City of
Gainesville

FloodWise Communities Vulnerability Assessment

for the

City of Gainesville, Florida

FLOOD WISE COMMUNITIES

Prepared by City of Gainesville

September 2022

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FIGURES

INTRODUCTION

In July 2021, FloodWise Communities (FWC) announced that the City of Gainesville (City) would be one of the Gulf Coast communities to complete a self-guided vulnerability assessment (VA). FWC is funded by the National Academy of Sciences and works to help cities and towns plan for extreme weather events and impacts on stormwater systems.

This VA process involves assessing the City's stormwater, water and wastewater system components for vulnerabilities due to weather and climate, including predicted changes. Each component is ranked for vulnerabilities.

A FWC-created tool using training videos, written instruction, and other resources, is used to guide the community through the assessment process. The end result is a tailored assessment report that is shaped by the best available data, local expertise, and guidance from the FloodWise team.

Access to the FWC tool began in October 2021 and a timeline established by FWC to complete tasks each month until its completion in February 2022. The Project Team (see Appendix A) expanded the self-assessment effort to include identification and mapping of critical assets, as well as, potentially impacted critical assets including affordable housing due to flooding. Due to the expanded effort, this final self-assessment report was completed in July 2022.

The VA will be utilized to improve the City's adaptation and mitigation planning efforts for stormwater facilities, be used for grant applications, be used for budget and project proposals, and overall, work to improve the City's resiliency to extreme weather events and climate conditions.

VULNERABLE TRACTS AT RISK

FWC incorporates social and economic factors into the assessment process utilizing the Neighborhoods at Risk tool by Headwaters Economics. The tool is an interactive map that helps identify neighborhoods that may be more impacted by weather and climate changes and may be subjected to unequal impacts from those changes. It uses multiple filters and census tracts to determine where the most vulnerable people are based on 13 socioeconomic and climate exposure variables. Four categories were used: Families in poverty, people of color and Hispanics, households with no car and housing units that are rentals.

A detailed discussion of how the vulnerable tracts at risk were determined is provided in full FloodWise-generated report located in Appendix B, under the 'Setting the foundation - Social & Economic Factors' section.

A figure identifying the "Vulnerable Tracts at Risk" is provided as Figure 1. Also analyzed were census tracts that had a greater potential for experiencing exposure due to increasing temperature. See Figure 2 mapping the Vulnerable Tracts at Risk with Impervious Surface of 35% and greater and Lack of Tree Canopy of 50% and greater.

CRITICAL ASSET DEVELOPMENT

Per Section 380.093 of the Florida Statutes (FS) creating the Statewide Flooding and Sea Level Rise Resilience Plan, the State of Florida has recognized the need to assess, address, and prepare for adverse impacts due to flooding from predicted changes to climate and extreme events. The Statewide Resilience Plan proposes to coordinate a statewide effort to improve the state's resilience to these impacts and will work to develop a comprehensive statewide assessment of specific risks. This includes the identification of critical assets per Section 380.093(2) F.S. Per that definition a critical asset includes:

1. Transportation assets and evacuation routes, including airports, bridges, bus terminals, ports, major roadways, marinas, rail facilities, and railroad bridges.
2. Critical infrastructure, including wastewater treatment facilities and lift stations stormwater treatment facilities and pump stations, drinking water facilities, water utility conveyance systems, electric production and supply facilities, solid and hazardous waste facilities, military installations, communications facilities, and disaster debris management sites.
3. Critical community and emergency facilities, including schools, colleges, universities, community centers, correctional facilities, disaster recovery centers, emergency medical service facilities, emergency operation centers, fire stations, health care facilities, hospitals, law enforcement facilities, local government facilities, logistical staging areas, affordable public housing, risk shelter inventory, and state government facilities.
4. Natural, cultural, and historical resources, including conservation lands, parks, shorelines, surface waters, wetlands, and historical and cultural assets.

To ensure a complete list of critical assets (to the extent practicable), the project team utilized existing City data as a starting point then met with internal staff from other City Departments to further review and update that data. Key departments consulted include Sustainable Development, Parks, Recreation and Cultural Affairs, Office of Equity and Inclusion. In addition, external sources were consulted including Alachua County Emergency Management, Alachua County Environmental Protection Department, Alachua County Property Appraiser, and UF Shimberg Center for Housing Studies.

Note: Some critical assets are protected by Chapter 119 F.S. Specific identifying information will not be provided.

See Figures 3 and 4 identifying the "Critical Assets within 1 Mile of Municipal Boundary" and "Critical Assets – City Owned (City, GRU, & Gainesville Housing Authority Sites)".

ASSESSMENT OF COMPONENTS

The assessment process involves the City's stormwater, water and wastewater system components and evaluates their vulnerabilities due to weather and climate, including predicted changes. Each component is ranked for vulnerabilities.

The components are categorized as conventional or Low Impact Development (LID)/natural. Conventional components include features such as pipes, culverts, storm drains, and water/wastewater treatment facilities. LID/natural components include features such as natural stream channels, open ditches, and floodplains.

Each component is assessed for its sensitivity and adaptability. Sensitivity is determined by how much is the component affected by weather, climate, and natural hazards. Adaptive Capacity is evaluated by how easily a component can be adjusted or modified to adjust to weather, climate, and natural hazards. An overall assessment score of how sensitive and adaptable a component is determined. A total of 17 components were evaluated and scored.

See Figures 5 – 9 to view the "Stormwater Infrastructure", "Natural Stream and Open Channels", "Culvert Crossings of Natural Creek Channels", "Pump Stations", and "Levee and Floodwall Locations".

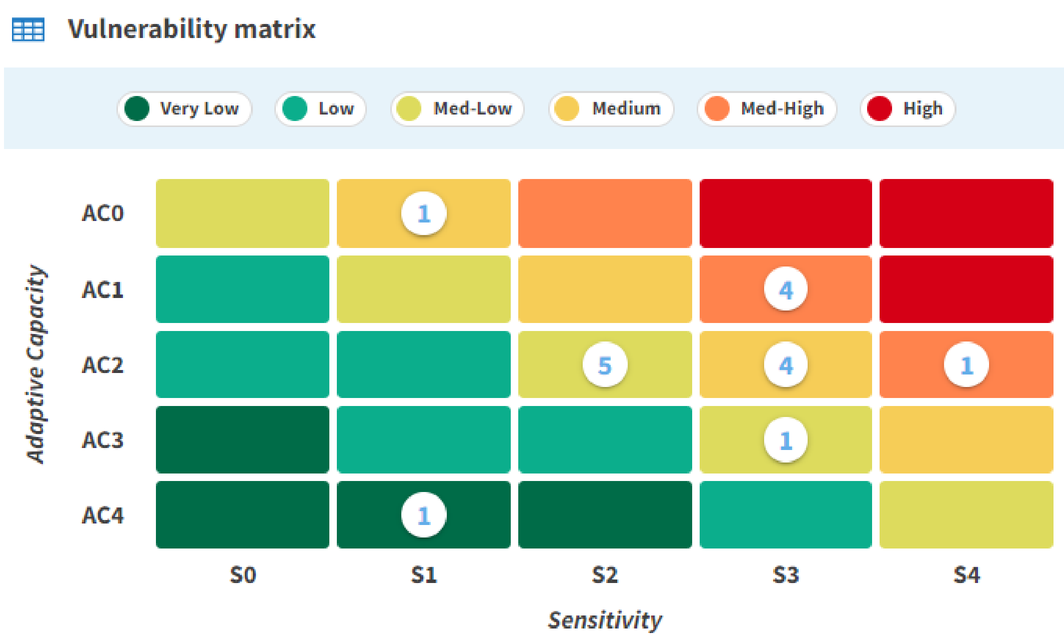
Note: Figures for the water/wastewater utility assets are not provided due to protection under Chapter 119 F.S.

FLOODWISE COMPONENT SUMMARY

Upon completion, the FWC component assessment generates an overall matrix. The matrix uses a sliding scale for both sensitivity (x-axis) and adaptive capacity (y-axis). See below.

- S0 represents that a component will not be affected by projected weather and climate conditions.
- S4 represents that a component will be greatly affected by projected weather and climate conditions.
- AC4 represents that a component can adjust to projected weather and climate conditions.
- AC0 represents that a component is not able to adjust to projected weather and climate conditions.

The matrix is color coded with green being the desired status of a component. A component in the red zones would be of great concern as that would indicate it is very sensitive and not very adaptable to projected weather and climate conditions.



The full FloodWise-generated written portion of vulnerability report is provided in Appendix B.

The vulnerability assessment estimates the City's capacity for stormwater management. The categories assessed were: engineering & infrastructure, data/modeling, personnel, funding, and administration. If a community has all of the resources needed to successfully perform a core function, then it has high capacity in that area. If a community does not have access to the resources needed to successfully perform a core function, it has low capacity in that area. It was determined by the Project Team that areas with only moderate capacity (5 of 10) were engineering & infrastructure and funding. Data /modeling were determined to be just above moderate (6 of 10). Personnel and administration were determined to be closest to full capacity (7 of 10).

CRITICAL ASSET POTENTIAL FLOODING ASSESSMENT

Using the critical assets data and the predicted flood model information by First Street Foundation for years 2021, 2036, and 2051, an analysis was completed to see which critical assets, roadways, and culvert crossings at creeks could potentially be impacted by flooding. See Figures 10-19 for a visual representation of the results. Note: The analysis is simple and only observes if an asset is within the area identified by First Street to potentially flood.

The flood model information utilized by First Street Foundation did not include the two planning horizons (years 2040 and 2070) specified in the Statewide Flooding and Sea Level Rise Resilience Plan criteria under 380.093 F.S.

SOCIOECONOMIC CONSIDERATIONS

The vulnerability assessment also includes identification of community members that are more likely to experience those impacts based on socioeconomic factors, which include People of Color and people who live in poverty.

Thirteen census tracts in Gainesville have populations at greater risk of experiencing negative weather and climate impacts when compared to others. In these areas, more than 75% of housing units are rentals, more than 60% of the population includes People of Color and Hispanics, more than 25% of families live in poverty, and close to 14% of households have no access to a vehicle. The area of the vulnerable tracts at risk within the municipal boundary is 23.5 square miles or 36.3% of the municipal boundary (64.7 square miles).

The Florida Department of Environmental Protection's business portal was used to identify the solid waste facilities and contaminated sites, which could pose an increased risk to the stormwater infrastructure and other critical assets and services under current and future weather and climate conditions. The portal identifies 82 Solid Waste facilities within the municipal boundary; 22 of those are within the 13 census tracts at risk (26.8%). The portal identifies 131 clean-up sites within the municipal boundary; 35 of those within the 13 census tracts at risk (26.7%). See Figures 20 and 21 in the Figures section.

SUMMARY – NEXT STEPS

Summary

The vulnerability assessment establishes understanding how the City's stormwater infrastructure might be impacted by present and future weather, climate, and natural hazard conditions. Gainesville is getting hotter and wetter. According to the FloodWise Communities tool 2,910 properties are currently at risk of flooding and this will increase to 3,273 in 30 years. As rainfall intensity-duration-frequency relationships change, the level of service for existing stormwater infrastructure will be reduced and floodplain limits will increase.

Stormwater hydrology in the Gainesville area is influenced by karst geologic features, including stream to sink watersheds and small isolated watersheds/depression basins connected to active sinkholes and paleosinks. Future conditions will likely include a rise in the groundwater table. As the groundwater table rises, the flood risk will increase.

Flooding events and high intensity or long duration rainfall during periods with high groundwater are also of great concern to the wastewater infrastructure. Flooding of streets can result in increased inflow of stormwater into the wastewater collection system. Elevated groundwater levels cause increased infiltration of groundwater into the sewer collection system. An increase in flooding impacts wastewater pump stations and force mains. During flooding events, multiple pump stations operating at the same time result in increased force main pressures thus limiting the ability of pump stations to pump and increasing the risk of force main failure.

Finally, the vulnerability assessment estimates the City's capacity for stormwater management. The categories assessed were: engineering & infrastructure, data/modeling, personnel, funding, and administration. If a community has all of the resources needed to successfully perform a core function, then it has high capacity in that area. If a community does not have access to the resources needed to successfully perform a core function, it has low capacity in that area. It was determined by the Project Team that areas with only moderate capacity (5 of 10) were engineering & infrastructure and funding. Data /modeling were determined to be just above moderate (6 of 10). Personnel and administration were determined to be closest to full capacity (7 of 10).

Next Steps:

Alachua County has initiated a county-wide vulnerability assessment. The project, is underway with a proposed finish in Spring 2023. The County flood risk model will be significantly more detailed than the First Street Model. The County model will include the 2040 and 2070 planning horizons specified in the Statewide Flooding and Sea Level Rise Resilience Plan criteria under 380.093 F.S.

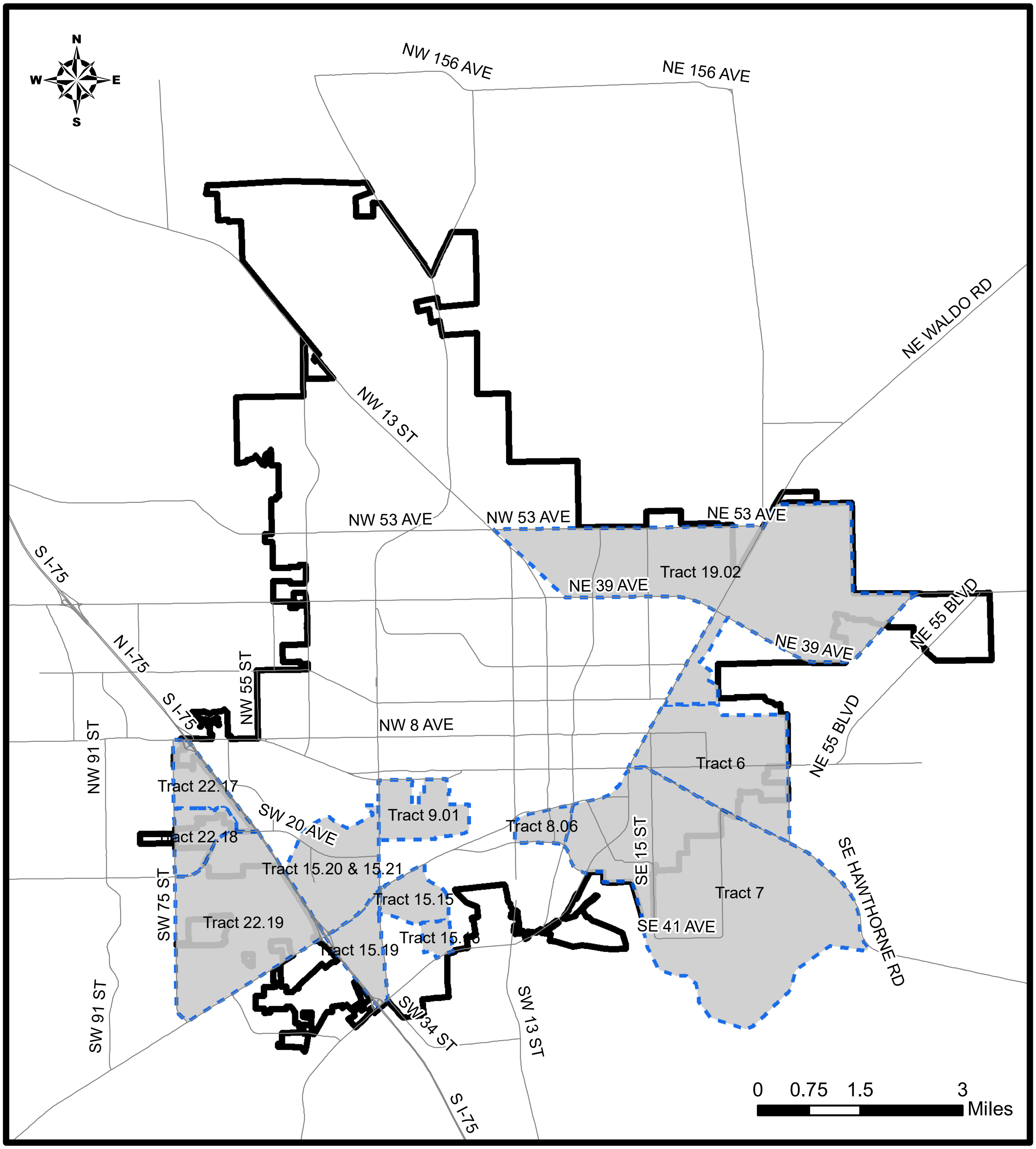
The Project Team has determined next steps towards building resiliency within the City's stormwater infrastructure. They include:

1. Further assess potentially impacted critical assets using elevation data and results from the Alachua County Vulnerability Assessment.
2. Identify adaptation action areas and potential adaptation projects.
3. Seek funding for adaptation plan(s) to address resiliency for impacted critical assets and adaptation action areas.

