnerability to health hazards varies depending on geographical location and social determinants of health (SDOH). These determinants encompass a broad spectrum of environmental conditions impacting where people are born, reside, learn, work, engage in recreational activities, worship, and age. They significantly influence diverse health outcomes and risks, spanning from safe housing, transportation, and community safety to issues like racism, discrimination, and violence. Moreover, factors such as educational access, employment prospects, income levels, availability of nutritious food, opportunities for physical activity, and environmental pollution also play crucial roles.[39,40]

A person's vulnerability to climate change health risks depends on three factors: their level of exposure, their sensitivity to these risks, and their ability to respond or adapt to climate variations and changes.[41] Depending on the context, people with high levels of vulnerability to climate may include women and girls, children, older adults, outdoor workers, and impoverished people. These individuals with higher levels of vulnerability possess limited ability to prepare for and cope with climate-related impacts and are anticipated to endure the most significant consequences.[42]

Given that the intersection of climate impacts and SDOH influences overall climate vulnerability, local governments require information and policy recommendations that consider the intersection of climate and health factors. The Environmental Defense Fund (EDF) launched the Climate and Health Catalyst Program to support local governments in addressing climate and health issues through the use of data-driven tools and resources to support urban resilience planning. To help EDF pilot and localize its Climate and Health Catalyst Program, we pose the following research questions:

1. How well do local governments understand the impacts of climate vulnerability on their communities?

2. How do local governments use data to develop policies to advance community well-being?
3. What strategies are needed for local governments to enhance their communities' health, well-being, and resilience?

This literature review contributes to the understanding of the above research questions by covering the following topic areas:

- The need for local government resilience planning and adaptive governance
- Multiple understandings of resilience by local governments
- Resilience frameworks for local governments
- Local governments' understanding of climate vulnerability

Local government resilience planning and adaptive governance are needed to address climate impacts on health

As the pace of environmental and social changes accelerates, resilience planning at the local level is essential to mitigate negative social and health-related impacts. Throughout the Climate and Health Catalyst Program, the LBJ team will use ***resilience planning* as a strategic approach that enhances the capacity of communities and individuals to adapt and withstand climate change impacts.**[43] Just as *vulnerability* to climate change health risks is defined by the level of exposure, sensitivity, and ability to respond or adapt to climate threats, *social resilience* is about the combination of coping, adaptive, and transformative capacities.[44] It represents a paradigm shift in local-level strategy implementation, moving beyond only large infrastructure development projects towards strategies that help local populations "fend for themselves" and manage climate crisis events through a systems-thinking method.[45]

Recent approaches to resilience planning shifted their focus from *prevention* to *preparedness* (being ready to handle a crisis) and *preemption* (taking anticipated action to prevent a threat before it occurs). This change represents an acceptance of certain crises as inevitable, redirecting efforts toward identifying vulnerabilities and strengthening response capabilities to climate impacts. Emphasizing anticipation, adaptation, and individual responsibility, resilience planning addresses the increasing unpredictability of climate changes, representing a significant evolution in how societies prepare for and respond to these challenges.[46]

The impact of climate on cities' health differs depending on the population's characteristics and vulnerability and the physical location, making it critical for governments at the local level to understand their specific challenges and develop tailored policies based on accurate data and climate equity. This approach aims to recognize and address the unequal burdens on vulnerable populations while ensuring that all people share the benefits of climate protection efforts.[47]

Adaptive governance and public participation are critical in creating resilient cities. This concept refers to how government institutions can manage the complexity and

unpredictability associated with socio-ecological systems amidst change and uncertainty. Traditional top-down, state-centered governments often struggle with the scale and complexity of socio-environmental systems, but adaptive governance emerges as a more suitable approach. This way, communities can be integrated into the decision-making process by using bottom-up approaches, local knowledge, and other community-based forms of collaboration.

According to the literature reviewed, effective resilience strategies must ensure *distributional equity* (fair distribution of resources), *procedural equity* (inclusive and representative decision-making processes), and *recognitional equity* (acknowledging and addressing underlying inequalities).[48] Effective resilience plans may include key indicators such as public outreach, education, community-based collaborations, and partnerships.[49]

Recent empirical studies have shown that climate adaptation policies, if not carefully designed to integrate social and vulnerability considerations, can otherwise heighten inequalities and reinforce power asymmetries, adversely affecting marginalized and underprivileged groups.[50] As urban systems are complex and interconnected, a holistic approach that integrates social justice and equity must be considered in resilience planning to address all community members' diverse vulnerability to climate change health risks and anticipate future exacerbated problems. For example, a New Orleans and Phoenix study found that their resilience plans focused on reducing carbon emissions but paid little attention to socio-environmental relations and social justice. In Los Angeles, another study shows that stormwater management can intensify the lack of access by low-income communities to parks, having other unintended consequences.[51, 52]

Local governments use multiple definitions in resilience planning

The concept of *resilience* is multi-faceted, drawing from market and complex systems theories. It has been adopted in different fields, reflecting a growing recognition of the interconnectedness of ecological, social, economic, and security issues. In the context of urban development, it represents a departure from traditional planning, emphasizing strategic thinking about probability and risk.[53] Lambrou and Loukaitou-Sideris (2022) describe city resilience "as a measure of how well a city would function in the face of a natural or human-caused disturbance."[54] Over the last decade, this concept has gained significant traction in urban planning, providing input into how societies prepare for and respond to future threats, including climate change. For instance, cities can reduce the negative impacts of climate change by analyzing trends, diversifying their economies, focusing on emerging industries, and ensuring future stability and recovery through adaptive infrastructure, technological investments, and anticipation policies.

In the last decade, several cities in the US have sought to develop resilience plans, which include goals and implementable actions to protect them from disaster and respond to climate change. These plans may differ depending on how resilience is conceptualized and formulated and for whom.

Lambrou and Loukaitou-Sideris (2022) analyzed and evaluated 38 large US cities' resilience plans. These plans provide insights into how local governments define resilience and conceptualize goals and implementation strategies while addressing equity issues. The

authors use *engineering resilience* and *ecological resilience* as lenses to analyze the definitions, each leading to different strategies and interventions. The importance of these concepts in the context of cities and planning lies in their influence on how urban areas prepare for and respond to disturbances while preparing for the future.

- *Engineering Resilience* views resilience as the ability of a system, such as a city, to return to a stable equilibrium state after a disturbance. The focus is on the system's strength to withstand external shocks and bounce back to its original state. This perspective has influenced government actions for disaster response, often aspiring to make cities "bounce back" to a previous "normal" condition.[55] For example, the city of San Francisco uses the concept of resilience as "the capacity of individuals, communities, institutions, business and systems within a city to survive, adapt and grow, no matter what kind of chronic stresses and acute shocks they experience."[56]

- *Ecological Resilience* acknowledges that ecosystems, including urban ones, are not in equilibrium but are constantly evolving. It accepts the existence of different equilibria and multiple possible stable states, focusing on adaptability to change and uncertainty. A city exhibiting ecological resilience cannot only persist through disturbances but also adapt and evolve in the aftermath, potentially reaching a better state than before the disaster.[57] The New Orleans plan provides an example of ecological resilience by defining the term as "striking a balance between human needs and the environment that surrounds us while also combating the chronic stresses of violence, poverty, and inequality."[58]

Lambrou and Loukaitou-Sideris (2022) conclude that local governments *define* resilience planning in varying ways, with a minority incorporating an ecological perspective and the majority focusing on engineering resilience. Meanwhile, a few cities do not explicitly define resilience in their plans, indicating diversity in how local governments conceptualize and approach resilience planning.

Local governments' resilience planning *visions* generally highlight environmental and climate change topics, including adaptation strategies, sustainability, and emissions reduction. Social themes such as community, safety, strength, and health are also prominently featured. However, while aspirations for equity and justice are common, issues related to disparities, inequalities, and vulnerabilities receive comparatively less focus.

From our project's perspective, the ecological approach aligns with the need for resilience planning to intersect with considerations of equity, governance, and public participation, offering more comprehensive and forward-thinking solutions to urban challenges regarding climate and health.

Local governments require resilience frameworks to develop and implement resilience plans

Facing multiple resilience challenges, local governments require a framework to guide resilience planning and decision-making. Using a framework facilitates understanding of factors that influence resilience and identifying the most effective actions and

investments.[59] For the purposes of this project, we have decided to use two different resilience frameworks to tailor our policy recommendations to the specific needs of our two city partners.

City Resilience Framework

One of the more widely used urban resilience frameworks is the Rockefeller Foundation's 100RC City Resilience Framework. 100RC was active 2013-2019 and was influential in setting resilience policy agendas in cities worldwide with its network cities adopting the City Resilience Framework.[60] The City Resilience Framework outlines four dimensions of resilience: health and well-being, economy and society, infrastructure and environment, and leadership and strategy (Figure 1).[61] The framework also describes qualities of resilient cities: reflectiveness, resourcefulness, robustness, redundancy, flexibility, inclusiveness, and integration.[62] The 100RC framework builds upon the concept of ecological resilience, recognizing that systems can develop new equilibriums that can enable the system to adapt better to future disruptions, and embeds this understanding of resilience into the framework.[63] However, the concept of ecological resilience does not explicitly incorporate consideration of social dynamics which is important for applying resilience frameworks in urban environments. This limitation motivates our use of the City Resilience Framework because it incorporates both the concept of ecological resilience as well as the social dynamics relevant within cities.
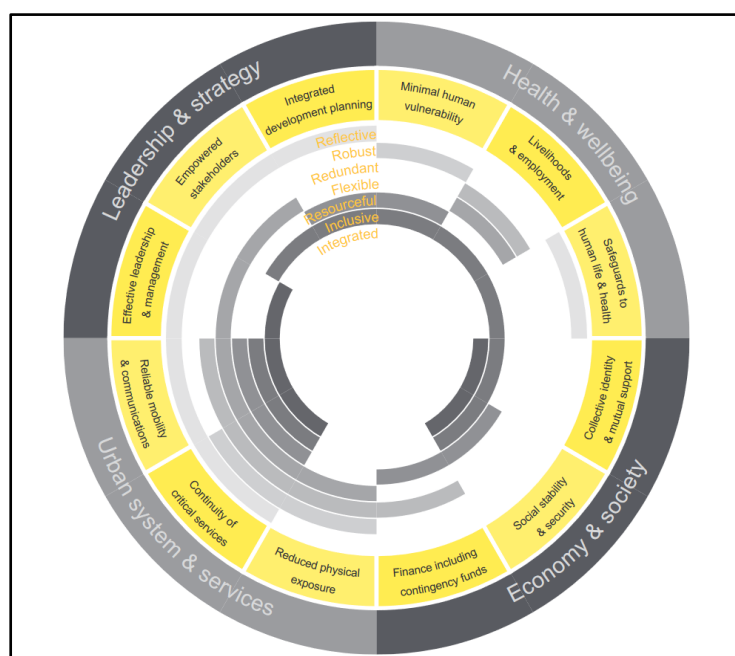
Figure 1: The City Resilience Framework developed by 100RC and Arup.[64]

The 100RC framework and program influenced urban resilience planning in member and non-member cities worldwide, shaping urban resilience planning and implementation. In total, 25 US cities joined 100RC, ranging from New York City to Tulsa.[65] As part of the 100RC network, the City of Dallas created a resilience strategy, "Resilient Dallas."[66] The strategy

adopts the definition of urban resilience utilized by 100RC and elements of the City Resilience Framework. The strategy describes a multi-stage development process, which started with an agenda-setting workshop, a review of City actions to date that support resilience, an assessment of perceptions of City actions, an assessment of the city's current state, and an inventory of resilience assets. These activities informed the development of the resilience strategy and goals.