It is anticipated that state agencies such as the Water Management Districts and the Florida Department of Transportation will develop policies and standards for future rainfall projects. City staff will monitor these efforts and incorporate as appropriate into development review standards for stormwater management, as well as, planned adaptation and resiliency efforts.

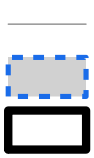
FIGURES

Vulnerable Tracts at Risk
City of Gainesville, Florida



Prepared 4/28/2022

Legend



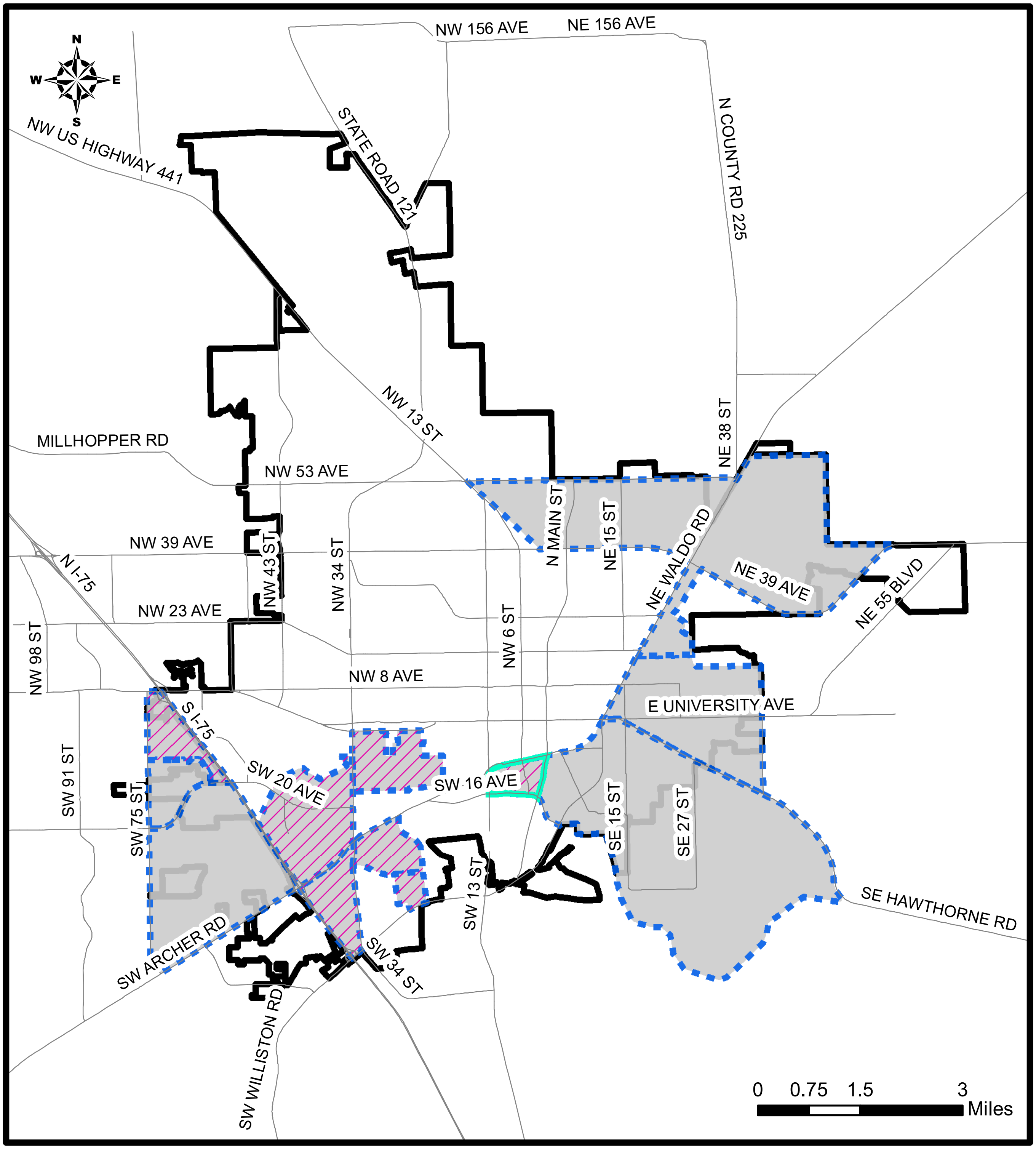
Streets

Vulnerable Tracts

Municipal Boundary

Figure 1

Vulnerable Tracts at Risk
City of Gainesville, Florida



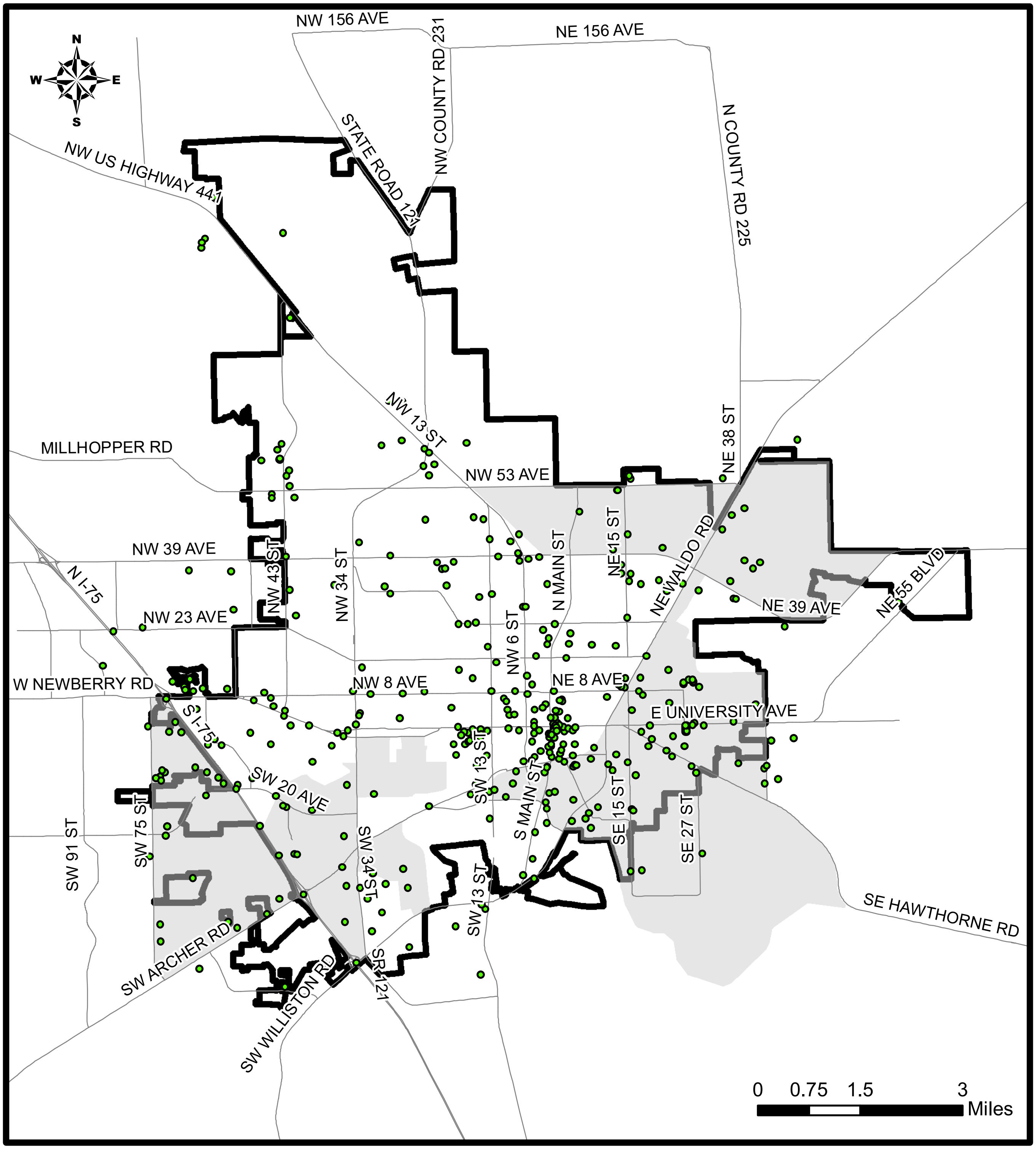
Prepared 4/19/2022

Legend

Streets
Vulnerable Tracts
Municipal Boundary
Impervious Surface 35% or >
Lack of Tree Canopy 50% or >

Figure 2

Critical Assets
Within One Mile of Municipal Boundary



Prepared 4/21/2022

Legend

Streets

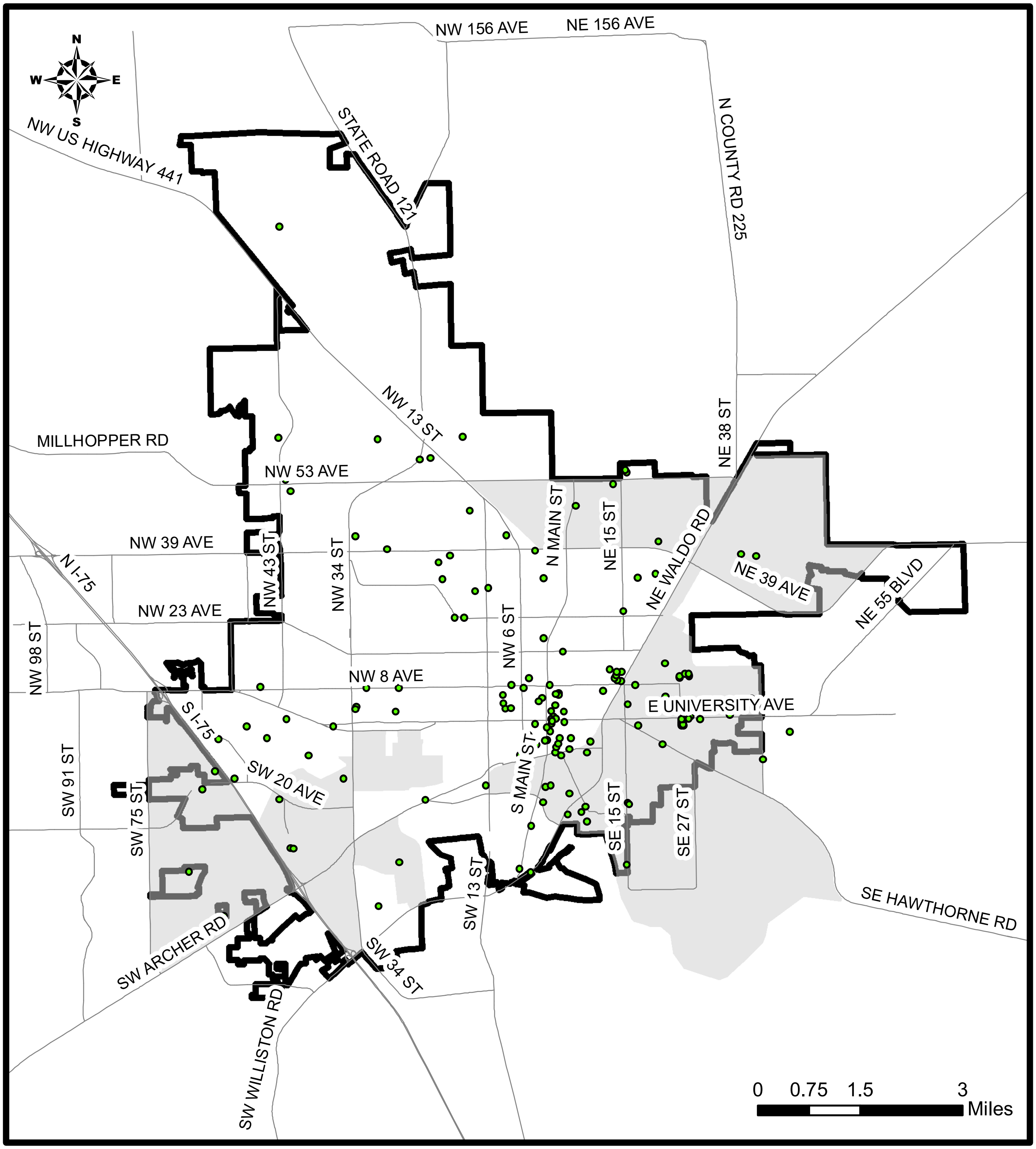
GNV Critical Assets

Vulnerable Tracts

Municipal Boundary

Figure 3

Critical Assets - City Owned
(City, GRU, & Gainesville Housing Authority Sites)



Prepared 4/19/2022

Legend

Streets

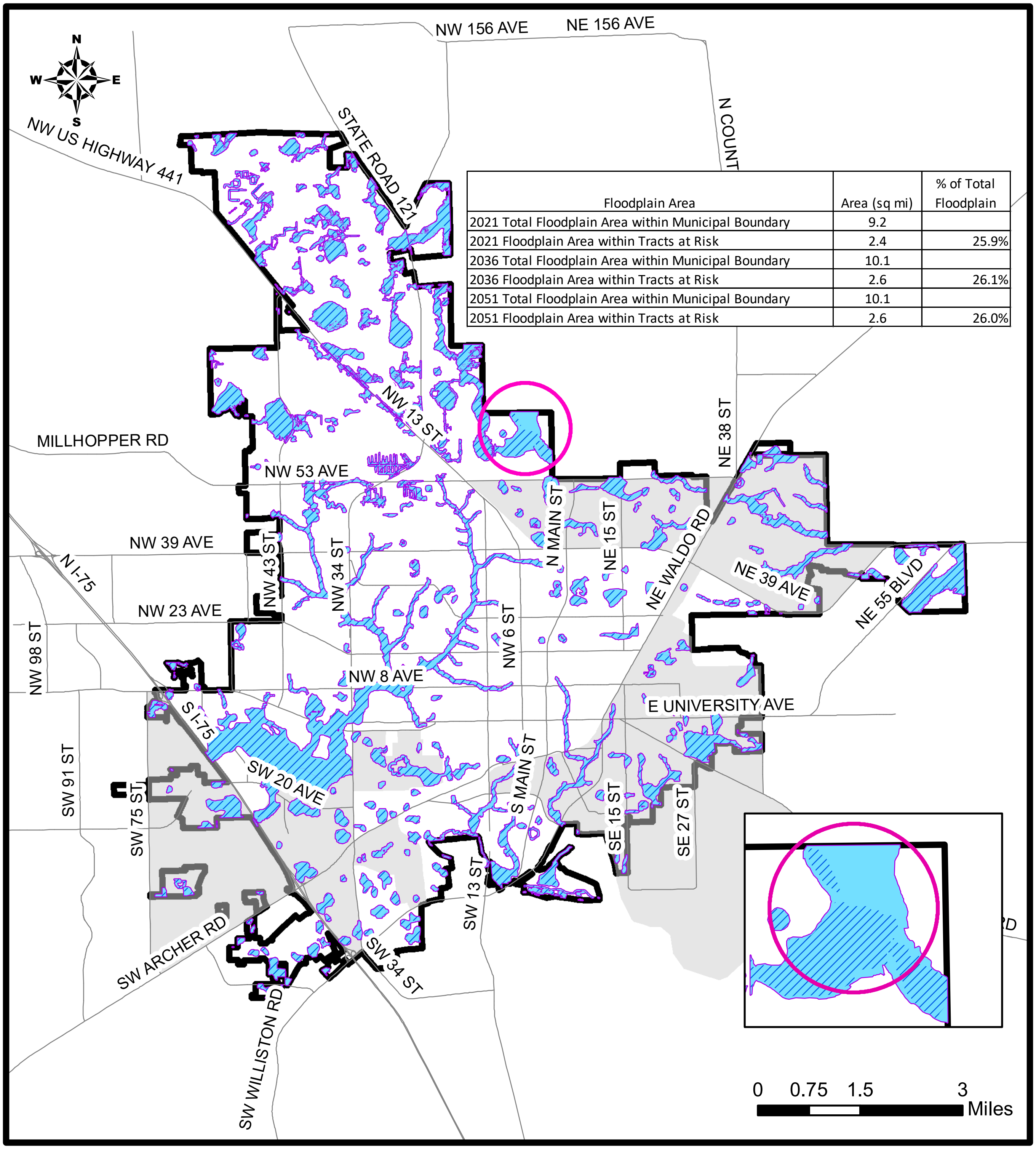
GNV Critical Assets

Vulnerable Tracts

Municipal Boundary

Figure 4

First Street Flood Model Extents
City of Gainesville, Florida



Floodplain Area	Area (sq mi)	% of Total Floodplain
2021 Total Floodplain Area within Municipal Boundary	9.2	
2021 Floodplain Area within Tracts at Risk	2.4	25.9%
2036 Total Floodplain Area within Municipal Boundary	10.1	
2036 Floodplain Area within Tracts at Risk	2.6	26.1%
2051 Total Floodplain Area within Municipal Boundary	10.1	
2051 Floodplain Area within Tracts at Risk	2.6	26.0%