Ultimately, Resilient Dallas identifies the economic vulnerability of the poor as the largest resilience challenge for the city and sets seven goals to enhance resilience. Notably, several of the goals are related to improving social equity in the city, including the first goal of advancing equity in city government and the third goal related to equitable transportation access.[67] Although Resilient Dallas identifies that there will be climate impacts on infrastructure, it does not examine climate vulnerability and its intersection with health vulnerabilities within the city.

The City of New Orleans was also selected by 100RC to join the network. Similarly to the City of Dallas, the City of New Orleans developed a resilience strategy, "Resilient New Orleans" using 100RC's urban resilience definition and based on the City Resilience Framework.[68] Resilient New Orleans identifies environmental shocks like hurricanes and flooding in combination with stressors like land subsidence and the poor health and economic outcomes for its residents as its main resilience challenges.[69]

Environmental Justice Framework

Environmental justice refers to all individuals' fair treatment and meaningful involvement in the development, implementation, and enforcement of environmental laws, regulations, and policies, regardless of an individual's race, color, national origin, income, tribal affiliation, or disability. Furthermore, it involves fair treatment and meaningful engagement in agency decision-making and other activities affecting human health and the environment. The aim is to ensure that people are safeguarded from disproportionate and adverse effects related to human health, environmental risks, and hazards, including those associated with climate change.[70, 71]

The environmental justice approach is crucial in addressing the inequitable health impacts of climate change because health disparities may arise due to social inequities and environmental factors that burden the places where individuals reside, work, learn, and engage in recreational activities.[72] In the context of resilience planning, environmental justice ensures that all communities have equitable access to the resources and capacity needed to respond to and recover from climate change impacts.[73] It is important to acknowledge that cities tend to use the terms "equity" over "environmental justice" or "climate justice." The difference relies on the notion of "justice" that typically entails prioritizing historically vulnerable communities and those bearing disproportionate impacts of climate change. Conversely, "equity" is often interpreted more broadly, focusing on ensuring fair access and distribution of the advantages stemming from climate policies.[74]

Over the past seven years, US cities have increasingly attempted to integrate environmental justice frameworks into their climate and resilience planning efforts, but significant progress

remains to be made. A recent empirical study by Diez Martinez & Short (2022) indicates that large cities are starting to integrate environmental justice issues into their climate action plans and recognize structural and historical injustices, patterns of racial segregation, disinvestment, and exclusion. However, a significant percentage of climate action plans either do not mention justice as a key element, or even if they do, they do not provide policies or strategic approaches to implement or track progress toward equitable climate mitigation, including health concerns.

The same study highlights the climate plans of Portland (2015), Washington D.C. (2018), and Dallas (2020), which effectively incorporate narratives of their institutional discriminatory practices and identify the specific neighborhoods or census tracts that have been historically disadvantaged within their boundaries. Yet, cities that recognize historical and current injustices are primarily focused on racial and income inequalities, with less attention to vulnerabilities and injustices associated with gender, age, or disability.[75] Experts have identified a need for tailored tools and metrics to formulate equitable climate policies. This study employs the following policy instruments to craft and assess just climate policies: 1) justice partnerships, 2) equity advisory boards, 3) equity tools, and 4) justice indicators.

Despite progress, the fight for environmental justice in the US persists and has been going on for decades. The Environmental Justice Movement (EJM) started during the 1960s and 1970s when minority groups took action against environmental injustices and advocated for their right to a safe and healthy environment. Cases such as the contamination of waterways in Triana, Alabama; the hazardous waste landfill in Warren County, North Carolina; and the Cancer Alley in Louisiana have led to the creation of the country's EJM, which aims to address the link between environmental issues and social inequality, including racial inequality.[76]

Despite the frameworks for resilience, Morcelle (2017) found that in practice, resilience strategies do not connect actions to health outcomes, with the health benefits of such actions treated as positive incidentals or entirely ignored.[77] The lack of health considerations in urban resilience strategies indicates an opportunity to leverage the intersection of climate and health vulnerability data to improve resilience strategies and strengthen the connection between resilience planning and health.

Grand Prairie, Texas can adapt and apply the City Resilience Framework

The City of Grand Prairie is a community in the Dallas-Fort Worth metropolitan area with a population of 196,000.[78] The city is home to several industries, with its top employers being Lockheed Martin Missiles and Fire Control HQ, Grand Prairie Independent School District, and Poly-America Inc., a trash bag manufacturer.[79]

Grand Prairie includes census tracts reaching up to the 87th percentile in overall climate and health vulnerability compared to the rest of the country, according to the Climate Vulnerability Index (CVI). Grand Prairie faces climate impacts like drought, extreme temperatures and flooding, with approximately 36% of the total city area within floodplain areas, more than any other city in the region.[80] Although Grand Prairie faces multiple climate impacts, vulnerability in Grand Prairie is primarily driven by social factors and exposure to

pollution.[81,82] For example, according to the Center for Disease Control and Agency for Toxic Substances and Disease Registry Social Vulnerability Index Tool, Grand Prairie has a medium-to-high level of vulnerability with the city in the 94th percentile of transportation barriers and in the 98th percentile of linguistic isolation, indicating the need to incorporate health and social considerations into any sustainability and resilience planning.[83]

Currently, the City of Grand Prairie is in the process of understanding its own GHG emissions to inform a city sustainability plan. Despite progress in this area, the City of Grand Prairie has not yet developed a resilience plan or integrated resilience planning into its planning and policies. A Climate and Health Vulnerability Assessment as well as an early understanding of different definitions and frameworks of resilience, will position the City to write and adopt a sustainability plan that integrates and is compatible with future resilience planning. Given the City's current progress on sustainability, adopting an ecological definition of resilience would better address social vulnerabilities. The 100RC City Resilience Framework can also inform the resilience strategy process to fit the City's size and resource constraints.

Furthermore, most urban resilience plans have been produced by larger cities or cities well-resourced through initiatives like 100RC. The development of a Climate and Health Vulnerability Assessment, its subsequent use by the city, and the application of the 100RC City Resilience framework for the City of Grand Prairie can create a model for other mid-sized, suburban cities that face resilience and resource challenges.

St. John the Baptist, Louisiana can use environmental justice as a framework for resilience planning

St. John the Baptist Parish is located in the *Cancer Alley,* an area in Louisiana known for high rates of cancer, especially in impoverished and black communities,[84,85] making the Parish critical for examining the connection between health and climate change in our project. Cancer Alley is a densely industrialized stretch along the Mississippi River from Baton Rouge to New Orleans, encompassing several Parishes such as St. James, Ascension, and East Baton Rouge.[86] It holds around 135 petrochemical plants, including oil refineries, chemical manufacturing facilities, and solid waste dumps. The majority of the population consists of low-income Black residents who have endured prolonged exposure to hazardous toxic substances, industrial accidents, and industrial toxic releases. For decades, the Parish has been engaged in a longstanding battle against industrial facilities, corporate lobbying, and inadequate regulatory oversight.[87]

St. John the Baptist Parish's susceptibility to climate change is exacerbated by factors such as the concentration of industrial facilities, which contribute to high levels of air pollution and health disparities. Hence, St. John the Baptist Parish serves as a compelling case illustrating the imperative for adopting an environmental justice approach to address climate vulnerabilities.

Presently, the Parish stands out as the most susceptible county in the US regarding climate vulnerability.[88] According to the CVI, it ranks in the 100th national vulnerability percentile, revealing shortcomings in transportation, financial services, and mental health support. Moreover, it exhibits high vulnerability metrics related to the expenses of climate disasters,

flooding, and disaster-related deaths.[89,90] These findings underscore the critical need to employ the environmental justice framework to address the identified climate vulnerabilities within this community.

Understanding climate vulnerability is a critical step for local government resilience planning

In order to conduct informed resilience planning, local governments must understand if and how their communities are vulnerable to climate change impacts. This highlights the relevance of assessing *climate vulnerability*. Because vulnerability is a theoretical concept, it cannot be measured directly.[91] Instead, it can be operationalized through a *vulnerability assessment* methodology, which is typically conducted through the use of *vulnerability indicators*.[92] However, there is confusion about what these indicators are and which kinds of policy problems they can help solve.[93] Hinkel (2011) developed a conceptual framework for vulnerability indicators and found that such indicators are appropriate for identifying vulnerable people, places, and sectors at local scales, indicating that vulnerability assessments are a valid and appropriate approach for local governments to undertake to understand local vulnerabilities.[94] Despite their use in identifying vulnerabilities, Hinkel (2011) cautions that vulnerability indicators should not be used for purposes such as raising awareness or monitoring and evaluating climate adaptation policies.[95] This indicates that developing a climate and health vulnerability assessment can assist local governments in identifying vulnerable populations and suggests that these types of assessments should be provided alongside guidance to ensure appropriate usage. EDF's CVI uses 184 health and climate vulnerability indicators.[96] Consistent with Hinkel's conceptual framework, these indicators are appropriate to identify vulnerable people and places within a local area and to create a climate and health vulnerability assessment. However, tools such as the CVI and localized vulnerability assessments should be accompanied with guidance describing their appropriate uses.

When conducting vulnerability assessments, understanding the framing that local governments use is critical because it determines different types of knowledge production and policy responses.[97] In a study about how vulnerabilities are assessed in urban America, McCormick (2016) found that stakeholders, including state and local governments, understood climate vulnerability using one of three frameworks: infrastructure, human populations, and other localized concerns.[98] These frameworks overlap but are different from the biophysical, human, and resilience lenses that academic experts use to understand climate vulnerability, demonstrating the public sector's greater focus on the health of vulnerable populations and risks to infrastructure.[99] The study also identified that the presence or absence of political commitment determined if local governments completed vulnerability assessments.[100] Additionally, McCormick found that climate vulnerabilities were discussed in an integrative way with health and infrastructure concerns rather than in terms of just climate change.[101] This suggests that vulnerability assessments that combine climate and health concerns are aligned with the integrated health and infrastructure frames that tend to be used by the public sector, suggesting that the public sector may be especially receptive to approaches that integrate health into a vulnerability assessment. Thus, EDF's

CVI, which integrates health, infrastructure, and climate indicators, is both suitable for use by the public sector and consistent with the public sector's preferred frames.

As part of the process of developing resilience strategies, many cities conduct resilience assessments to understand community needs. Cities that were members of 100RC developed resilience assessments as a component of the process to develop resilience strategies.[102] For example, the City of New Orleans developed a Preliminary Resilience Assessment in 2015.[103] The assessment recognized both environmental shocks and stressors, like hurricanes and land subsidence, as well as social stressors like education, economic, and health outcomes, especially for communities of color. The assessment found highly disparate health outcomes based on race, with African American communities experiencing higher rates of cancer, heart disease, and diabetes compared to white residents.[104] The assessment identifies correlations between social stressors and physical shocks such as flooding. The assessment examines the intersection of climate and health vulnerability, connecting climate impacts to negative health and social outcomes. The assessment highlights the New Orleans Health Department's New Orleans Community Health Improvement Plan's work to increase health insurance coverage as well as its "health in all policies" approach.