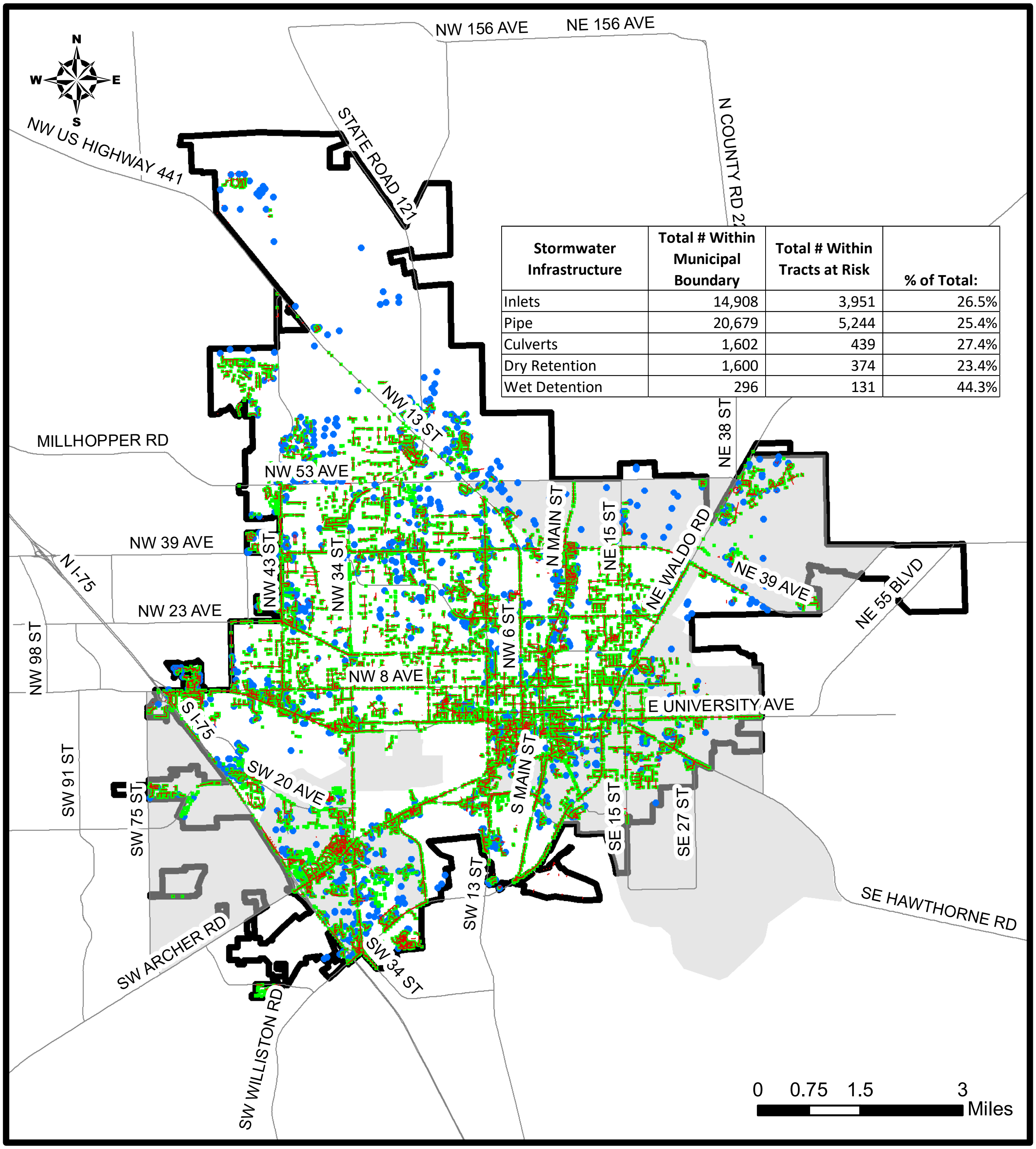
Prepared 4/19/2022

Legend

- Streets
- Vulnerable Tracts
- Municipal Boundary
- 2021 First Street Flood Model
- 2036 First Street Flood Model
- 2051 First Street Flood Model

Figure 10

Stormwater Infrastructure
Within City of Gainesville Municipal Boundary



Stormwater Infrastructure	Total # Within Municipal Boundary	Total # Within Tracts at Risk	% of Total:
Inlets	14,908	3,951	26.5%
Pipe	20,679	5,244	25.4%
Culverts	1,602	439	27.4%
Dry Retention	1,600	374	23.4%
Wet Detention	296	131	44.3%

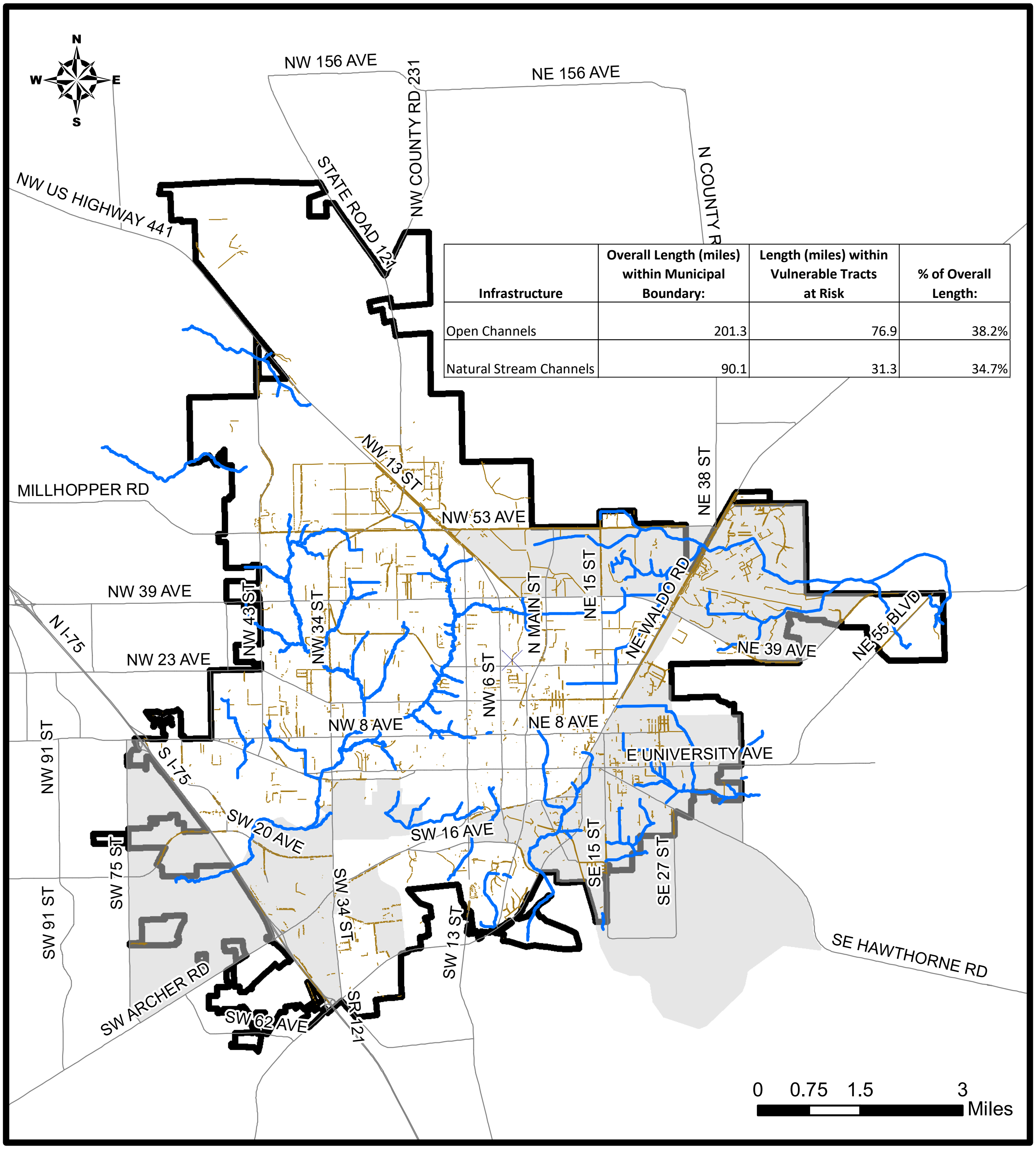
Prepared 4/19/2022

Legend

- Streets
- Vulnerable Tracts
- Municipal Boundary
- Pipe
- Inlet
- Dry Retention/Wet Detention

Figure 5

Natural Creek and Open Channels
City of Gainesville, Florida



Infrastructure	Overall Length (miles) within Municipal Boundary:	Length (miles) within Vulnerable Tracts at Risk	% of Overall Length:
Open Channels	201.3	76.9	38.2%
Natural Stream Channels	90.1	31.3	34.7%

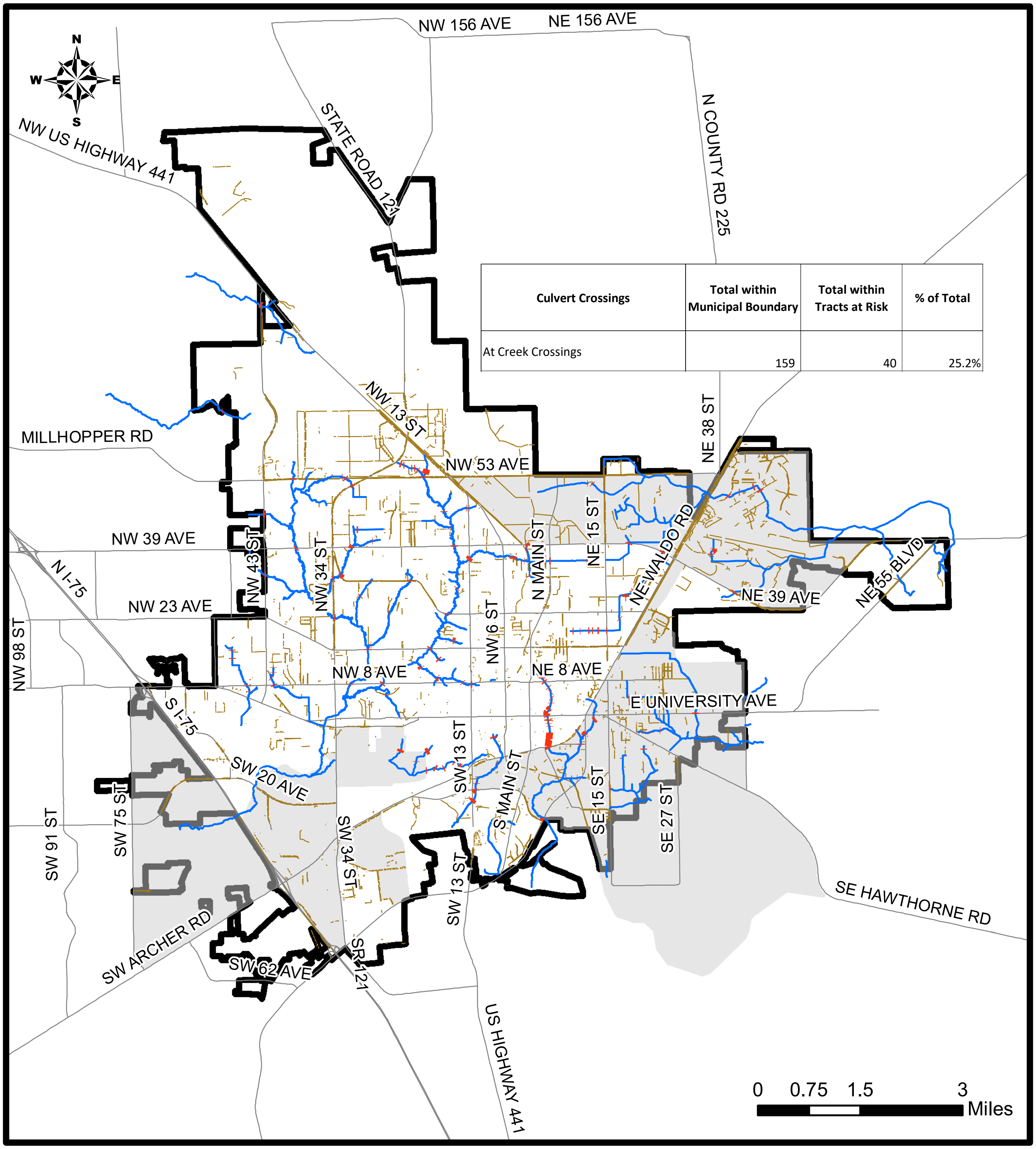
Prepared 4/20/2022

Legend

Streets
Natural Stream Channels
Vulnerable Tracts
Open Channels
Municipal Boundary

Figure 6

Culvert Crossings at Natural Creek Channels



Culvert Crossings	Total within Municipal Boundary	Total within Tracts at Risk	% of Total
At Creek Crossings	159	40	25.2%