Conclusion

Urban resilience is a contested concept with multiple definitions. How a community defines resilience is important because it describes the desired end state as maintaining the status quo or recognizing resilience as a transformative force that can address multiple climate and health challenges. Climate and health vulnerabilities must be understood at the local level to identify and efficiently address these challenges. Climate and Health vulnerability assessments as well as resilience strategies, require data-driven tools to facilitate analysis and decision-making.

Although conceptual frameworks for urban resilience have been developed and frameworks such as the 100RC City Resilience Framework have been put into practice by cities across the globe, resilience frameworks and their implementation still need to better incorporate the intersection of climate and health. Furthermore, urban resilience frameworks must be tested and used in a variety of cities, including smaller, suburban cities early in their sustainability and climate action journeys such as the City of Grand Prairie.

In conclusion, local governments wield significant influence in advancing resilience efforts and safeguarding public health by ensuring equitable access to support and resources for all communities to mitigate and adapt to climate change. In the case of St. John the Baptist, integrating an environmental justice approach into policymaking is essential for addressing the inequitable health impacts of climate change, particularly evident in this community, where a history of environmental hazards, poverty, and racial disparities intersect.

Appendix 2: Interview Protocol

Interview Protocol Form
Date: Time: City: Interviewers: Interviewee: Government department/Organization:
Beginning of call: ● Thank you for your participation. Your input will be valuable to our research on climate-related impacts. ● Can we record this call? The recording will be used for notetaking and analysis purposes only. *[If yes, hit record].* ● We will be taking notes throughout the call. Your responses will be confidential and only be used for the purposes of our research. ● Introduce ourselves; have the interviewees introduce themselves.
RQ 1 How well do local governments understand the impacts of climate vulnerability on their communities? 1. What are some of the biggest climate issues your communities are facing? Which specific communities are at risk? 2. What are some health implications of these climate-related impacts (e.g. diseases derived from climate change, mental health)? 3. Do you identify any other implications from climate change in terms of urban planning (such as to transportation, workforce, education, etc.)? 4. How is the city addressing these implications? Are there any comprehensive/resilience plans in place to address them?
RQ 2 How do local governments use data to develop policies to advance community well-being? 5. What main sources/resources or data tools helped you identify the climate issues and communities at risk? Have you encountered any challenges? 6. How informative are these resources or data tools for developing policies? How are they reflected in the current city policies? 7. How do you think the city could better integrate data into the decision-making process?
RQ3 What strategies are needed for local governments to enhance their communities' health, well-being, and resilience? 8. What policies/strategies/plans would help in addressing the issues you identified?

9. What was the process of designing these policies/strategies/plans? Who made them, and what stakeholders were involved (e.g., non-profits, academia, community representatives)?

10. If you are involved, can you describe the current implementation and evaluation process?

11. What specific best practices do you or your department utilize to inform policies/strategies/plans? Do you collaborate with other cities or organizations dealing with similar climate issues?

End of call:

● Thank you again for your time. We will share the preliminary findings of our assessment soon and will be in touch.

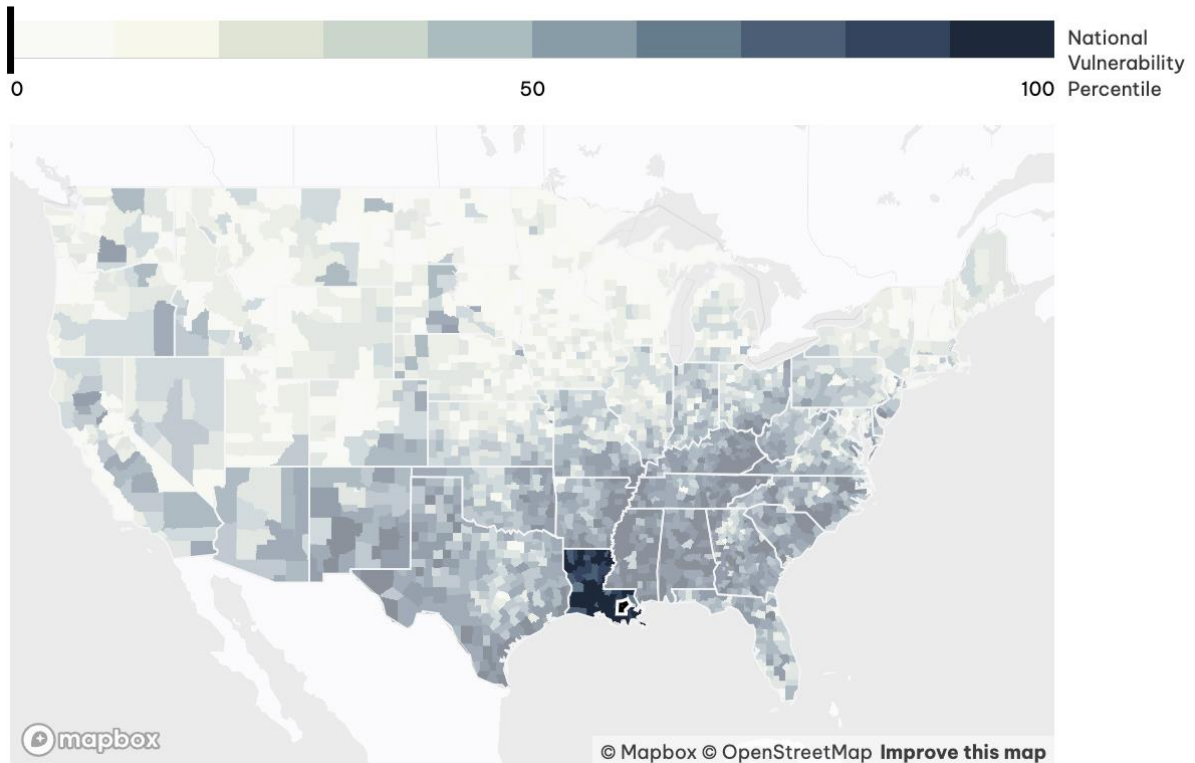**Appendix 3: Overall Climate Vulnerability Map of St. John the Baptist**

Image source: Climate Vulnerability Index

Appendix 4: St. John the Baptist, Louisiana - Climate and Health Vulnerability Assessment

According to the CVI, the top drivers of *Community Baseline Vulnerability* in St. John the Baptist are contained in the *Infrastructure, Environment, Health*, and *Social & Economic* categories. However, *Social & Economic* shows a national vulnerability percentile below the 75th threshold established for this analysis and, thus has not been incorporated.

1. **Infrastructure**

The *Infrastructure* category encompasses vital structures, services, and resources crucial for bolstering community resilience. According to the CVI, key indicators exhibiting the highest vulnerability within this category include *Transportation*, *Financial Services*, and *Governance*.

1.1 Transportation

Transportation refers to the quality and accessibility of community connectivity options within the Parish. This factor encompasses several indicators, with our focus directed toward the foremost three: *lane miles*, *public transit performance*, and *road flooding risk*.

Land miles denote the total miles of road lanes per person. The *Public Transit Performance* score gauges the connectivity and accessibility of public transit, including service frequency. Lastly, road flooding risks quantify the average risk to roads within a census tract.

Table 4.1. This table shows the national vulnerability percentiles for key transportation indicators.

Driver	National Vulnerability Percentile	Top Indicators	National Percentile for Indicator
Transportation	99	Lane miles	100
		Public Transit Performance	100
		Flooding risk to roads	99

1.2 Financial Services

Financial services encompass the methods employed by individuals within a community to manage their finances. The metric *Percent of Unbanked Households* signifies the proportion of family households in the state without access to or utilization of banking services. *Payday lending* quantifies the density of payday loan establishments per 10,000 households. Lastly, *Housing Affordability for Owners* measures the number of owner-occupied houses where households earn incomes equal to or less than 30% of the Department of Housing and Urban Development (HUD) Area Median Family Income.

Table 4.2. This table shows the national vulnerability percentiles for key financial services indicators.

Driver	National Vulnerability Percentile	Top Indicators	National Percentile for Indicator
Financial Services	99	Percentage of unbanked households	100
		Payday lending	100
		Housing Affordability for Owners	88

1.3 Governance

Governance signifies the extent of publicly funded services and resources within a community. This driver encompasses pivotal indicators like *Real Estate Taxes Paid* and *HUD Public Housing. Real Estate Taxes Paid* denotes the estimated average yearly amount of real estate taxes paid by residents across the state. *HUD Public Housing* indicates the quantity of HUD public housing units available.

Table 4.3. This table shows the national vulnerability percentiles for key governance indicators.

Driver	National Vulnerability Percentile	Top Indicators	National Percentile for Indicator
Governance	96	Real Estate Taxes Paid	92
		Housing & Urban Development Public Housing	87

2. Environment

The *Environment* category encompasses factors that threaten the community's well-being. According to the CVI, key indicators exhibiting the highest vulnerability within this category include *Exposures & Risks*, *Transportation Sources*, and *Pollution Sources*.

2.1 Exposure & Risks

This category sheds light on the various community health exposures and risks and encompasses several indicators. Our attention primarily focuses on two key metrics: *Risk-Screening Environmental Indicators (RSEI)* and *Toxic Air Pollutants.*

RSEI quantifies the cumulative amount of multiple toxic chemicals released into an area, utilizing data from the Toxic Release Inventory.[105] *Toxic Air Pollutants* provide insights into several health risks, including cancer, thyroid, neurological, kidney, respiratory, and immunological impacts. This index evaluates the risk of developing cancer due to exposure to specific toxic air pollutants and diesel particle pollution. It also assesses the potential harm to the thyroid, which regulates metabolism through hormone production, and the

impact on the nervous system, kidneys, lungs, respiratory system, and immune system caused by these pollutants.

Table 4.4. This table shows the national vulnerability percentiles for key exposure and risks indicators.

Driver	National Vulnerability Percentile	Top Indicators	National Percentile for Indicator
Exposures & Risks	96	Risk-Screening Environmental Indicators (RSEI)	100
		Toxic Air Pollutants - Cancer Risk	100
		Toxic Air Pollutants - Thyroid & Neurological	99
		Toxic Air Pollutants - Kidney	92
		Toxic Air Pollutants - Respiratory	90
		Toxic Air Pollutants - Immunological	82

2.2 Transportation Sources

Transportation Sources encompass both the available infrastructure and the models of mobility within a community. Our focus centers on three key metrics: *Ports*, *Traffic Proximity and Volume*, and *Truck Vehicle Miles*.

Ports indicate the proximity to major US ports within approximately 3 miles or 5 kilometers of the census tract. *Traffic Proximity and Volume* encapsulate the average vehicle count on major roads within 500 meters. Lastly, *Truck Vehicle Miles* denotes the distance trucks travel per person.

Table 4.5. This table shows the national vulnerability percentiles for key transportation sources indicators.

Driver	National Vulnerability Percentile	Top Indicators	National Percentile for Indicator
Transportation sources	98	Ports	98
		Traffic Proximity and Volume	76
		Truck Vehicle Miles	75

2.3 Pollution Sources

Pollution Sources encompass both the quantity and types of polluters within a community. We focus on three key metrics: *Toxic Substances Chemical Act (TSCA) Facilities, Chemical Manufacturers,* and *Facilities with Enforcement or Violation.*

TSCA Facilities are establishments involved in the production or processing of chemicals posing significant human health risks, regulated by the EPA under the TSCA. *Chemical Manufacturers* indicate the proximity to facilities engaged in chemical production. *Facilities with Enforcement or Violation* represent establishments regulated by the EPA that have incurred violations or enforcement actions related to air, soil, or water located within approximately 3 miles or 5 kilometers from the county.

Table 4.6. This table shows the national vulnerability percentiles for key pollution sources indicators.

Driver	National Vulnerability Percentile	Top Indicators	National Percentile for Indicator
Pollution sources	91	TSCA Facilities	98
		Chemical Manufacturers	97
		Facilities with Enforcement or Violation	97

3. Health

The *Health* category encompasses factors that reflect the foundation state of the population's well-being. According to the CVI, key indicators exhibiting the highest vulnerability within this category include *Mental Health & Deaths of Despair*, *Infectious Diseases*, and *Child & Maternal Health*.

3.1 Mental Health & Deaths of Despair

This category captures the repercussions of depression, addiction, and feelings of hopelessness, delineated through two key indicators: *Self-reported Mental Health* and *Drug Overdose Deaths*.

Self-reported Mental Health signifies the percentage of adults who report experiencing poor mental health for more than two weeks within a month. Meanwhile, *Drug Overdose Deaths* represent the number of fatalities resulting from drug poisoning per 100,000 individuals.

Table 4.7. This table shows the national vulnerability percentiles for key mental health and deaths of despair indicators.

Driver	National	Top Indicators	National Percentile

	Vulnerability Percentile		for Indicator
Mental Health & Deaths of Despair	98	Self-reported Mental Health	88
		Drug Overdose Deaths	85

3.2 Infectious Diseases

This category indicates the presence of communicable diseases, assessed through the rate of infection per 100,000 individuals across three main indicators: *HIV, Chlamydia,* and *Syphilis.*

Table 4.8. This table shows the national vulnerability percentiles for key infectious diseases indicators.

Driver	National Vulnerability Percentile	Top Indicators	National Percentile for Indicator
Infectious Diseases	97	HIV	95
		Chlamydia	90
		Syphilis	87

3.3 Child & Maternal Health

This category assesses the well-being of mothers and children under 18 years old, measured through three key indicators: *ADHD Treatment*, *ADHD Prevalence*, and *Low Birthweight*. A low score in these categories signals increased vulnerability within the community.

ADHD Treatment and *Prevalence* indicate the percentage of children with ADHD receiving medication and the percentage of children ever diagnosed with ADHD, respectively. *Low birthweight* denotes the percentage of newborns with a birthweight below the threshold considered healthy.

Table 4.9. This table shows the national vulnerability percentiles for key child and maternal health indicators.

Driver	National Vulnerability Percentile	Top Indicators	National Percentile for Indicator
	96	ADHD Treatment	100

Child & Maternal Health		ADHD Prevalence	95
		Low birth weight	92

Climate Impacts

The *Climate Impacts* category encompasses how a community is vulnerable to environmental and economic disruptions. According to the CVI, the top drivers of climate impacts in St. John the Baptist are sorted into *Social & Economic, Health,* and *Extreme Events* categories. However, *Extreme Events* have a 49th national vulnerability percentile, below the 75th percentile threshold established for this analysis and, thus have not been incorporated.

1. **Social & Economic**

This category represents the social and economic costs and impacts within a community associated with climate change through three key indicators: *Costs of Climate Disasters, Economic and Productivity Losses*, and *Transition Risks.*

1.1 Cost of Climate Disasters

Costs of Climate Disasters encompass the potential escalation in expenses associated with disaster preparedness and recovery due to climate change. Key indicators within this category include the *Cost of Climate Disasters*, *Loss in Property Taxes from Flooding,* and *Flooding Risk to Properties*.

The *Cost of Climate Disasters* represents the cumulative expenses incurred from climate-related disasters stemming from major weather events. *Loss in Property Taxes from Flooding* indicates the projected property tax revenue anticipated to be lost by 2045 due to chronic inundation. *Flooding Risk to Properties* quantifies the anticipated change in the percentage of properties at risk of flooding by 2050.

Table 4.10. This table shows the national vulnerability percentiles for key cost of climate disasters indicators.

Driver	National Vulnerability Percentile	Top Indicators	National Percentile for Indicator
Cost of Climate Disasters	94	Cost of Climate Disasters	97
		Loss in Property Taxes from Flooding	97
		Flooding risk to properties	96

1.2 Economic and Productivity Losses

Economic and Productivity Losses illuminate the potential impact of climate change on individuals' capacity to work effectively. This category encompasses several key indicators, including *Outdoor Workers, Expected Annual Loss of Building Value*, and *High-Risk Jobs Productivity*.

Outdoor Workers measure the projected reduction in workdays per year for outdoor workers due to climate change by 2050. The *Expected Annual Loss of Building Value* quantifies the annual depreciation in building value attributed to climate change. *High-Risk Jobs Productivity* gauges the anticipated changes in productivity among workers in high-climate-risk jobs by the year 2100; a decline in productivity indicates higher vulnerability.

Table 4.11. This table shows the national vulnerability percentiles for key economic and productivity losses indicators.

Driver	National Vulnerability Percentile	Top Indicators	National Percentile for Indicator
Economic and Productivity Losses	87	Outdoor Workers	98
		Expected Annual Loss of Building Value	94
		High-Risk Jobs Productivity	87

1.3 Transition Risks

Transition Risks signify the potential threats posed by climate change to farming and energy costs. This category comprises two primary indicators: *State energy-related carbon dioxide emissions by year* and *Methane emissions*.

State energy-related carbon dioxide emissions denote the average amount of carbon dioxide emissions stemming from energy-related activities. *Methane emissions* quantify the average level of methane pollution.

Table 4.12. This table shows the national vulnerability percentiles for key transition risks indicators.

Driver	National Vulnerability Percentile	Top Indicators	National Percentile for Indicator
Transition Risks	84	State energy-related carbon dioxide emissions by year	94
		Methane emissions	78

2. Health

This category represents the expected changes in community health resulting from a warming climate through two key indicators: *Disaster-related deaths* and *temperature-related deaths.*

2.1 Disaster-related deaths

Disaster-related deaths refer to how climate disasters could increase deaths in a community. This driver is composed of deaths from climate disasters and measured by the number of total deaths from climate disasters or major weather events.

Table 4.13. This table shows the national vulnerability percentile for key disaster-related deaths indicators.

Driver	National Vulnerability Percentile	Top Indicators	National Percentile for Indicator
Disaster-related deaths	93	Deaths from climate disasters	95

2.2 Temperature-related deaths

Temperature-related deaths refer to deaths in a community due to hotter temperatures. This driver is composed of temperature-related mortality, measured by the ranking of temperature-related deaths from climate change by age.

Table 4.14. This table shows the national vulnerability percentile for temperature-related deaths indicator.

Driver	National Vulnerability Percentile	Top Indicator	National Percentile for Indicator
Temperature-related deaths	82	Temperature-related mortality	82

3. Extreme Events

This category encompasses the historical and projected extreme weather events delineated by two key indicators: *Flooding and Drought*.

3.1. Flooding

Flooding signifies the potential alterations in sea level rise and other flood occurrences projected by 2050, captured through two primary indicators: *Seal Level Rise* and *Coastal Flooding*.

Sea-level rise measures the annual change in sea level in meters anticipated by 2050. Coastal Flooding quantifies the annual frequency of coastal flooding events.

**Table 4.15.** This table shows the national vulnerability percentiles for key flooding indicators.

| Driver	National Vulnerability Percentile	Top Indicators	National Percentile for Indicator
Flooding	93	Sea Level Rise	99
		Coastal Flooding	97

3.2 Drought

Drought assessment involves monitoring the duration and frequency of drought occurrences, utilizing two key indicators: Consecutive Dry Days and Drought - Annualized Frequency.