Prepared 4/22/2022

Legend

Streets

Vulnerable Tracts

Municipal Boundary

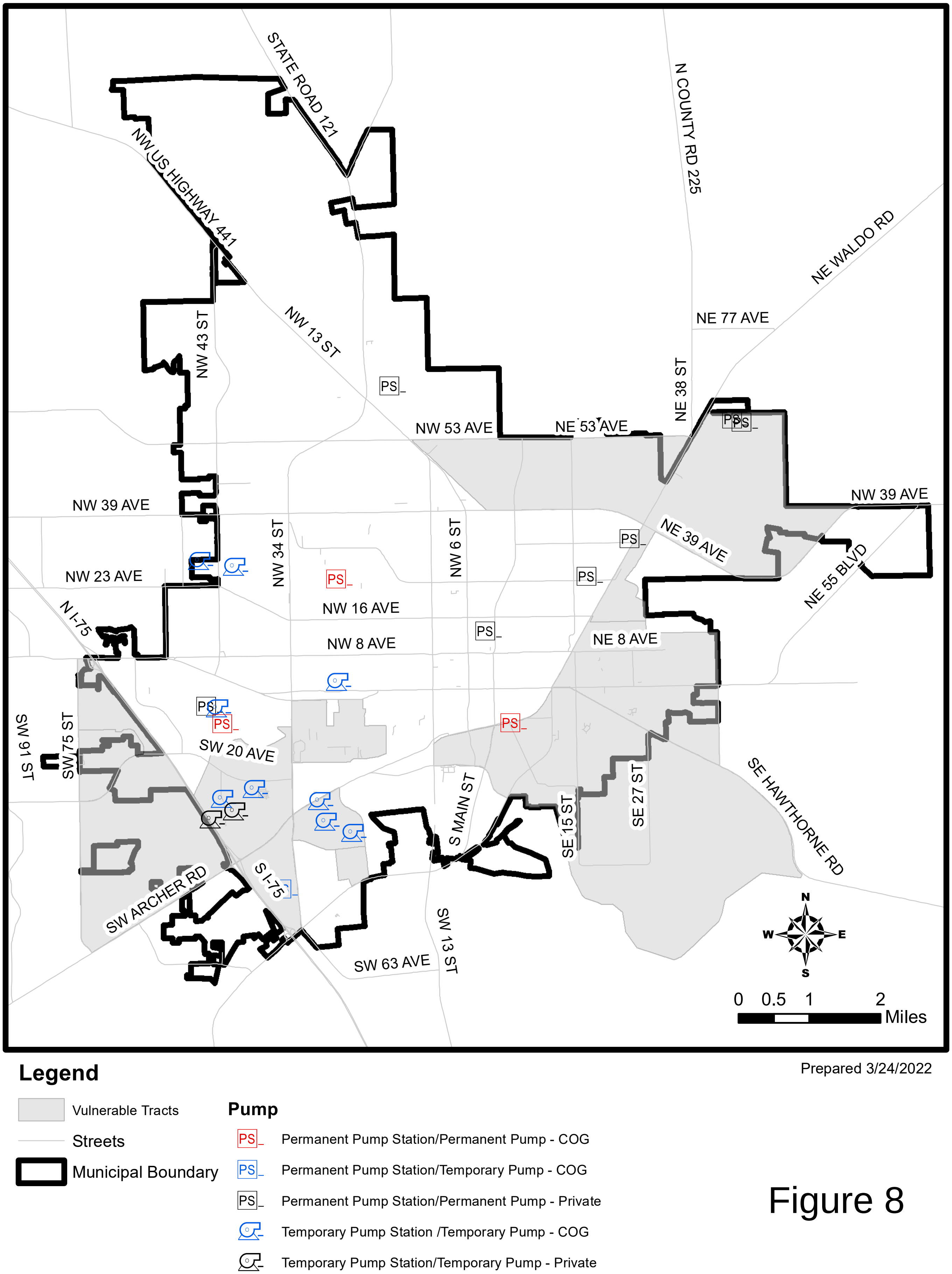
Culvert Crossing at Natural Channels

Natural Stream Channels

Open Channels

Figure 7

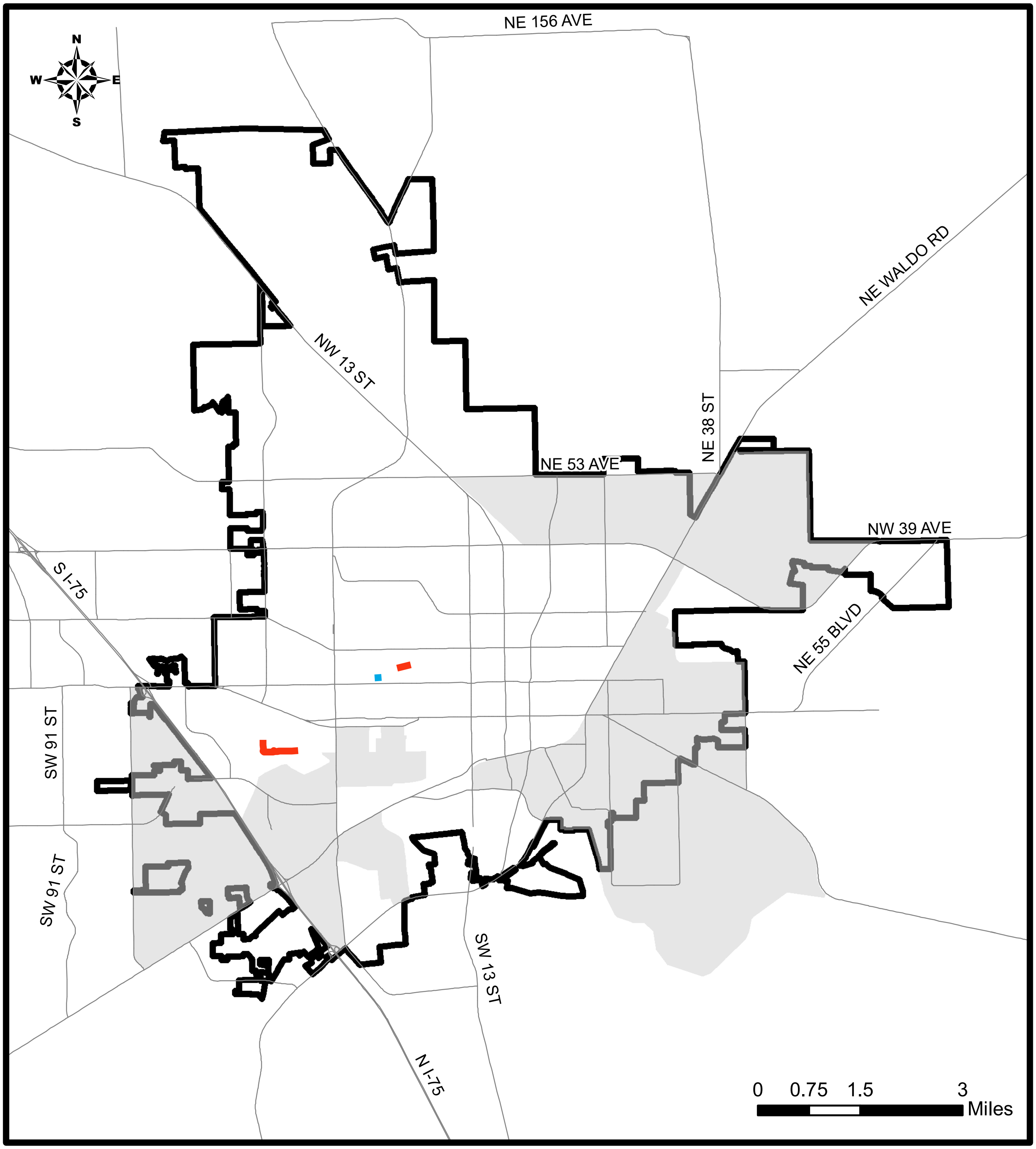
Pump Stations
City of Gainesville, Florida



Prepared 3/24/2022

Figure 8

Levee and Floodwall Locations



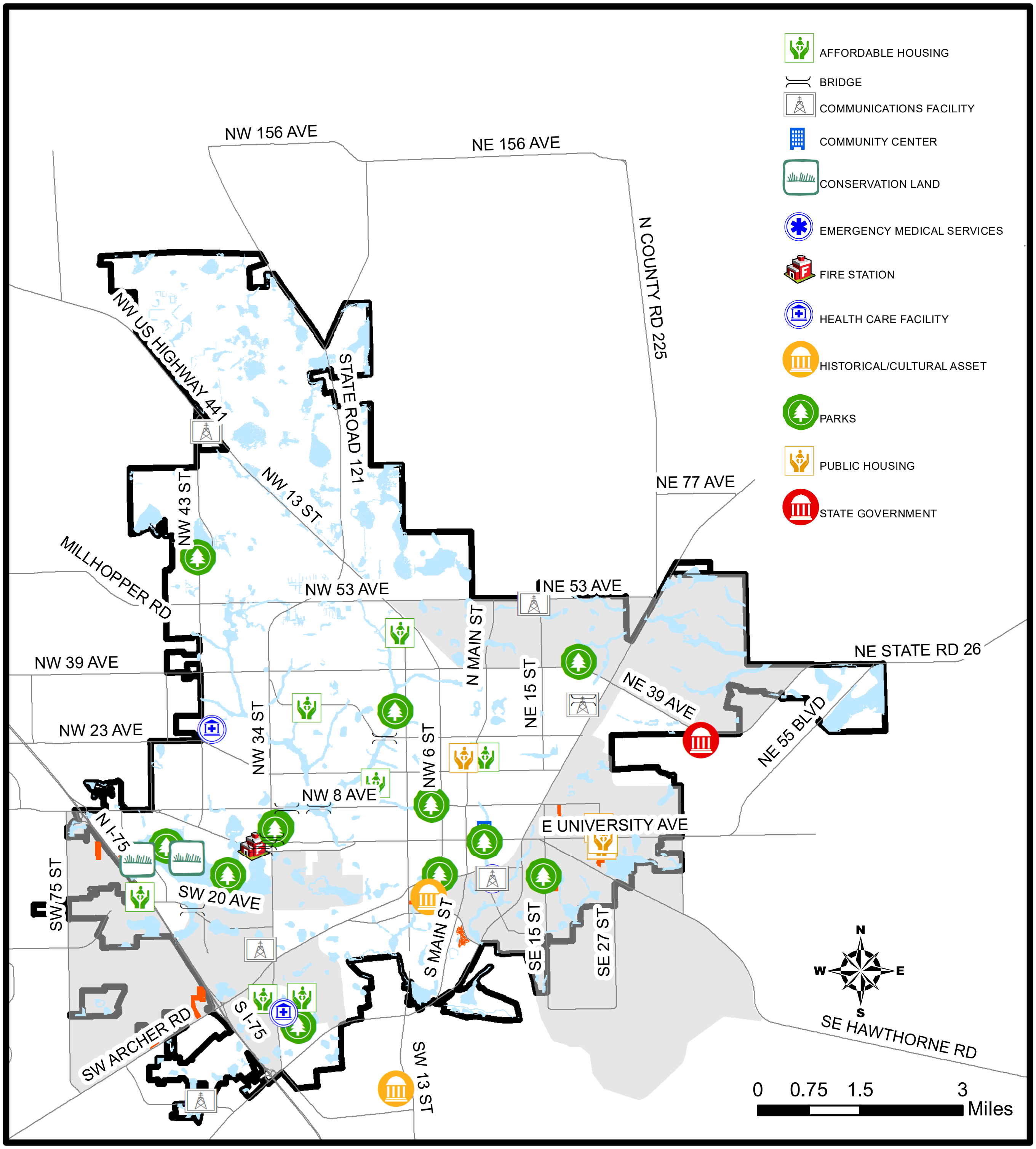
Prepared 4/22/2022

Legend

Streets
Vulnerable Tracts
Municipal Boundary
Levee
Floodwall

Figure 9

Potentially Impacted Critical Facilities 2021 First Street Flood Model - 100 year



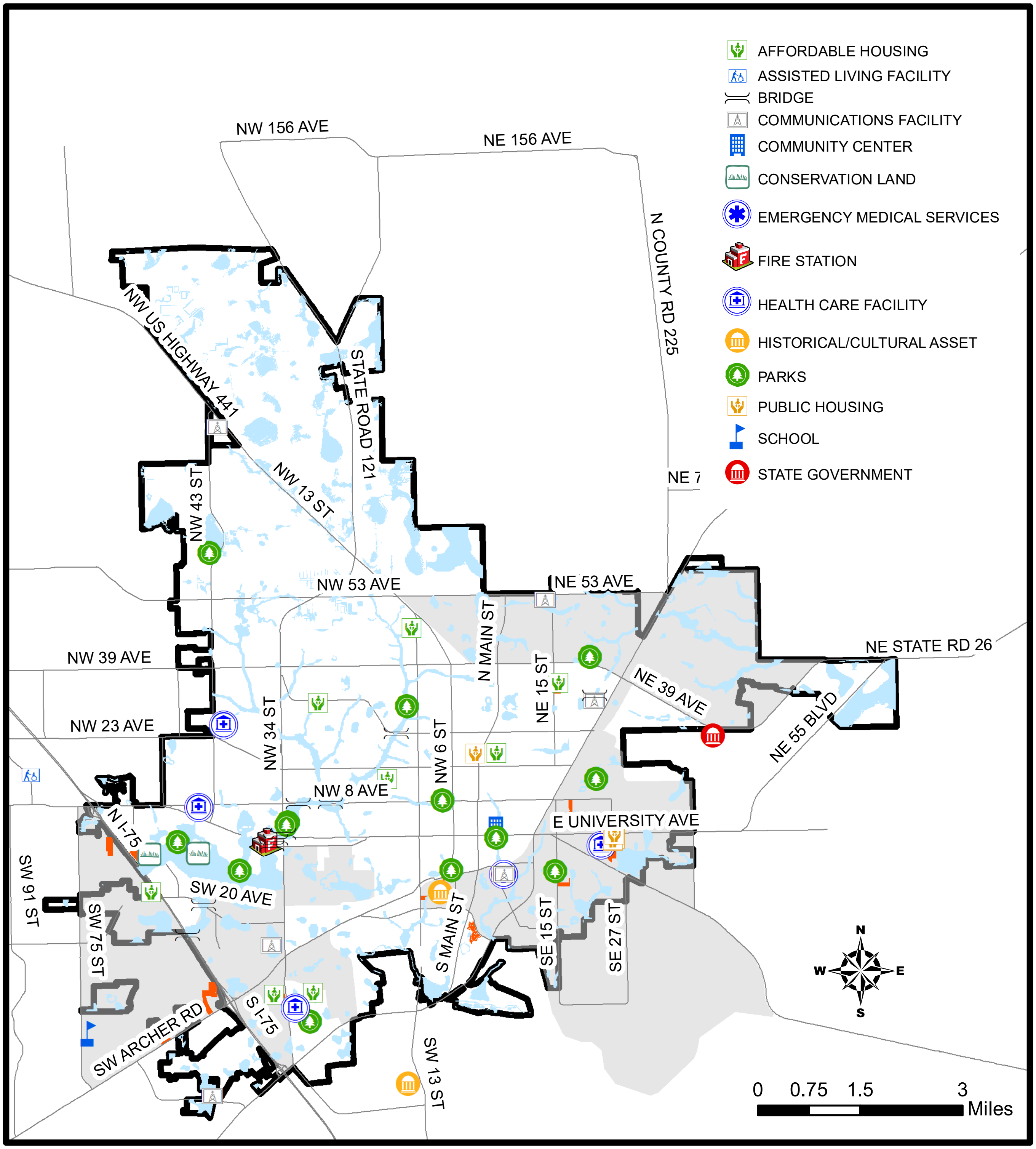
Prepared 4/14/2022

Legend

Streets	Potential Impacted Affordable Housing_2021
Vulnerable Tracts	2021 First Street Flood Model
Municipal Boundary	

Figure 11

Potentially Impacted Critical Facilities
2036 First Street Flood Model - 100 year



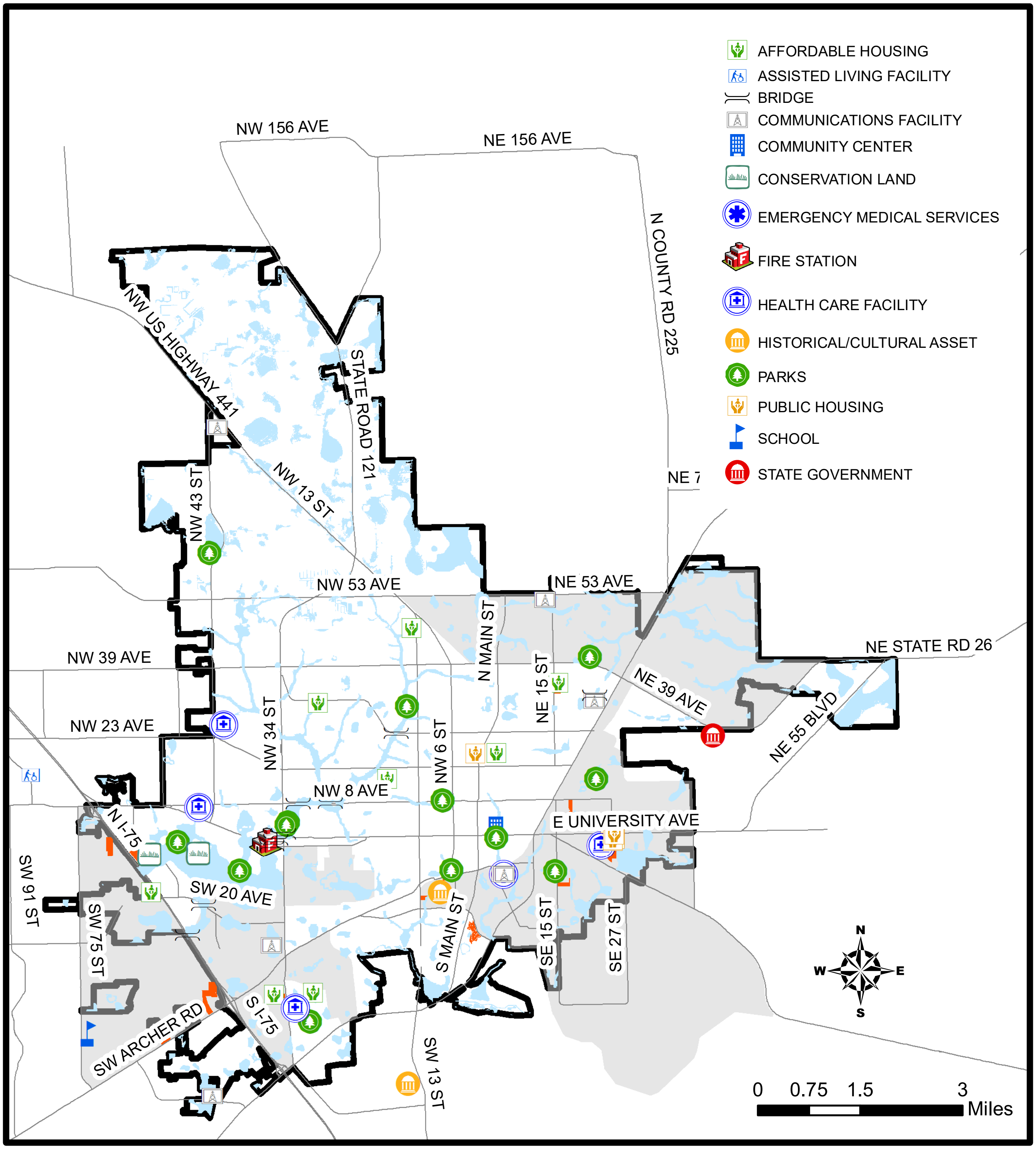
Prepared 4/14/2022

Legend

- Streets
- Vulnerable Tracts
- Municipal Boundary
- Potential Impacted Affordable Housing_2036
- 2036 First Street Flood Model

Figure 12

Potentially Impacted Critical Facilities
2051 First Street Flood Model - 100 year