According to the CVI data, Drought exhibits a national vulnerability percentile of 78. However, its two subcategories are positioned at the 67th and 62nd percentiles, indicating a slightly lower vulnerability level in these specific aspects.
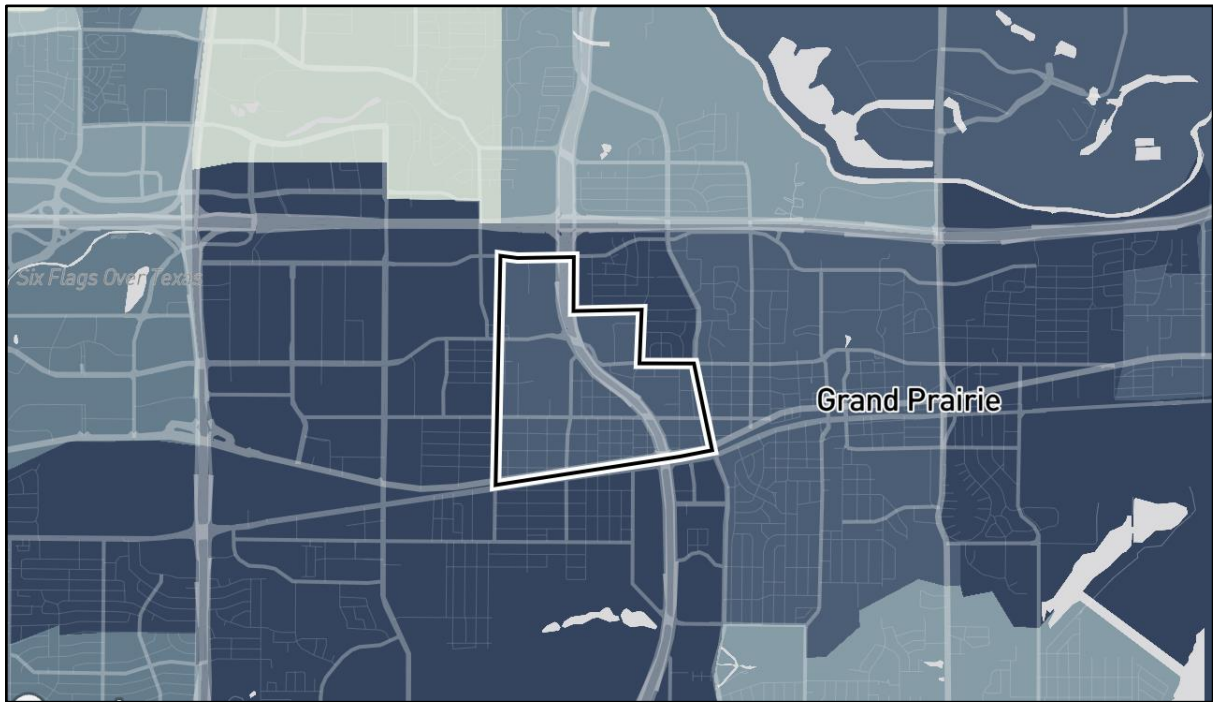
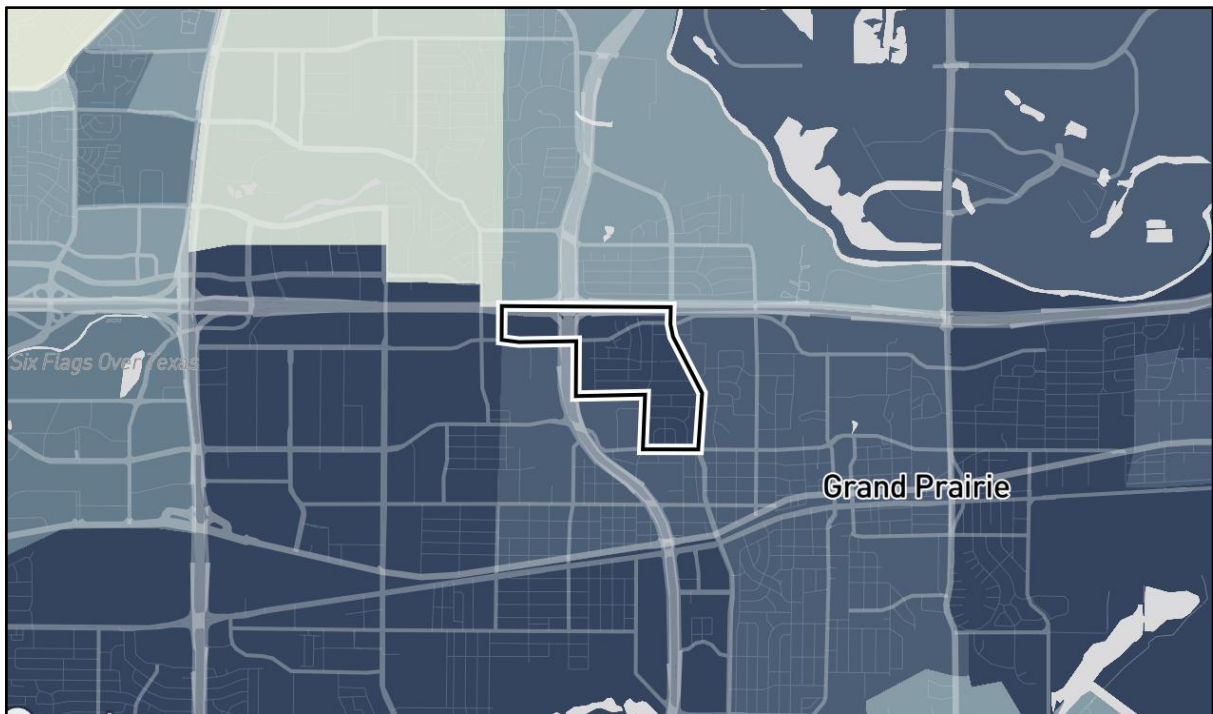**Appendix 5: Overall Climate Vulnerability Maps of most vulnerable census tracts in Grand Prairie**
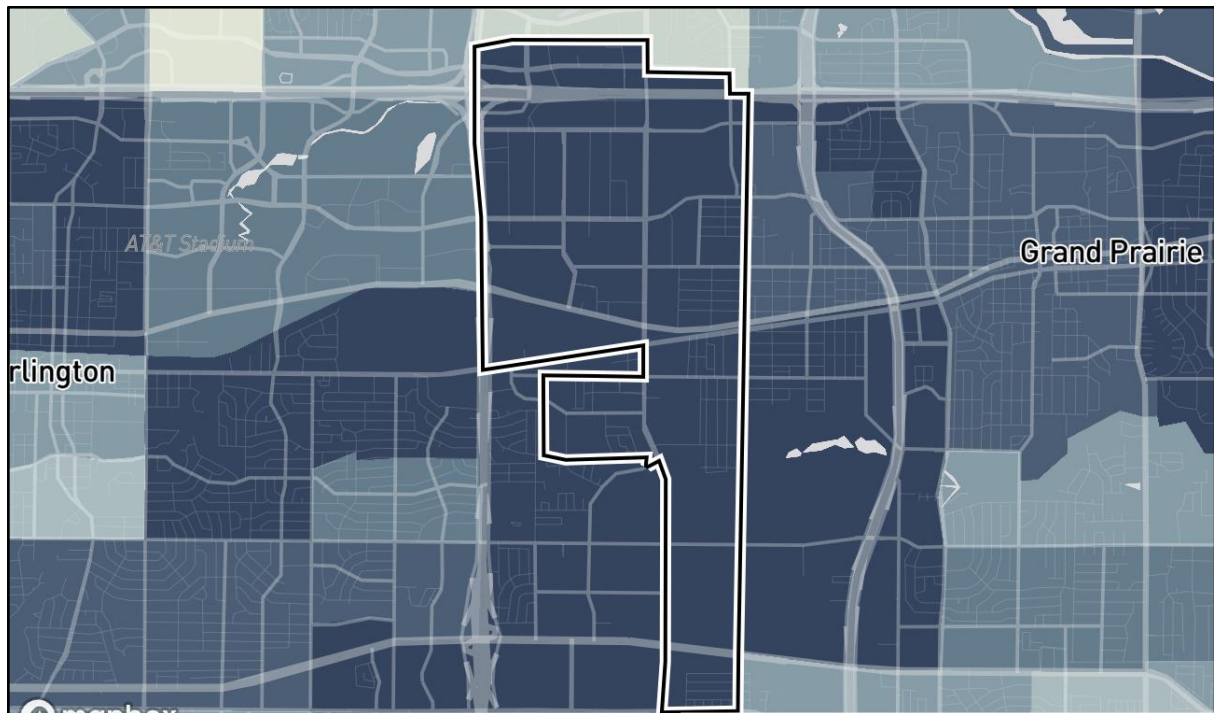
Figure 5.1. Census tract 48439113002 is in the 82nd national percentile of overall climate vulnerability.
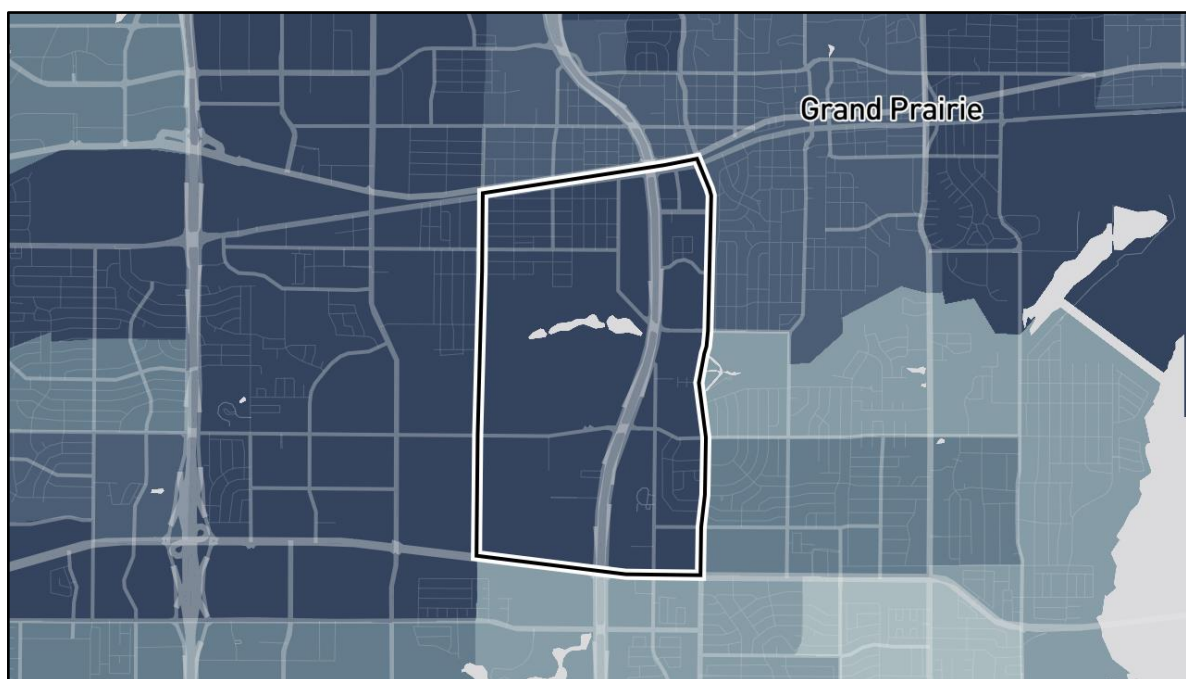
Figure 5.2. Census tract 48113016100 is in the 80th national percentile of overall climate vulnerability.

Figure 5.3. Census tract 48113015404 is in the 77th national percentile of overall climate vulnerability.

Figure 5.4. Census tract 48113015403 is in the 80th national percentile of overall climate vulnerability.

Figure 5.5. Census tract 48113016001 is in the 76th national percentile of overall climate vulnerability.

Figure 5.6. Census tract 48113015900 is in the 82nd national percentile of overall climate vulnerability.

Figure 5.7. Census tract 48113015600 is in the 87th national percentile of overall climate vulnerability.

Figure 5.8. Census tract 48113015700 is in the 77th national percentile of overall climate vulnerability.

Figure 5.9. Census tract 48113015800 is in the 77th national percentile of overall climate vulnerability.
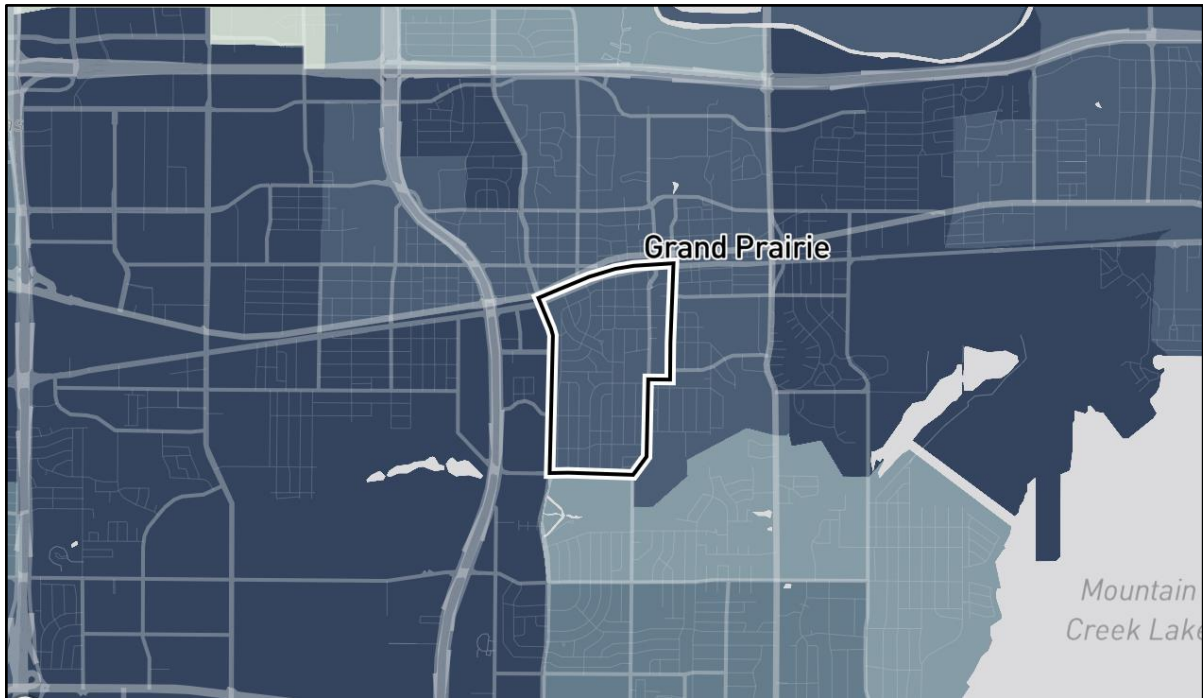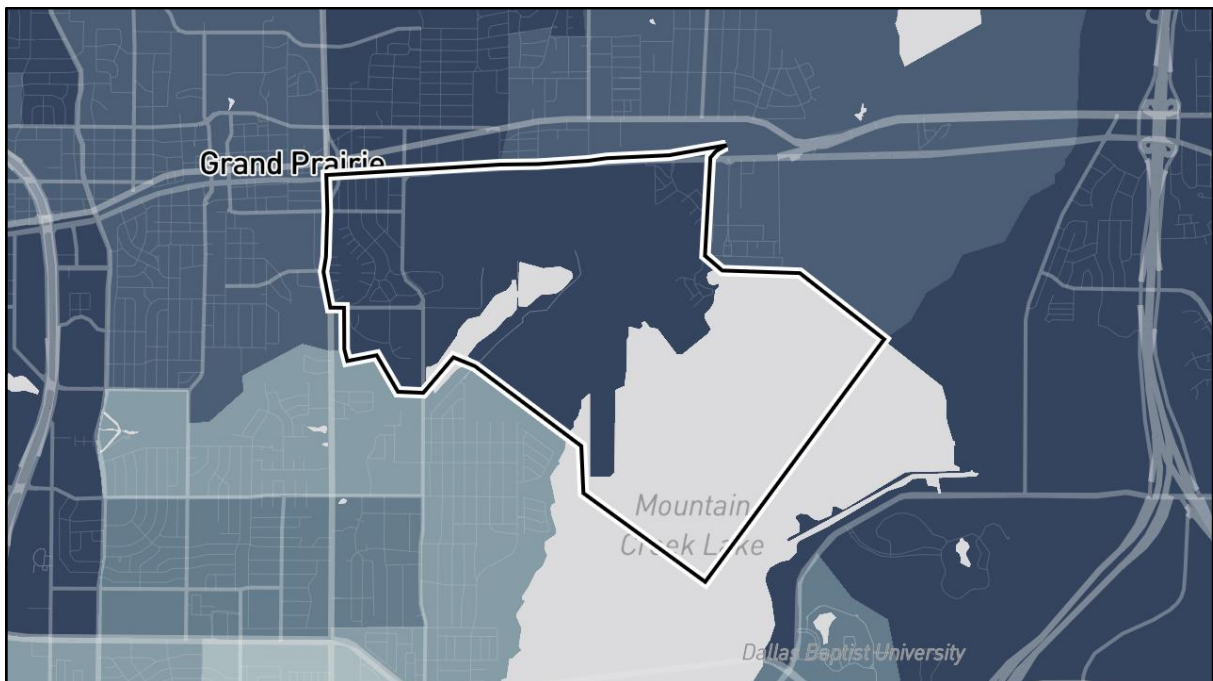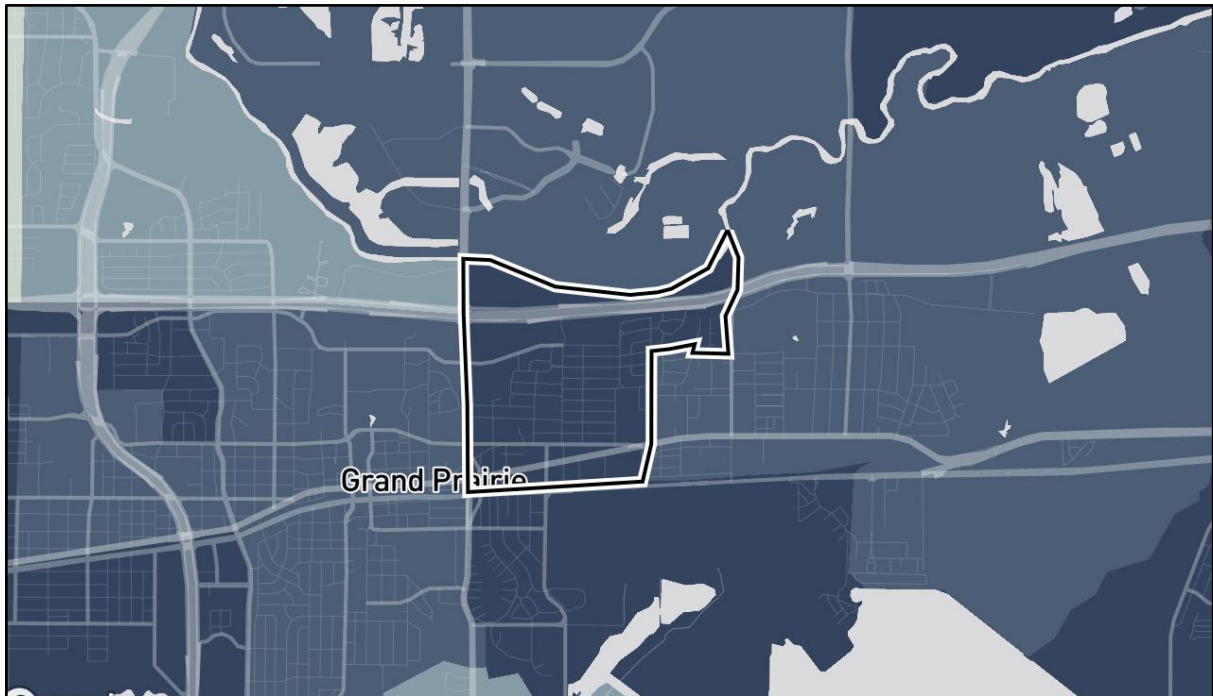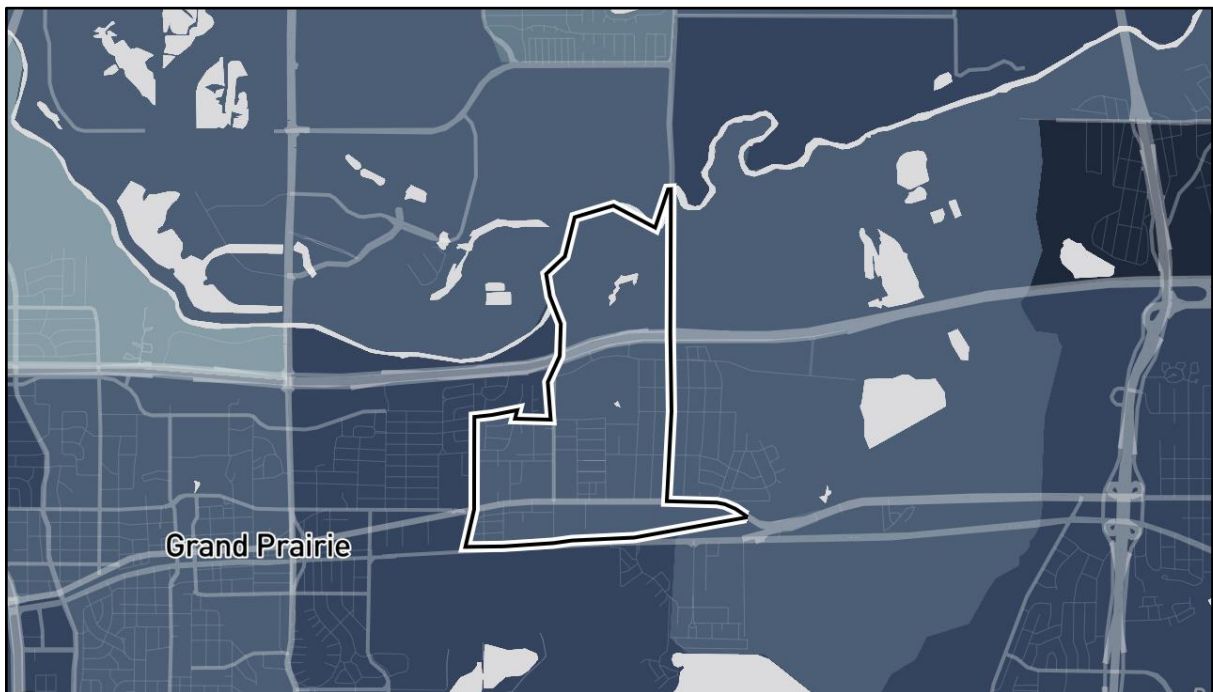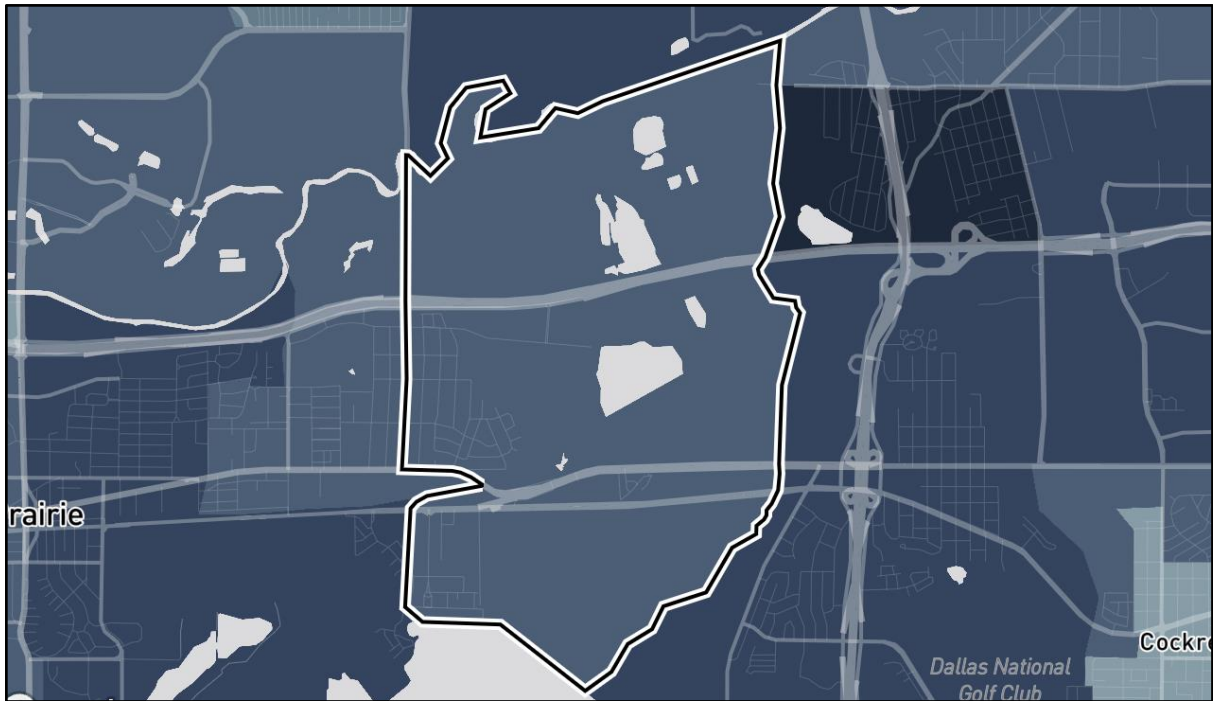
Appendix 6: Grand Prairie, Texas - Climate and Health Vulnerability Assessment

Community Baseline Vulnerability

Community Baseline vulnerability describes the long-standing inequities and injustices within a community that may reduce the community's resilience to climate change impacts. In EDF's CVI, the indicators of Community Baseline Vulnerability are organized into Health, Social & Economic, Infrastructure, and Environment categories. Here, we identify the top drivers of community baseline vulnerability in census tracts in Grand Prairie that have high overall climate vulnerability. Within these top drivers, we identify the top indicators that influence the drivers of community baseline vulnerability. The specific indicators can be used to design policies that target the specific indicators and drivers to reduce overall climate vulnerability in Grand Prairie.