Prepared 4/14/2022

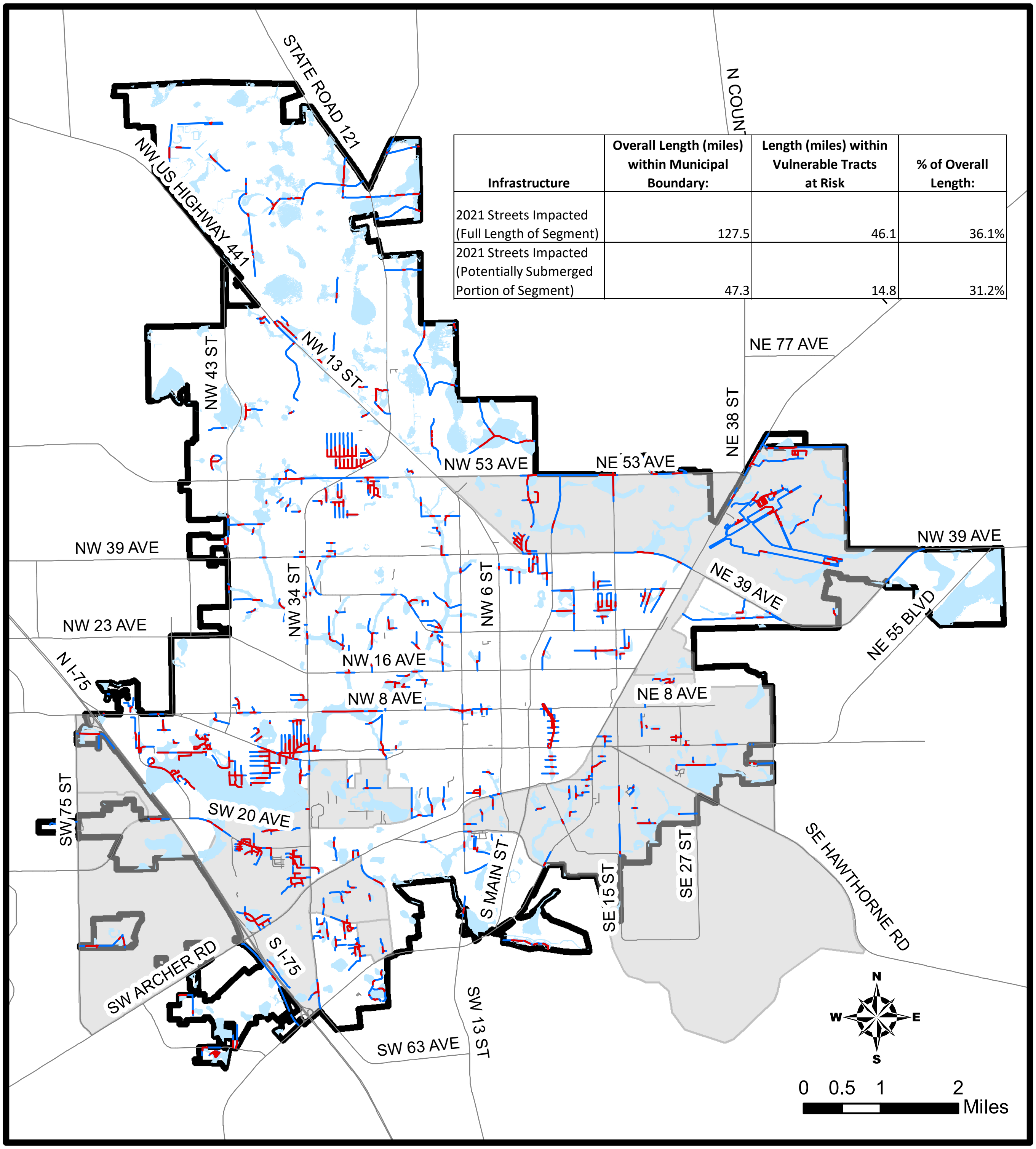
Legend

	Streets		Potential Impacted Affordable Housing_2051
	Vulnerable Tracts		2051 First Street Flood Model
	Municipal Boundary		

Figure 13

Potential Street Flooding
2021 First Street Flood Model - 100 year

Infrastructure	Overall Length (miles) within Municipal Boundary:	Length (miles) within Vulnerable Tracts at Risk	% of Overall Length:
2021 Streets Impacted (Full Length of Segment)	127.5	46.1	36.1%
2021 Streets Impacted (Potentially Submerged Portion of Segment)	47.3	14.8	31.2%



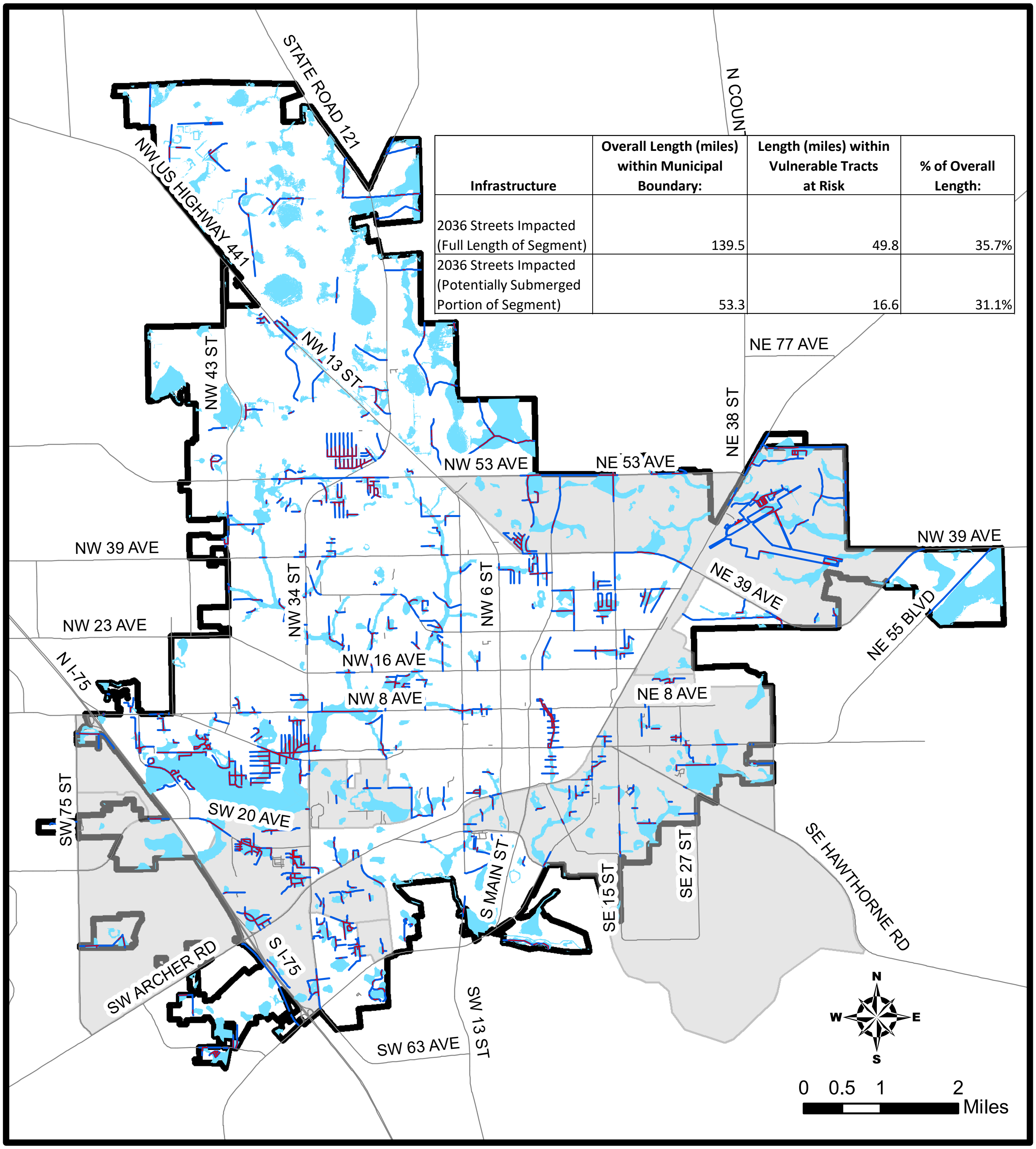
Prepared 3/24/2022

Legend

- Streets
- Vulnerable Tracts
- Municipal Boundary
- Potential Submerged Portion
- Full Length of Segment Impacted
- 2021 First Street Flood Model

Figure 14

Potential Street Flooding
2036 First Street Flood Model - 100 year



Infrastructure	Overall Length (miles) within Municipal Boundary:	Length (miles) within Vulnerable Tracts at Risk	% of Overall Length:
2036 Streets Impacted (Full Length of Segment)	139.5	49.8	35.7%
2036 Streets Impacted (Potentially Submerged Portion of Segment)	53.3	16.6	31.1%

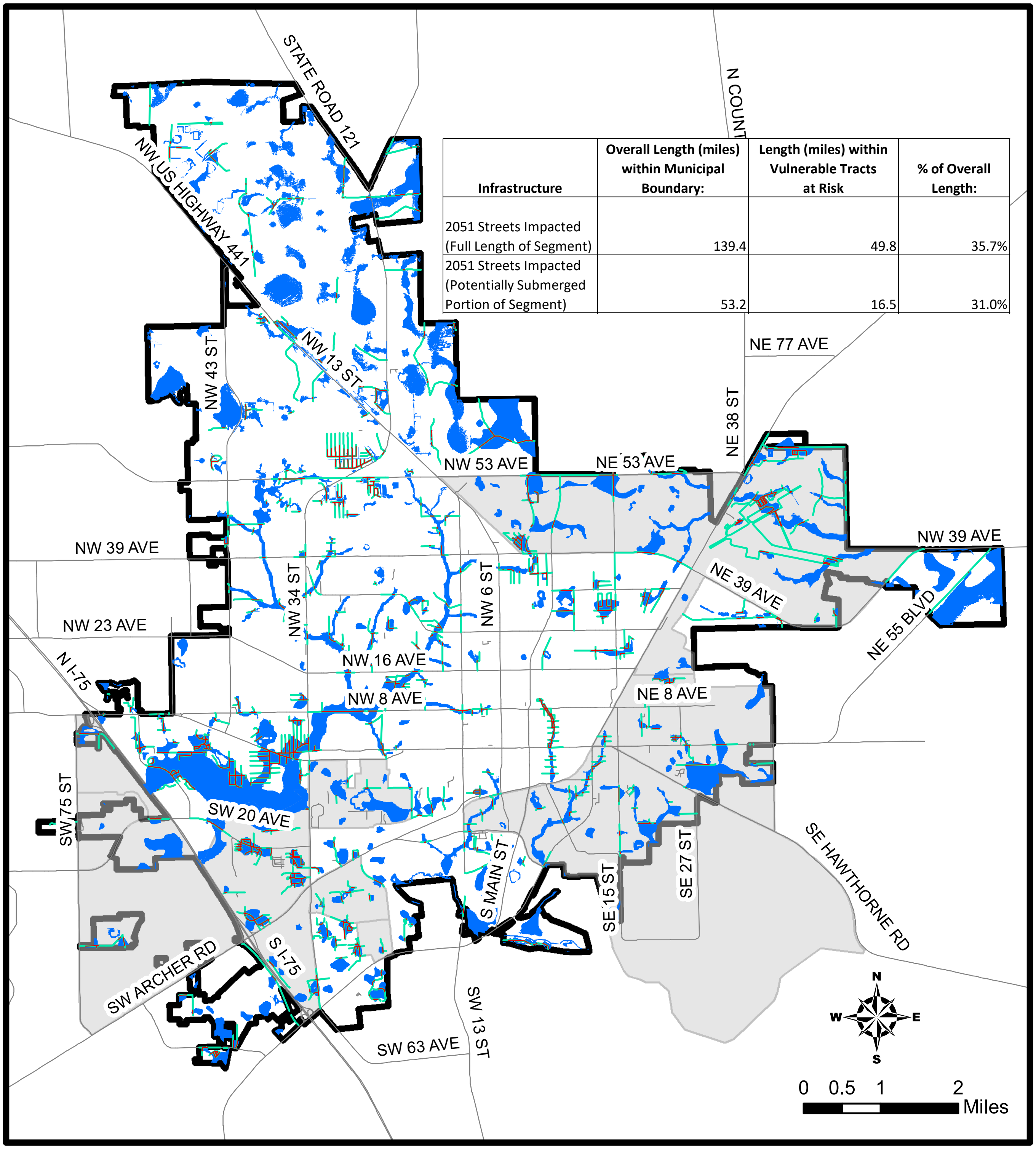
Prepared 3/24/2022

Legend

- Streets
- Vulnerable Tracts
- Municipal Boundary
- Potential Submerged Portion
- Full Length of Segment Impacted
- 2036 First Street Flood Model

Figure 15

Potential Street Flooding
2051 First Street Flood Model - 100 year



Infrastructure	Overall Length (miles) within Municipal Boundary:	Length (miles) within Vulnerable Tracts at Risk	% of Overall Length:
2051 Streets Impacted (Full Length of Segment)	139.4	49.8	35.7%
2051 Streets Impacted (Potentially Submerged Portion of Segment)	53.2	16.5	31.0%

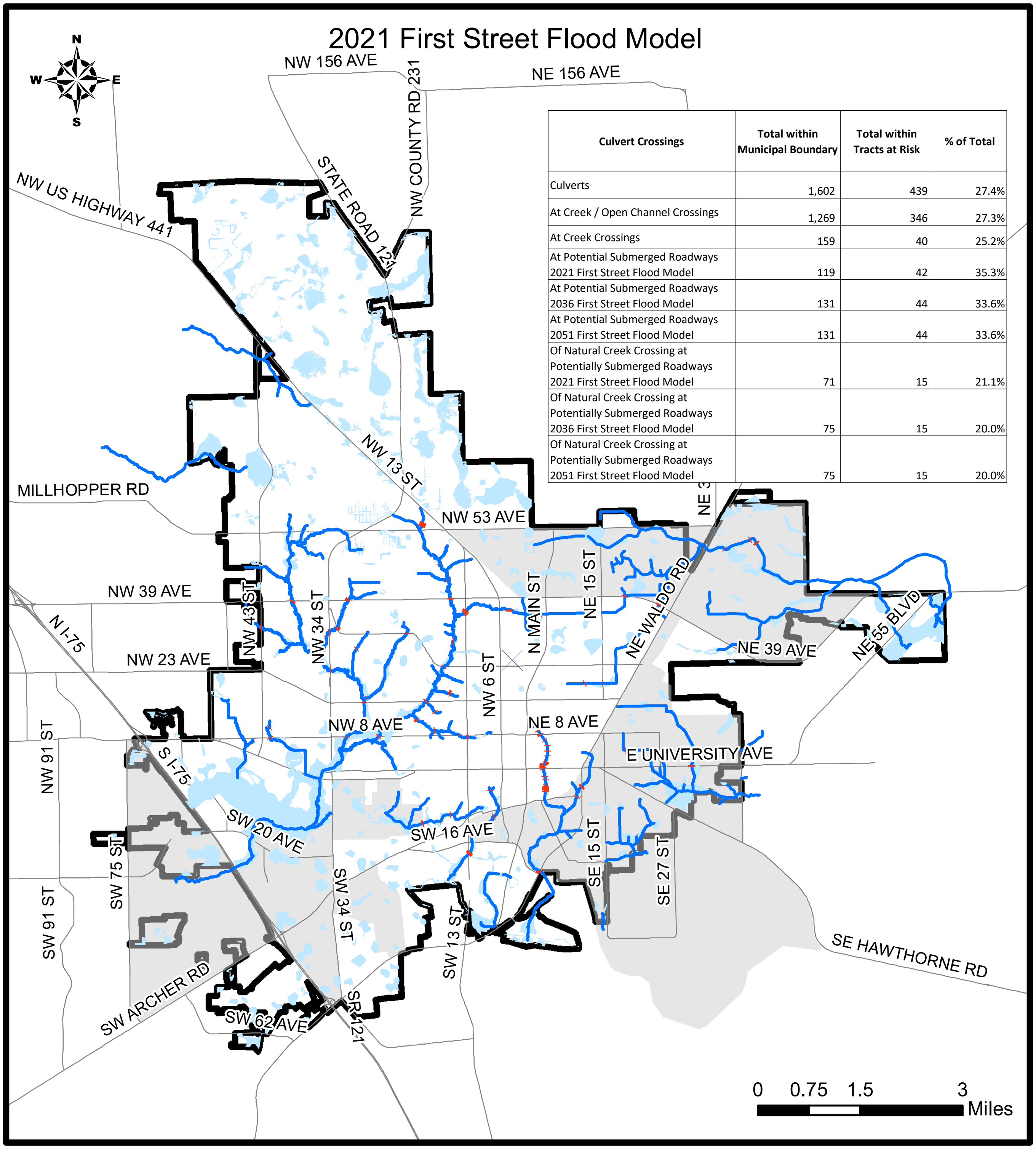
Prepared 3/24/2022

Legend

- Streets
- Vulnerable Tracts
- Municipal Boundary
- Potential Submerged Portion
- Full Length of Segment Impacted
- 2051 First Street Flood Model

Figure 16

Culvert Crossings of Natural Creek Channels at Potentially Submerged Roads



Culvert Crossings	Total within Municipal Boundary	Total within Tracts at Risk	% of Total
Culverts	1,602	439	27.4%
At Creek / Open Channel Crossings	1,269	346	27.3%
At Creek Crossings	159	40	25.2%
At Potential Submerged Roadways 2021 First Street Flood Model	119	42	35.3%
At Potential Submerged Roadways 2036 First Street Flood Model	131	44	33.6%
At Potential Submerged Roadways 2051 First Street Flood Model	131	44	33.6%
Of Natural Creek Crossing at Potentially Submerged Roadways 2021 First Street Flood Model	71	15	21.1%
Of Natural Creek Crossing at Potentially Submerged Roadways 2036 First Street Flood Model	75	15	20.0%
Of Natural Creek Crossing at Potentially Submerged Roadways 2051 First Street Flood Model	75	15	20.0%

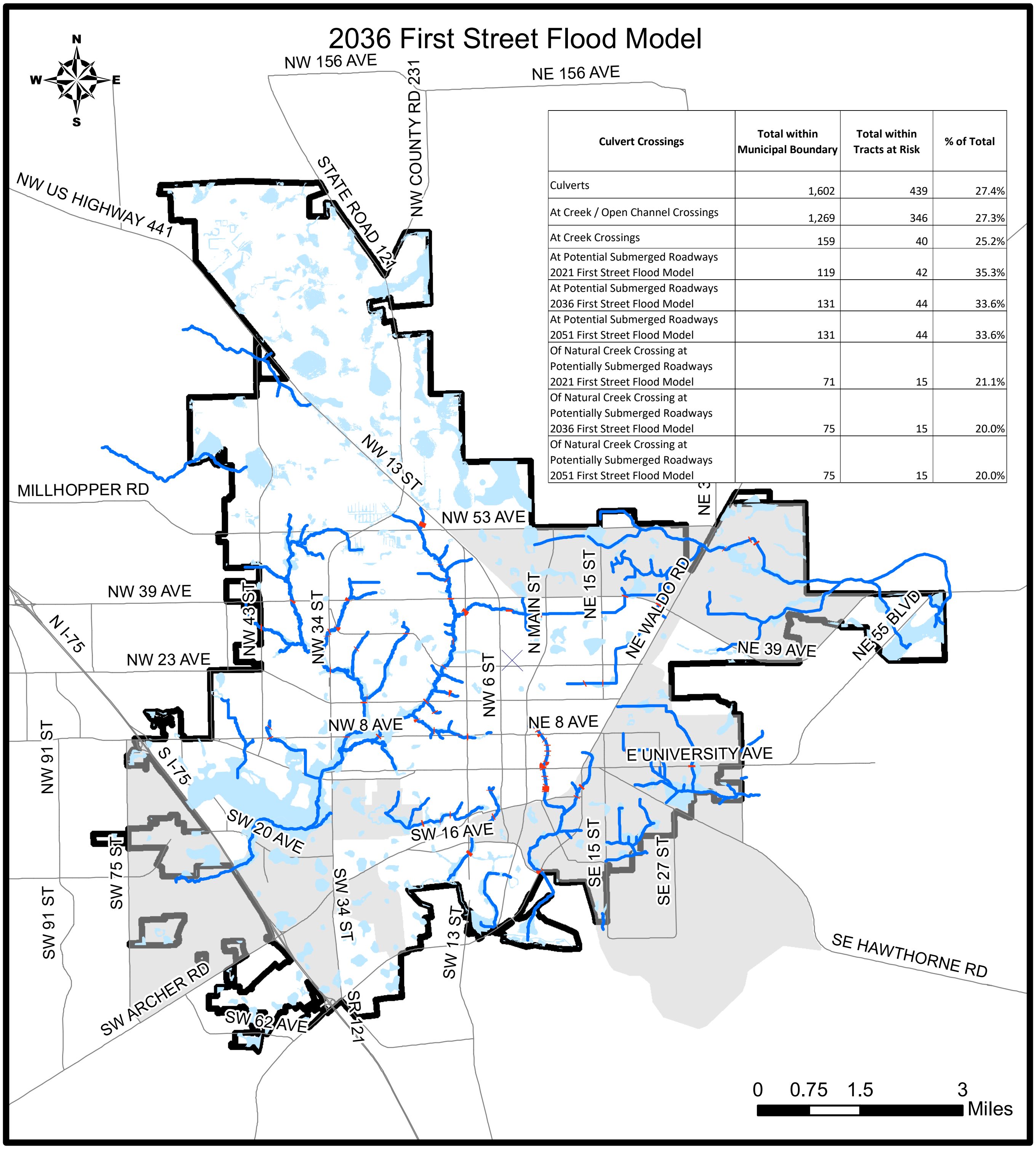
Prepared 4/20/2022

Legend

- Streets
- Vulnerable Tracts
- Municipal Boundary
- Potentially Impacted Culvert Crossing
- Natural Stream Channels
- 2021 First Street Flood Model

Figure 17

Culvert Crossings of Natural Creek Channels at Potentially Submerged Roads



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Of Natural Creek Crossing at Potentially Submerged Roadways 2051 First Street Flood Model	75	15	20.0%

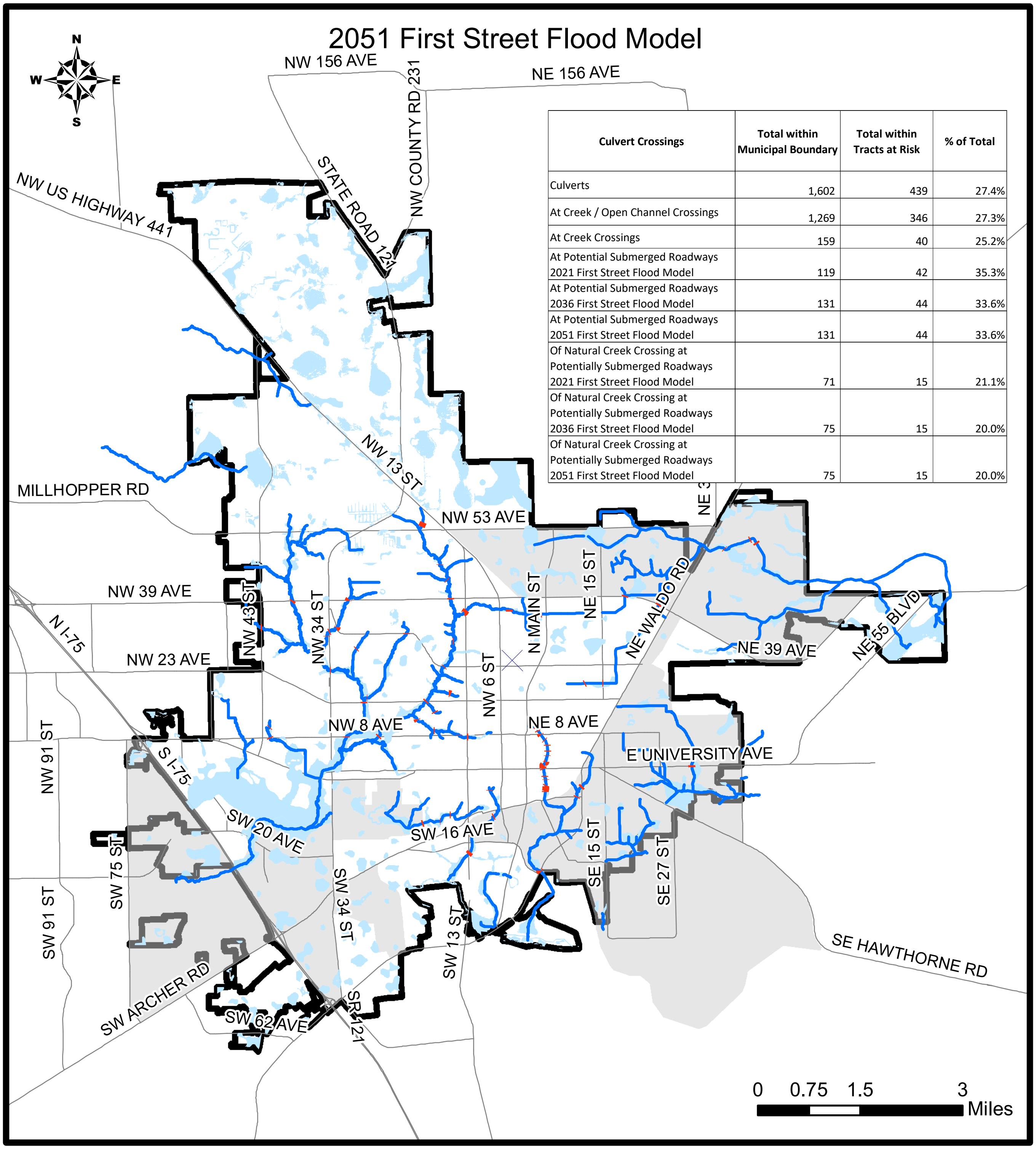
Prepared 4/20/2022

Legend

- Streets
- Vulnerable Tracts
- Municipal Boundary
- Potentially Impacted Culvert Crossing
- Natural Stream Channels
- 2036 First Street Flood Model

Figure 18

Culvert Crossings of Natural Creek Channels at Potentially Submerged Roads



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Of Natural Creek Crossing at Potentially Submerged Roadways 2021 First Street Flood Model	71	15	21.1%
Of Natural Creek Crossing at Potentially Submerged Roadways 2036 First Street Flood Model	75	15	20.0%
Of Natural Creek Crossing at Potentially Submerged Roadways 2051 First Street Flood Model	75	15	20.0%

Prepared 4/20/2022

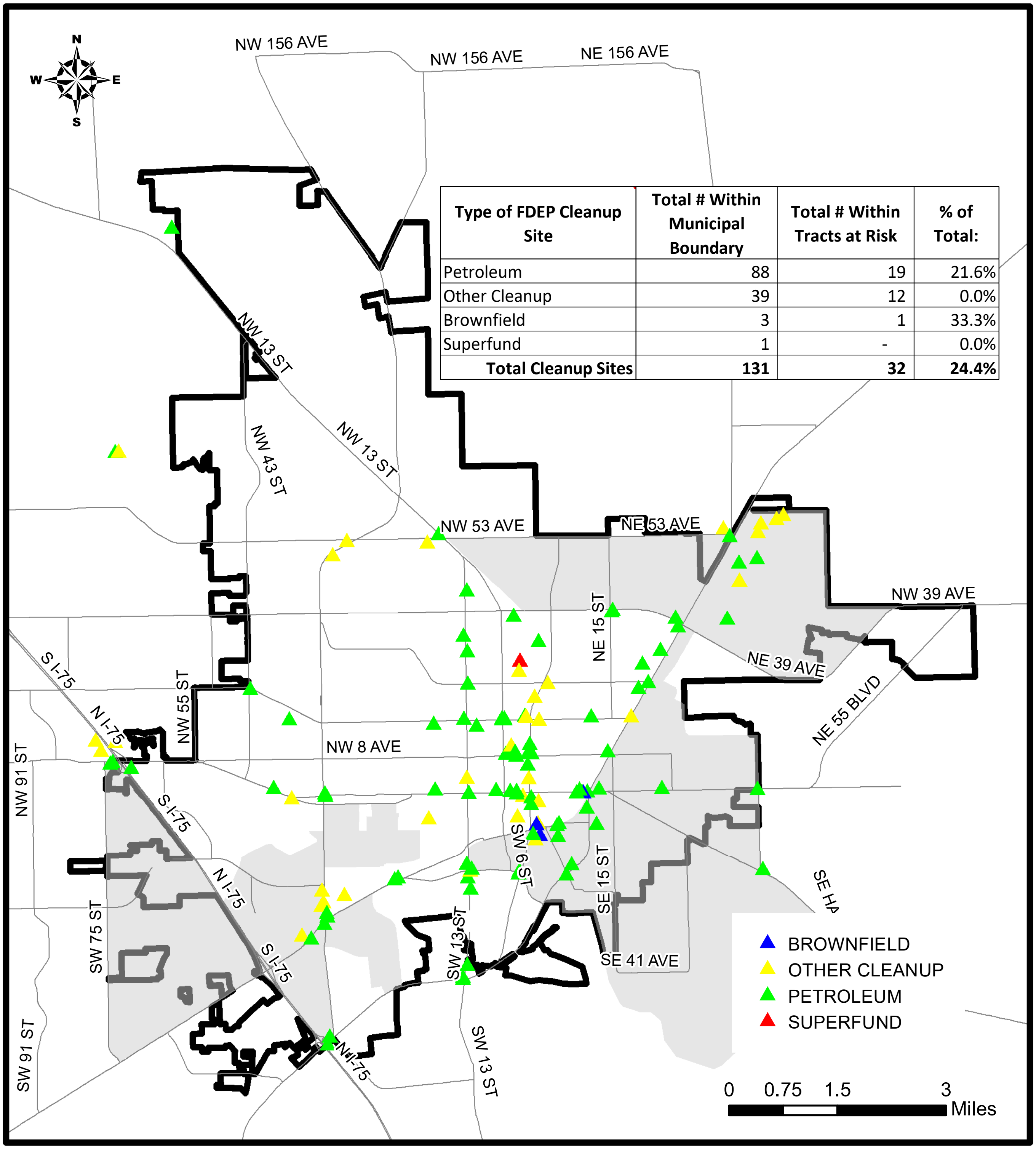
Legend

- Streets
- Vulnerable Tracts
- Municipal Boundary
- Potentially Impacted Culvert Crossing
- Natural Stream Channels
- 2051 First Street Flood Model

Figure 19

Waste Cleanup Sites Per FDEP Business Portal

Type of FDEP Cleanup Site	Total # Within Municipal Boundary	Total # Within Tracts at Risk	% of Total:
Petroleum	88	19	21.6%
Other Cleanup	39	12	0.0%
Brownfield	3	1	33.3%
Superfund	1	-	0.0%
Total Cleanup Sites	**131**	**32**	**24.4%**



Prepared 7/18/2022

Legend

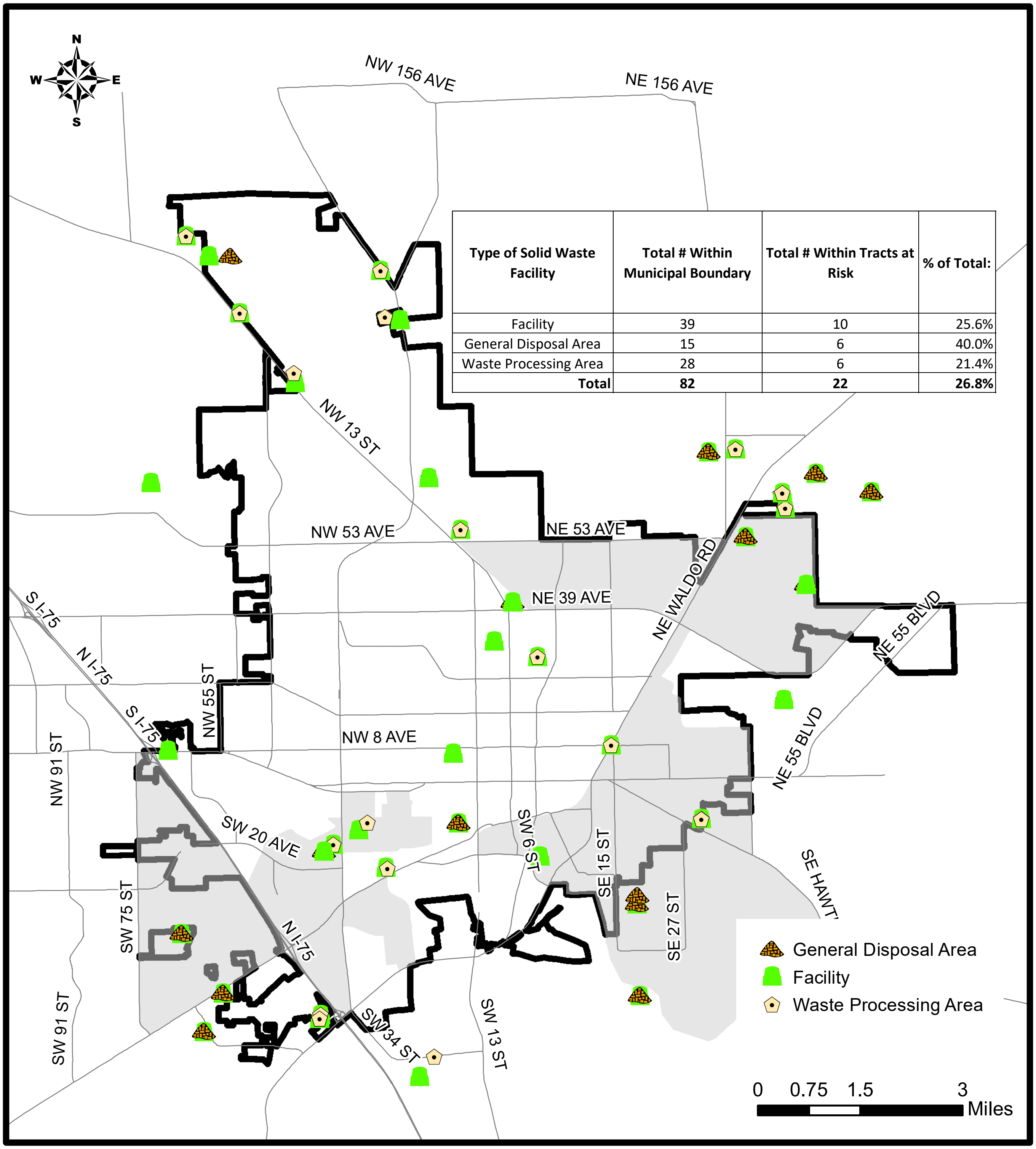
Streets

Vulnerable Tracts

Municipal Boundary

Figure 20

Solid Waste Facilities
Per FDEP Business Portal



Type of Solid Waste Facility	Total # Within Municipal Boundary	Total # Within Tracts at Risk	% of Total:
Facility	39	10	25.6%
General Disposal Area	15	6	40.0%
Waste Processing Area	28	6	21.4%
Total	**82**	**22**	**26.8%**

Prepared 4/28/2022

Legend

Streets

Vulnerable Tracts

Municipal Boundary

Figure 21

APPENDIX A – TEAM MEMBERS

Staff Member		Department
Nathaniel	Chan	Sustainable Development
Nia	Davis	Equity and Inclusion
Ben	Howort	Equity and Inclusion
Rick	Hutton	GRU, Water/Wastewater
Liliana	Kolluri	Sustainable Development
Katherine	Michael	PW, GIS
Gail	Mowry	PW, Stormwater
Alice	Rankeillor	PW, Stormwater
Roberto	Rosario	GRU, Water/Wastewater
Kristen	Sealey	GRU, Water/Wastewater

APPENDIX B - NEIGHBHOODS AT RISK & FLOODWISE GENERATED REPORT

NEIGHBHOODS AT RISK REPORT

Neighborhoods at Risk

Selected Tracts

Selected Location(s):

Gainesville, FL

Comparison Location:

U.S.