Chronic Disease Prevention

'Chronic disease prevention' driver falls within the 'Health' risk category and refers to the number of adults who get regular preventive tests or examinations. This driver is composed of multiple indicators including Older Women Preventive Screening, Older Men Preventive Screening, Colonoscopy screening, High Blood Pressure, Dental Exams, and Routine Doctor Visits. A higher national vulnerability percentile in Chronic Disease Prevention indicates the need for strategies and policies to improve health care access targeted for the following census tracts:

Table 6.1. Census tracts with Chronic Disease Prevention as a top driver, the top indicators for each census tract.

Census Tract	National Percentile for Chronic Disease Prevention Driver	Top Indicators	National Percentile for Indicator
48439113002	94	Older Women Preventive Screening	93
		Colonoscopy	93
		Older Men Preventive Screening	93
48113016100	96	Older Women Preventive Screening	89
		Older Men Preventive Screening	89
		High Blood Pressure	85
48113015404	95	Colonoscopy	98
		Dental Exams	97
		Older Men Preventive Screening	96
48113015403	93	Colonoscopy	93
		Older Women Preventive Screening	90

		Routine Doctor Visit	90
48113016001	99	Colonoscopy	99
		Dental Exams	98
		Older Women Preventive Screening	97
48113015900	98	Colonoscopy	98
		Dental Exams	97
		Older Women Preventive Screening	96
48113015600	98	Colonoscopy	98
		Dental Exams	97
		Older Women Preventive Screening	97
48113015700	98	Colonoscopy	99
		Dental Exams	97
		Older Men Preventive Screening	97
48113015800	98	Colonoscopy	97
		Routine Doctor Visit	96
		Older Men Preventive Screening	95

Definitions of Top Chronic Disease Prevention Indicators in Vulnerable Grand Prairie Census Tracts

- **Colonoscopy:** Percentage of adults 50-75 years who report having had a colonoscopy exam in the past year; lower percentage of colonoscopy exams indicates higher vulnerability.
- **Dental Exams:** Percentage of adults reporting having been to the dentist in the past year; lower percentage of dental exams indicates higher vulnerability.
- **High Blood Pressure:** Percentage of adults with high blood pressure.
- **Older Men Preventive Screening:** Percentage of men older than 65 years who report having had annual physical (preventive health screening); lower percentage of annual physical indicates higher vulnerability.
- **Older Women Preventive Screening:** Percentage of women older than 65 years who report having had an annual physical (preventive health screening); lower percentage of annual physical exams indicates higher vulnerability.
- **Routine Doctor Visit:** Percentage of adults reporting annual routine doctor visit in the past year; lower percentage of annual routine doctor visits indicates higher vulnerability.

Pollution Sources

'Pollution Sources' driver falls within the 'Environment' risk category and refers to the number and kinds of polluters within a community. This diver is composed of multiple indicators including Toxic Substances Chemical Act (TSCA) Facilities, Chemical Manufacturers, Active Oil and Gas Wells, National Priority List Sites, Superfund Sites, and Landfills. A higher national vulnerability percentile in Pollution Sources indicates the need for strategies and policies to mitigate pollution in the following census tracts:

Table 6.2. Census tracts with Pollution Sources as a top driver and the top indicators for each census tract.

Census Tract	National Percentile	Indicator	National Percentile
48439113002	93	TSCA Facilities	99
		Chemical Manufacturers	98
		Active Oil and Gas Wells	94
48113015404	92	TSCA Facilities	99
		Chemical Manufacturers	97
		Active Oil and Gas Wells	91
48113015600	92	National Priority List Sites	95
		Superfund Sites	95
		Landfills	88
48113015800	96	National Priority List Sites	98
		Landfills	97
		Superfund Sites	97

Definitions of Top Chronic Disease Prevention Indicators in Vulnerable Grand Prairie Census Tracts

- **Active Oil and Gas Wells:** Closeness to an active oil and gas well.
- **Chemical Manufacturers:** Closeness to a facility which makes chemicals.
- **Landfills:** Landfill / waste disposal site is located within approximately 3 miles or 5 kilometers from the census tract.
- **National Priority List Sites:** Number of possible and confirmed National Priority List (NPL) sites. NPL sites are areas important in the U.S. known or suspected to have releases of unsafe chemicals.
- **Superfund Sites:** Neighborhood is within approximately 3 miles or 5 kilometers from a superfund site, an area designated by the EPA to be heavily contaminated by hazardous substances and require government oversight in clean up.
- **TSCA Facilities:** Facilities that make or process chemicals (or mixtures) that pose a significant human health risk and are regulated by the EPA Toxic Substances

Chemical Act (TSCA), located within approximately 3 miles or 5 kilometers of the census tract.

Transportation

'Transportation' driver falls within the 'Infrastructure' risk category and refers to the quality and accessibility of transportation options. This diver is composed of multiple indicators including Lane miles, Bridge Quality and Maintenance, and Public Transit Performance. A higher national vulnerability percentile in Transportation indicates the need for strategies and policies to improve transportation access and quality in the following census tracts:

Table 6.3. Census tracts with Transportation as a top driver and the top indicators for each census tract. Please note that as of the time of writing, the indicator "Bridge Quality and Maintenance," was scored incorrectly within the CVI, and thus has been omitted in this analysis.

Census Tract	National Percentile	Indicator	National Percentile
48113016100	96	Lane miles	100
		Public Transit Performance	95
48113015403	93	Lane miles	100
		Public Transit Performance	95
48113015700	98	Lane miles	100
		Public Transit Performance	95

Definitions of Top Transportation Indicators in Vulnerable Grand Prairie Census Tracts
- **Lane miles:** Total miles of road lanes per person; lower lane miles indicates higher vulnerability.
- **Public Transit Performance:** Public transit performance score defined by how connected and accessible public transit is, and how often service comes; lower score indicates higher vulnerability.

Financial Services

'Financial Services' driver falls within the 'Infrastructure' risk category and refers to ways people in a community manage their money. This diver is composed of multiple indicators including Percent of Unbanked Households, Housing Affordability for renters, and Housing Affordability for owners. The 2020-2024 Consolidated Plan identifies cost burden (paying > 30 percent of household income on housing expenses) and extreme cost burden (paying more than 60 percent) as the most common housing problem across all lower income households in Grand Prairie. Sudden and unexpected expenses can lead to an increased risk of homelessness. A higher national vulnerability percentile in Financial Services indicates the need for strategies and policies to improve access to banking services and to improve housing affordability in the following census tracts:

Table 6.4. Census tracts with Financial Services as a top driver and the top indicators for each census tract.

Census Tract	National Percentile	Indicator	National Percentile
48113016100	92	Percent of Unbanked Households	88
		Housing Affordability (renters)	68
		Housing Affordability (owners)	62
48113016001	97	Housing Affordability (owners)	96
		Percent of Unbanked Households	88
		Housing Affordability (renters)	73

Definitions of Top Financial Services Indicators in Vulnerable Grand Prairie Census Tracts
- **Housing Affordability (owners):** Number of houses that are owner occupied where households have an income less than or equal to 30% of the Department of Housing and Urban Development (HUD)'s Area Median Family Income (2014-2018).
- **Housing Affordability (renters):** Number of rental houses where households have an income less than or equal to 30% of HUD Area Median Family Income (2014-2018).
- **Percent of Unbanked Households:** Percent of family households in the state that do not use or have access to banking services, average from 2015-2019.

Communications

'Communications' falls within the 'Infrastructure' risk category and refers to the community's ability to access and share information. This driver is composed of two indicators, households without internet access and households with smartphones but no other device. A higher proportion of households in one or both of the indicators drive the national vulnerability percentile for Communications. This poses dangerous implications for communications during emergency and disaster events from a hazard mitigation perspective. A higher national vulnerability percentile indicates the need for strategies and policies to strengthen the communication infrastructure targeted for the following census tracts:

Table 6.5. Census tracts with Communications as a top driver and the top indicators for each census tract. For the Communications driver, there were only two indicators.

Census Tract	National Percentile	Indicator	National Percentile
48113015404	94	Households without internet access	91
		Households with smartphone but no other device	89
48113016001	96	Households without internet access	96
		Households with smartphone but no other device	87

Definitions of Top Communications Indicators in Vulnerable Grand Prairie Census Tracts
- **Households with smartphone but no other device:** Percent of household with smartphone but no other electronic device, average of 2013-2017.
- **Households without internet access:** Percent of household with no internet access, average of 2013-2017.

Socioeconomic Stressors

'Socioeconomic Stressors' falls within the 'Social & Economic' risk category and refers to the aspects of a person's identity and daily lives that can increase stress. This driver is composed of multiple indicators, including Unemployment, Religious Organizations, High School Diploma, Low Income, and Poverty. A higher national vulnerability percentile in Socioeconomic Stressors indicates the need for strategies and policies to address quality of life and safety concerns targeted for the following census tracts:

Table 6.6. Census tracts with Socioeconomic Stressors as a top driver and the top indicators for each census tract.

Census Tract	National Percentile	Indicator	National Percentile
48113015403	97	Unemployment	93
		Religious Organizations	93
		High School Diploma	87
48113015900	92	High School Diploma	98
		Low Income	94
		Poverty	83

Definitions of Top Socioeconomic Stressors Indicators in Vulnerable Grand Prairie Census Tracts
- **High School Diploma:** Ranking by percentage of the population without a high school diploma, average of 2014-2018.

- **Low Income:** Ranking by percentage of the population's income per person, average of 2014-2018.
- **Poverty:** Rank by percentage of the population with an income below federal poverty level, average of 2014-2018.
- **Religious Organizations:** Number of religious organizations per 1,000 people, average of 2003-2017; lower number of religious organizations indicates higher vulnerability.
- **Unemployment:** Ranking by percentage of the population who is unemployed, average of 2014-2018.