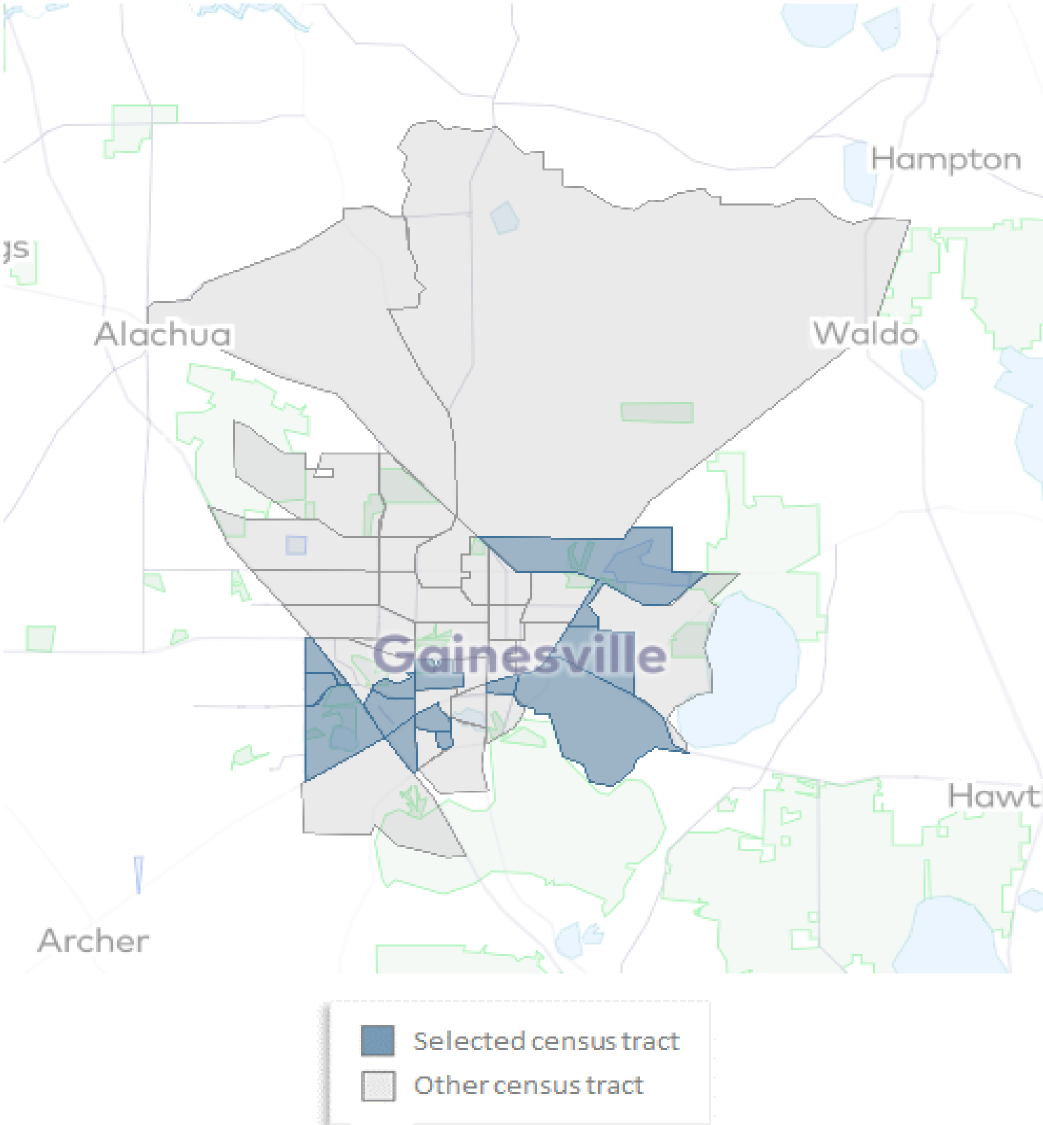
Produced by

Headwaters Economics'

Economic Profile System (EPS)

December 6, 2021

Area of Interest



Headwaters Economics

Headwaters Economics is an independent, nonprofit research group that works to improve community development and land management decisions: **headwaterseconomics.org**.

Neighborhoods at Risk

Neighborhoods at Risk is a free, web-based tool that provides cities with neighborhood-level information about at-risk populations and their vulnerability to the impacts of climate change.

Free and easy-to-use: Quickly create maps and reports of socioeconomic and climate data.

Available nation-wide: Explore socioeconomic and climate data for any community or county in the nation.

Updated continuously: Make use of the latest available, published government data.

headwaterseconomics.org/apps/neighborhoods-at-risk

Neighborhoods at Risk

Selected Tracts

Table of Contents

Click the links above for quick access to report sections.

Neighborhoods at Risk

Selected Tracts

Summary

Indicators 2019*	Selected Tracts	U.S.	Percent Difference Selected Tracts vs. U.S.
People under 5 years	5.2%	6.1%	-16%
People over 65 years	6.7%	15.6%	-80%
People of color (including Hispanic)	60.6%	39.3%	43%
People who don't speak English well	2.6%	4.3%	-49%
People without a high school degree	13.4%	12.0%	11%
Families in poverty	25.4%	9.5%	91%
Housing units that are rentals	75.4%	36.0%	71%
Households with no car	14.1%	8.6%	48%
People with disabilities	11.7%	12.6%	-7%
People without health insurance	13.2%	8.8%	40%

High Reliability: Data with coefficients of variation (CVs) < 12% are in black to show that the sampling error is small.
Medium Reliability: Data with CVs between 12 & 40% are in orange. These values should be interpreted with caution.
Low Reliability: Data with CVs > 40% are displayed in red to indicate that the estimate is considered very unreliable.

* ACS 5-year estimates: 2019 represents average characteristics from 2015-2019.

CITATION: U.S. Department of Commerce. 2020. Census Bureau, American Community Survey Office, Washington, D.C., reported by Headwaters Economics' Neighborhoods at Risk, headwaterseconomics.org/par.

Summary

What do we measure on this page?

This page shows a quick comparison for many of the indicators covered in this report to highlight how the selected tracts differ from the United States as a whole.

The percent, or relative, difference between the selected tracts and the U.S. is calculated by dividing the difference between the values by the arithmetic mean of the values.

Why is it important?

These indicators are all measures of a population more likely to experience adverse outcomes from disruptions due to extreme weather events, climate change, pollution, or limited health care access.

Particularly high percentages for any of these indicators may highlight populations that are at higher risk and in need of outreach from disaster planning, public health, or social service organizations.

CHANGES IN BOUNDARIES: Data describing change over time can be misleading when geographic boundaries have changed. The Census provides documentation about changes in boundaries at this site: www.census.gov/geo/reference/boundary-changes.html

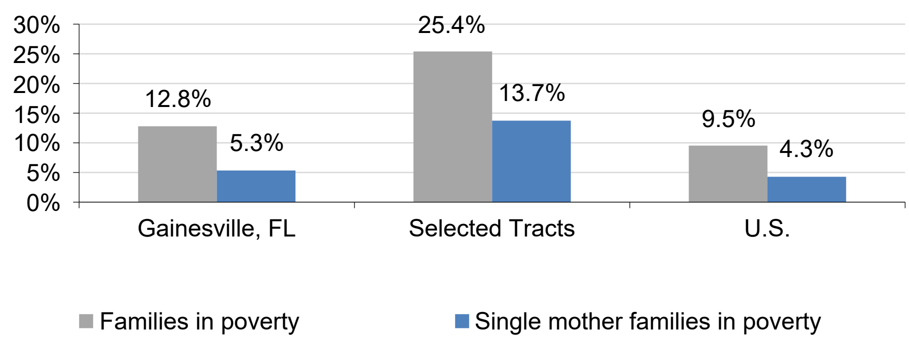
Families in Poverty

	Gainesville, FL	Selected Tracts	U.S.
Total families for whom poverty status is determined, 2019*	18,927	7,375	79,114,031
Families in poverty	2,421	1,873	7,541,196
Families with children in poverty	1,396	1,344	5,581,063
Single mother families in poverty	1,010	1,013	3,385,236
Percent of Total, 2019*			
Families in poverty	12.8%	25.4%	9.5%
Families with children in poverty	7.4%	18.2%	7.1%
Single mother families in poverty	5.3%	13.7%	4.3%
Change in Percentage Points, 2010*-2019*			
For example, if the value is 3% in 2010* and 4.5% in 2019*, the reported change in percentage points is 1.5.			
Families in poverty	-3.1	-0.2	-0.5
Families with children in poverty	-3.3	-1.6	-0.8
Single mother families in poverty	-1.6	-2.1	-0.5

High Reliability: Data with coefficients of variation (CVs) < 12% are in black to indicate that the sampling error is relatively small.
Medium Reliability: Data with CVs between 12 & 40% are in orange to indicate that the values should be interpreted with caution.
Low Reliability: Data with CVs > 40% are displayed in red to indicate that the estimate is considered very unreliable.

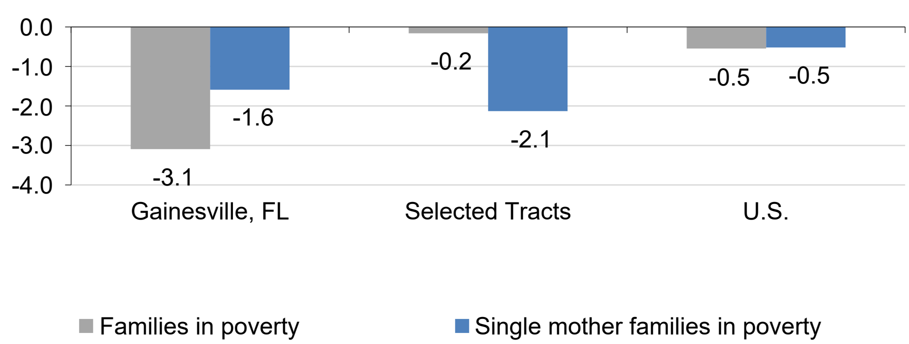
Families in Poverty, Percent of Total, 2019*

- Selected Tracts has the largest share of single mother families in poverty (13.7%).



Families in Poverty, Change in Percentage Points, 2010*-2019*

- The largest change in the share of single mother familes in poverty occurred in Selected Tracts, which went from 15.9% to 13.7%.



* ACS 5-year estimates used. 2019 represents average characteristics from 2015-2019; 2010 represents 2006-2010.

CITATION: U.S. Department of Commerce. 2020. Census Bureau, American Community Survey Office, Washington, D.C., reported by Headwaters Economics' Neighborhoods at Risk, headwaterseconomics.org/apps/neighborhoods-at-risk.

Families in Poverty

What do we measure on this page?

This page describes the number of families living below the poverty line, and separately reports families with children and single mother families with children.

The Census defines a family as a group of two or more people who reside together and who are related by birth, marriage, or adoption.

The Census Bureau uses a set of income thresholds that vary by family size and composition to define who is poor. If the total income for a family or an unrelated individual falls below the relevant poverty threshold, then the family or an unrelated individual is classified as being "below the poverty level."

Why is it important?

Families in poverty may lack the resources to meet their basic needs. Their challenges cross the spectrum of food, housing, health care, education, vulnerability to natural disasters, and emotional stress.

> To save money, families with low incomes often have to make lifestyle compromises such as unhealthy foods, less food, substandard housing, or delayed medical care.[1]
>
> Lack of financial resources makes families in poverty more vulnerable to natural disasters. This is due to inadequate housing, social exclusion, and an inability to re-locate or evacuate.[11, 2]
>
> Inadequate shelter exposes occupants to increased risk from storms, floods, fire, and temperature extremes.[2] Households with low incomes are more likely to have unhealthy housing such as leaks, mold, or rodents.[5]
>
> The expense of running fans, air conditioners, and heaters makes low-income people hesitant to mitigate the temperature of their living spaces.[1, 2] Furthermore, those in high-crime areas may not want to open their windows.[2]
>
> Families in poverty are disproportionately affected by higher food prices, which are expected to rise in response to climate change.[1]
>
> Children in poor families, on average, receive fewer years of education compared to children in wealthier families.[12]
>
> Low-income residents are less likely to have adequate property insurance, so they may bear an even greater burden from property damage due to natural hazards.[2]
>
> Living in poverty can lead to a lack of personal control over potentially hazardous situations such as increased air pollution or flooding. Impoverished families may be less likely to take proactive measures to prevent harm.[11]

Superscript numbers refer to references provided at the end of the report.

CHANGES IN BOUNDARIES: Data describing change over time can be misleading when geographic boundaries have changed.
The Census provides documentation about changes in boundaries at this site: www.census.gov/geo/reference/boundary-changes.html

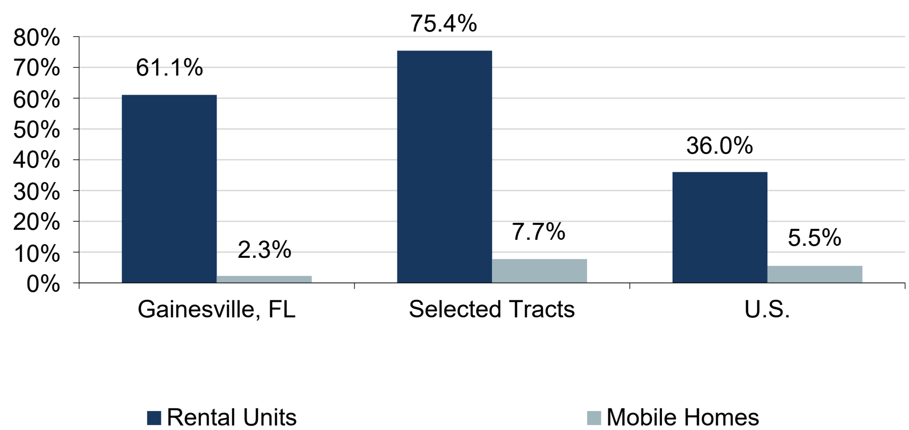
Rental & Mobile Homes

	Gainesville, FL	Selected Tracts	U.S.
Total Occupied Housing Units, 2019*	49,143	18,843	120,756,048
Rental Units	30,010	14,212	43,481,667
Mobile Homes	1,115	1,458	6,681,368
Percent of Total, 2019*			
Rental Units	61.1%	75.4%	36.0%
Mobile Homes	2.3%	7.7%	5.5%
Change in Percentage Points, 2010*-2019*			
For example, if the value is 3% in 2010* and 4.5% in 2019*, the reported change in percentage points is 1.5.			
Rental Units	1.2	-6.7	4.4
Mobile Homes	0.3	-0.3	-0.3
Median Home Value (MHV), 2019* (2020 $s)	$163,843	na	$220,110
Change in MHV, 2010*-2019* (2020 $s)	-$36,048	na	-$3,521

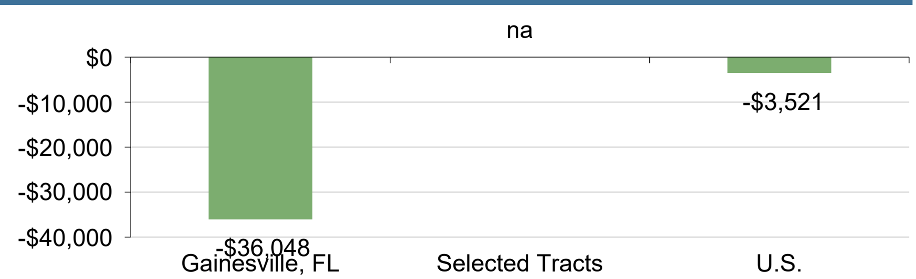
High Reliability: Data with coefficients of variation (CVs) < 12% are in black to indicate that the sampling error is relatively small.
Medium Reliability: Data with CVs between 12 & 40% are in orange to indicate that the values should be interpreted with caution.
Low Reliability: Data with CVs > 40% are displayed in red to indicate that the estimate is considered very unreliable.