Governance

'Governance' falls within the 'Infrastructure' risk category and refers to the extent of publicly funded services and resources. This driver is composed of multiple indicators, including Housing and Urban Development (HUD) grants, Voter Turnout, 2020, and Public Library Locations. A higher national vulnerability percentile indicates the need for strategies and policies to improve civic engagement and public funding procurement targeted for the following census tracts:

Table 6.7. Census tracts with Governance as a top driver and the top indicators for each census tract.

Census Tract	National Percentile	Indicator	National Percentile
48113015700	95	HUD grants	100
		Voter Turnout, 2020	91
		Public Library Locations	85
48113015800	97	HUD grants	100
		Voter Turnout, 2020	91
		Public Library Locations	85

Definitions of Housing Governance Indicators in Vulnerable Grand Prairie Census Tracts
- **HUD grants:** Total funding for Housing and Urban Development (HUD) grants.
- **Public Library Locations:** Closeness to a public library (within approximately 3 miles or 5 kilometers); longer distance to a public library indicates higher vulnerability.
- **Voter Turnout, 2020:** Voter turnout rate among those eligible to vote in the 2020 presidential election; lower voter turnout indicates higher vulnerability.

Access to Care

'Access to Care' falls within the 'Health' risk category and refers to the availability, affordability, and proximity to health care. This driver is composed of multiple indicators, including Medically Underserved Areas, Health Insurance, Major Hospital. Lack of public transportation also creates difficulty for residents to access health care services. A higher national vulnerability percentile in Access to Care indicates the need for strategies and policies to improve health care access targeted for the following census tracts:

Table 6.8. Census tracts with Access to Care as a top driver and the top indicators for each census tract.

Census Tract	National Percentile	Indicator	National Percentile
48113015900	93	Medically Underserved Areas	100
		Health Insurance	98
		Major Hospital	86

Definitions of Access to Care Indicators in Vulnerable Grand Prairie Census Tracts
- **Health Insurance:** Percentage of adults without health insurance.
- **Major Hospital:** Closeness to a hospital (within approximately 3 miles or 5 kilometers); longer distance to a hospital indicates higher vulnerability.
- **Medically Underserved Areas:** Availability of primary care / medical services.

Food, Water, and Waste Management

'Food, Water, and Waste Management' driver falls within the 'Infrastructure' risk category and describes the access a community has to food and how the community disposes of waste. This diver is composed of multiple indicators including Indoor Plumbing, Modified Retail Food Environment Index (mRFEI), and Access to Healthy Foods. According to the 2018 Comprehensive Plan update, food desert conditions exist in some areas north of IH 30. In addition, the Planning and Development Department considers food deserts pertaining to city development projects. A higher national vulnerability percentile in Food, Water, and Waste Management indicates the need for strategies and policies to improve wastewater infrastructure and access to food within Census Tract 48439113002.

Table 6.9. Census tracts with Food, Water, and Waste Management as a top driver and the top indicators for each census tract.

Census Tract	National Percentile	Indicator	National Percentile
48439113002	91	Indoor Plumbing	89
		Modified Retail Food Environment Index (mRFEI)	88
		Access to Healthy Foods	71

Definitions of Top Food, Water, and Waste Management Indicators in Vulnerable Grand Prairie Census Tracts
- **Access to Healthy Foods:** Percentage of population in the county who are low-income and do not live close to a grocery store (food desert).
- **Indoor Plumbing:** Percent of households by county with plumbing indoors; lower percent of households with indoor plumbing indicates higher vulnerability.
- **Modified Retail Food Environment Index (mRFEI):** Modified Retail Food Environment Index (mRFEI) Score which describes the number of healthy or less healthy food stores; a lower mRFEI score indicates higher vulnerability.

Housing Type & Transportation

'Housing Type and Transportation' falls within the 'Social & Economic' risk category and refers to the availability of housing and mobility options in a community. This driver is composed of multiple indicators, including Old Housing Stock (Built Between 1940-1969), Crowding, and Group Quarters. Additionally, residents may not be aware of various housing programs and services offered by the city. A higher national vulnerability percentile indicates the need for strategies and policies to improve housing infrastructure targeted for the following census tracts:

Table 6.10. Census tracts with Housing Type and Transportation as a top driver and the top indicators for each census tract.

Census Tract	National Percentile	Indicator	National Percentile
48113015600	96	Old Housing Stock (Built Between 1940-1969)	97
		Crowding	94
		Group Quarters	81

Definitions of Housing Type and Transportation Indicators in Vulnerable Grand Prairie Census Tracts
- **Crowding:** Rank by percentage of population living in housing with more people than rooms, average of 2014-2018.
- **Group Quarters:** Rank by percentage of population living in group housing, such as jails, nursing homes, barracks, shelters, etc., average of 2014-2018.
- **Old Housing Stock (Built Between 1940-1969):** Percent of housing built from 1940-1969, average of 2015-2019.

Climate Impacts

Climate change risks include direct and indirect impacts. In EDF's CVI, the indicators of Climate Impact are sorted into extreme events, social and economic, and health categories. In this section on climate impacts, we identify the top drivers of climate impacts in census tracts in Grand Prairie that have high overall climate vulnerability. Within these top drivers, we identify the top indicators that influence the drivers of climate impacts. The specific indicators can be used to design policies that target the specific indicators and drivers to reduce overall climate vulnerability in Grand Prairie.

Transition Risks

'Transition Risks' falls within the 'Social & Economic' risk category and refers to how climate change could threaten farming and energy costs. This driver is composed of multiple indicators including State energy-related carbon dioxide emissions by year, Methane Emissions, and Residential Energy Expenditures. A higher national vulnerability percentile indicates the need for strategies and policies to reduce carbon dioxide and methane emissions and to reduce residential energy costs for the following census tracts:

Table 6.11. Census tracts with Transition Risks as a top driver and the top indicators for each census tract. Several census tracts contain only two indicators associated with the Transition Risks driver.

Census Tract	National Percentile	Top Indicators	National Percentile
48439113002	79	State energy-related carbon dioxide emissions by year	85
		Methane Emissions	74
		Residential Energy Expenditures	61
48113016100	80	State energy-related carbon dioxide emissions by year	85
		Methane Emissions	74
		Residential Energy Expenditures	67
48113015404	80	State energy-related carbon dioxide emissions by year	85
		Methane Emissions	74
		Residential Energy Expenditures	67
48113015403	80	State energy-related carbon dioxide emissions by year	85
		Methane Emissions	74
		Residential Energy Expenditures	67
48113016001	80	State energy-related carbon dioxide emissions by year	85
		Methane Emissions	74
		Residential Energy Expenditures	67
48113015900	90	Methane Emissions	96
		State energy-related carbon dioxide emissions by year	85
48113015600	90	Methane Emissions	96
		State energy-related carbon dioxide emissions by year	85
48113015700	90	Methane Emissions	96
		State-energy related carbon dioxide emissions by year	85
48113015800	90	Methane Emissions	96

		State-energy related carbon dioxide emissions by year	85

Definitions of Housing Transition Risks Indicators in Vulnerable Grand Prairie Census Tracts
- **Methane Emissions:** Average methane pollution.
- **Residential Energy Expenditures:** Change in amount of money spent to heat and cool homes by the year by 2100.
- **State energy-related carbon dioxide emissions by year:** Carbon dioxide emissions from energy, average of 2015-2017.

Disaster-related deaths

'Disaster-related deaths' falls within the 'Health' risk category and refers to how climate disasters could increase deaths in a community. This driver is composed of Deaths from climate disasters, measured by Number of total deaths from climate disasters or major weather events. A higher national vulnerability percentile indicates the need for strategies and policies to reduce mortality from climate and weather related disasters in the following census tracts:

Table 6.12. Census tracts with Disaster-related deaths as a top driver and the top indicators for each census tract. The Disaster-related deaths driver has only one indicator associated with it in the most vulnerable Grand Prairie census tracts.

Census Tract	National Percentile	Top Indicators	National Percentile
48113016100	78	Deaths from climate disasters	79
48113015404	78	Deaths from climate disasters	79
48113015403	78	Deaths from climate disasters	79
48113016001	78	Deaths from climate disasters	79
48113015900	78	Deaths from climate disasters	79
48113015600	78	Deaths from climate disasters	79
48113015700	78	Deaths from climate disasters	79
48113015800	78	Deaths from climate disasters	79

Definitions of Disaster-related deaths Indicators in Vulnerable Grand Prairie Census Tracts
- **Deaths from climate disasters:** Number of total deaths from climate disasters (major weather events).

Temperature-related deaths

'Temperature-related deaths' falls within the 'Health' risk category and refers to deaths in a community due to hotter temperatures. This driver is composed of temperature-related mortality, measured by the ranking of temperature related death from climate change by age. A higher national vulnerability percentile indicates the need for strategies and policies to mitigate productivity and safety risks targeted for the following census tracts:

Table 6.13. Census tracts with Temperature-related deaths as a top driver and the top indicators for each census tract. For the Temperature-related deaths driver, there was only one indicator in these census tracts.

Census Tract	National Percentile	Top Indicators	National Percentile
48439113002	79	Temperature-related mortality	79
48113015404	78	Temperature-related mortality	78
48113015403	78	Temperature-related mortality	78
48113016001	78	Temperature-related mortality	78
48113015700	78	Temperature-related mortality	78

Definition of Temperature-related deaths Indicators in Vulnerable Grand Prairie Census Tracts

- **Temperature-related mortality:** Ranking of temperature related death from climate change by age.

Economic & Productivity Losses

'Economic & Productivity Losses' falls within the 'Social & Economic' risk category and refers to the impact of climate change on people's ability to work. This driver is composed of multiple indicators, High-Risk Jobs Productivity, Expected Annual Loss of Building Value Outdoor Workers, and Crop Yields. A higher national vulnerability percentile indicates the need for strategies and policies to mitigate productivity and safety risks targeted for the following census tracts:

Table 6.14. Census tracts with Economic & Productivity Losses as a top driver and the top indicators for each census tract.

Census Tract	National Percentile	Top Indicators	National Percentile
48439113002	81	High-Risk Jobs Productivity	91
		Expected Annual Loss of Building Value	87
		Outdoor Workers	83
48113016100	86	Crop Yields	95
		High-Risk Jobs Productivity	86
		Outdoor Workers	86
48113015900	80	Crop Yields	95
		High-Risk Jobs Productivity	86
		Outdoor Workers	86
48113015600	80	Crop Yields	95
		High-Risk Jobs Productivity	86

		Outdoor Workers	86
48113015800	83	Crop Yields	95
		High-Risk Jobs Productivity	86
		Outdoor Workers	86

Definitions of Economic & Productivity Losses Indicators in Vulnerable Grand Prairie Census Tracts

- **Crop Yields:** Change in amount of staple crops produced by the year 2100; lower crop yields indicates higher vulnerability.
- **Expected Annual Loss of Building Value:** Loss of building value due to climate change per year.
- **High-Risk Jobs Productivity:** Changes in how productive workers in high climate risk jobs are by the year 2100; lower productivity indicates higher vulnerability.
- **Outdoor Workers:** Work days at risk per year for outdoor workers due to climate change by the 2050s.

XIV. Endnotes

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