Rental Units and Mobile Homes as a Percent of Total Housing Units, 2019*

- Selected Tracts has the largest share of rental units (75.4%).
- Selected Tracts has the largest share of mobile homes (7.7%).



Change in Median Home Value, 2010*-2019* (2020 $s)



* ACS 5-year estimates used. 2019 represents average characteristics from 2015-2019; 2010 represents 2006-2010.

CITATION: U.S. Department of Commerce. 2020. Census Bureau, American Community Survey Office, Washington, D.C., reported by Headwaters Economics' Neighborhoods at Risk, headwaterseconomics.org/apps/neighborhoods-at-risk.

Rental & Mobile Homes

What do we measure on this page?

This page reports the numbers of housing units that are either rental units or mobile homes, and provides median home value.

Why is it important?

In general, home ownership contributes to well-being and stability. However, each type of living situation has its own risks and health concerns.

Home ownership is often associated with mental health benefits such as high self-esteem, a sense of control over one's living situation, and financial stability.[13]

The financial stress associated with losing one's home is heightened by people's emotional attachment to their home and their neighborhood.[14]

Homeowners typically pay a greater overall housing cost, but renters pay a larger proportion of their income. The high proportion of household costs for renters has further increased over the past 25 years.[15]

Rental homes are generally not maintained as well as those that are owned. Substandard housing conditions like dampness, mold, and exposure to toxic substances or allergens are linked with compromised health outcomes.[13]

Areas with high-density residences, such as urban areas, tend to have a greater proportion of renters.[1] High density living conditions and large, multistory apartment buildings exacerbate heat-related health stresses.[4]

Mobile homes are more likely to be damaged in extreme weather, which poses a risk for both the structure and the occupants.[4,11]

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People of Color and Hispanics

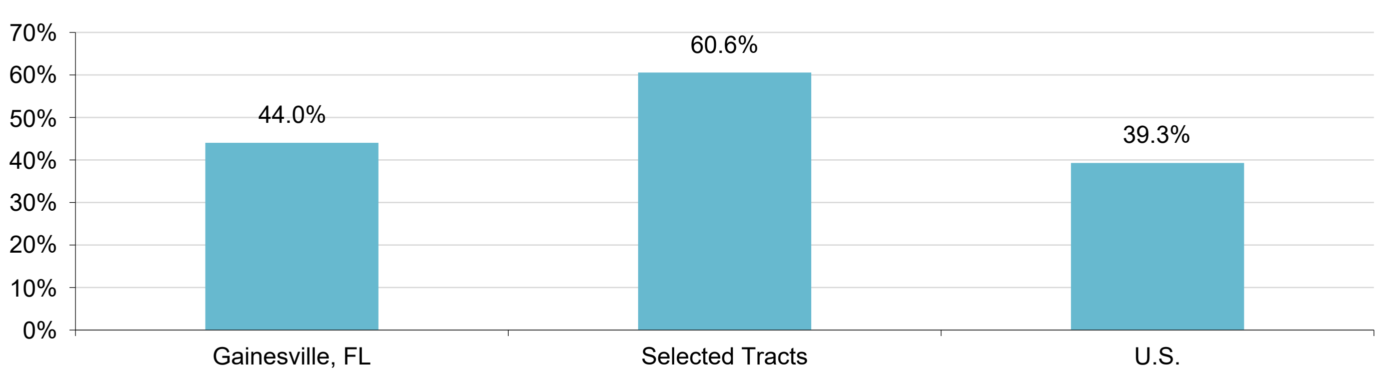
	Gainesville, FL	Selected Tracts	U.S.
Total Population, 2019*	132,127	52,165	324,697,795
White alone	86,422	25,449	235,377,662
Black or African American alone	28,748	19,367	41,234,642
American Indian alone	˙572	˙250	2,750,143
Asian alone	9,515	4,212	17,924,209
Native Hawaii & Other Pacific Is. alone	˙137	**¨35**	599,868
Some other race alone	˙1,559	˙1,000	16,047,369
Two or more races	5,174	˙1,852	10,763,902
Hispanic or Latino (of any race)	15,672	6,059	58,479,370
Not Hispanic or Latino	116,455	46,106	266,218,425
Not Hispanic & White alone	73,937	20,571	197,100,373
People of Color and Hispanics	58,190	31,594	127,597,422

Percent of Total, 2019*

	Gainesville, FL	Selected Tracts	U.S.
White alone	65.4%	48.8%	72.5%
Black or African American alone	21.8%	37.1%	12.7%
American Indian alone	˙0.4%	˙0.5%	0.8%
Asian alone	7.2%	8.1%	5.5%
Native Hawaii & Other Pacific Is. alone	0.1%	**¨0.1%**	0.2%
Some other race alone	˙1.2%	˙1.9%	4.9%
Two or more races	3.9%	˙3.6%	3.3%
Hispanic or Latino (of any race)	11.9%	11.6%	18.0%
Not Hispanic or Latino	88.1%	88.4%	82.0%
Not Hispanic & White alone	56.0%	39.4%	60.7%
People of Color and Hispanics	44.0%	60.6%	39.3%

High Reliability: Data with coefficients of variation (CVs) < 12% are in black to indicate that the sampling error is relatively small.
Medium Reliability: Data with CVs between 12 & 40% are in orange to indicate that the values should be interpreted with caution.
Low Reliability: Data with CVs > 40% are displayed in red to indicate that the estimate is considered very unreliable.

People of Color and Hispanics, Percent of Total, 2019*



* ACS 5-year estimates used. 2019 represents average characteristics from 2015-2019; 2010 represents 2006-2010.

CITATION: U.S. Department of Commerce. 2020. Census Bureau, American Community Survey Office, Washington, D.C., reported by Headwaters Economics' Neighborhoods at Risk, headwaterseconomics.org/apps/neighborhoods-at-risk.

People of Color and Hispanics

What do we measure on this page?

Race is self-identified by Census respondents who choose the race or races with which they most closely identify. Included in "Other Races" are "Asian," "Native Hawaiian or Other Pacific Islander," and respondents providing write-in entries such as multiracial, mixed, or interracial.

Ethnicity has two categories: Hispanic or Latino, and Non-Hispanic or Latino. The federal government considers race and Hispanic origin to be two separate and distinct concepts. Hispanics and Latinos may be of any race.

"People of Color and Hispanics" is calculated by subtracting those who identify as both "Not Hispanic or Latino" and "White alone" from "Total Population."

Why is it important?

Race and ethnicity are strongly correlated with disparities in health, exposure to environmental pollution, and vulnerability to natural hazards.[1]

Research consistently has found race-based environmental inequities, including the tendency for minority populations to live closer to noxious facilities and Superfund sites, and to be exposed to pollution at greater rates than whites.[7, 1]

Many health outcomes are closely related to the local environment. Minority communities often have less access to parks and nutritious food, and are more likely to live in substandard housing.[1]

Minorities tend to be particularly vulnerable to disasters and extreme heat events. This is due to language skills, housing patterns, quality of housing, community isolation, and cultural barriers.[8, 4]

Blacks and Hispanics, two segments of the population that are currently experiencing poorer health outcomes, are an increasing percentage of the US population.[1,9]

Research has identified measurable disparities in health outcomes between various minority and ethnic communities.

Across races, the rates of preventable hospitalizations are highest among black and Hispanic populations. Preventable hospital visits often reflect inadequate access to primary care. These types of hospital visits are also costly and inefficient for the health care system.[5]

Relative to other ethnicities and races, Hispanics and blacks are less likely to have health insurance, but rates of uninsured are dropping for both groups.[10]

Compared to other races, blacks have higher rates of infant mortality, homicide, heart disease, stroke, and heat-related deaths.[5]

Hispanics have higher rates of diabetes and asthma.[5]

American Indians have a distinct pattern of health effects different from blacks and Hispanics. Native populations are less likely to have electricity than the general population.[2] They have high rates of infant mortality, suicide and homicide, and nearly twice the rate of motor vehicle deaths than the U.S. average.[5]

CHANGES IN BOUNDARIES: Data describing change over time can be misleading when geographic boundaries have changed. The Census provides documentation about changes in boundaries at this site: www.census.gov/geo/reference/boundary-changes.html

Language Proficiency

	Gainesville, FL	Selected Tracts	U.S.
Population 5 years or older, 2019*	127,018	49,447	304,930,125
Speak English "not well"***	2,284	1,271	13,193,113
Speak English "not well"***, percent	1.8%	2.6%	4.3%
Speak English "not well"***, change in percentage points**, 2010*-2019*	0.1	0.8	-0.4

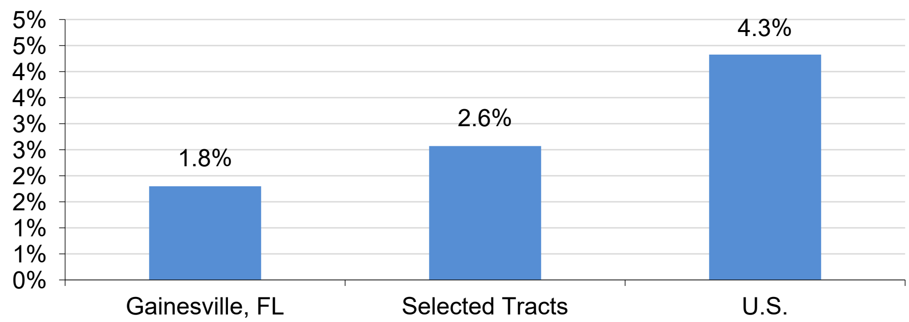
**For example, if the value is 3% in 2010* and 4.5% in 2015*, the reported change in percentage points is 1.5.

*** Includes "not well" and "not well at all".

High Reliability: Data with coefficients of variation (CVs) < 12% are in black to indicate that the sampling error is relatively small.
Medium Reliability: Data with CVs between 12 & 40% are in orange to indicate that the values should be interpreted with caution.
Low Reliability: Data with CVs > 40% are displayed in red to indicate that the estimate is considered very unreliable.

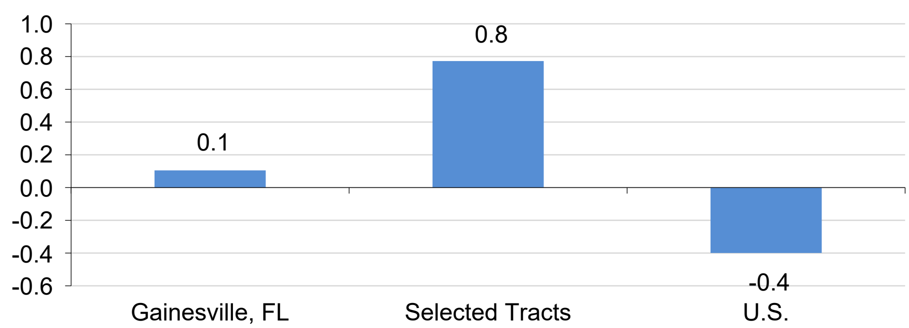
People Who Speak English "Not Well", Percent of Total, 2019*

- The U.S. has the largest share of people who speak English "not well" (4.3%).



People Who Speak English "Not Well", Change in Percentage Points, 2010*-2019*

- The largest change in the share of people who speak English "not well" occurred in Selected Tracts, which went from 1.8% to 2.6%.



* ACS 5-year estimates used. 2019 represents average characteristics from 2015-2019; 2010 represents 2006-2010.

CITATION: U.S. Department of Commerce. 2020. Census Bureau, American Community Survey Office, Washington, D.C., reported by Headwaters Economics' Neighborhoods at Risk, headwaterseconomics.org/apps/neighborhoods-at-risk.

Language Proficiency

What do we measure on this page?

This page reports the results of self-rated English-speaking ability questions in the American Community Survey.

Why is it important?

Many aspects of life in the US assume basic fluency in English. Thus, people with limited language skills are at risk for inadequate access to health care, social services, or emergency services.

A person's ability to take action during an emergency is compromised by language and cultural barriers.[4]

Poor English skills can make it harder to follow directions or interact with agencies.[4]

Lack of language skills can also instill lack of trust for government agencies.

In many industries, poor English skills can make it harder for people to get higher wage jobs.[1]

Language barriers make it harder to obtain medical or social services; and make it more difficult to interact with caregivers.[1]

Limited English skills may result in isolation from other segments of the US population, and social isolation is a health risk.[1] However some minority communities can be very tightly-knit and not isolated, so this risk factor cannot be generalized across all populations.

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Young & Elderly Populations

	Gainesville, FL	Selected Tracts	U.S.
Total Population, 2019*	132,127	52,165	324,697,795
Under 5 years old	5,109	2,718	19,767,670
65 years and older	14,245	3,514	50,783,796
80 years and older	2,086	321	6,269,017
Percent of Total, 2019*			
Under 5 years old	3.9%	5.2%	6.1%
65 years and older	10.8%	6.7%	15.6%
80 years and older	1.6%	0.6%	1.9%
Change in Percentage Points, 2010*-2019*			
For example, if the value is 3% in 2010* and 4.5% in 2019*, the reported change in percentage points is 1.5.			
Under 5 years old	-0.4	-1.6	-0.5
65 years and older	3.2	1.3	2.9
80 years and older	0.4	0.1	0.2

High Reliability: Data with coefficients of variation (CVs) < 12% are in black to indicate that the sampling error is relatively small.
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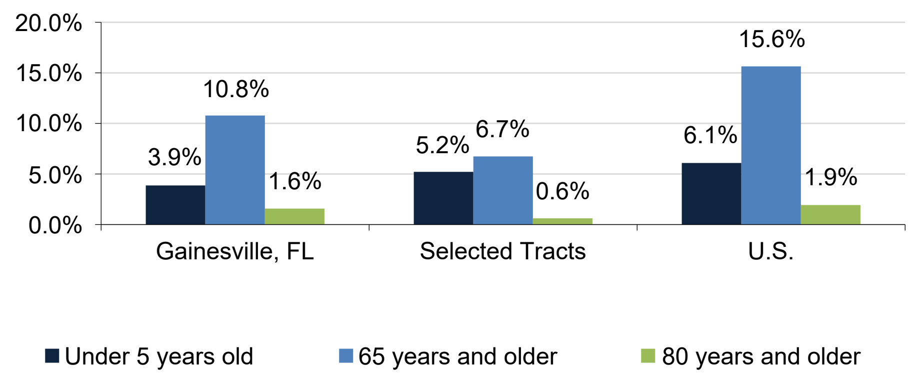
Low Reliability: Data with CVs > 40% are displayed in red to indicate that the estimate is considered very unreliable.

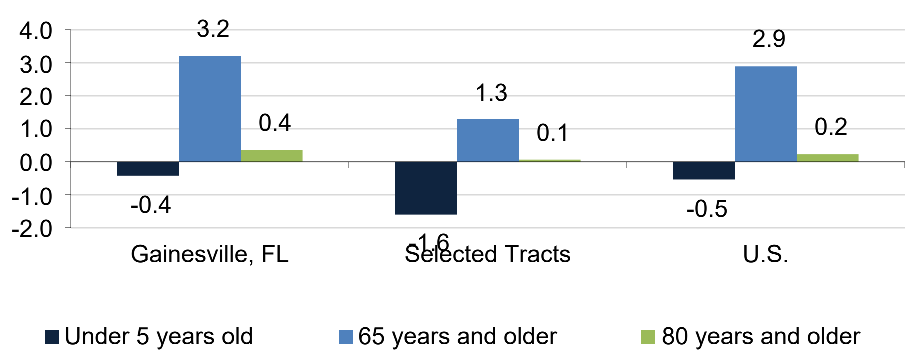
Population by Group, Percent of Total, 2019*

- The U.S. has the largest share of people under 5 years old (6.1%).
- The U.S. has the largest share of people 80 years and older (1.9%).



Population by Group, Change in Percentage Points, 2010*-2019*

- The largest change in the share of people under 5 years old occurred in Selected Tracts, which went from 6.8% to 3.9%.
- The largest change in the share of people 80 years and older occurred in Gainesville, FL, which went from 1.2% to 1.6%.



* ACS 5-year estimates used. 2019 represents average characteristics from 2015-2019; 2010 represents 2006-2010.

CITATION: U.S. Department of Commerce. 2020. Census Bureau, American Community Survey Office, Washington, D.C., reported by Headwaters Economics' Neighborhoods at Risk, headwaterseconomics.org/apps/neighborhoods-at-risk.

Young & Elderly Populations

What do we measure on this page?

This page describes the number of people by specific age category.

The "Under 5 years old" category includes individuals younger than 5 years old. The "65 years and older" category includes individuals age 65 and older and the "80 years and older" category includes individuals age 80 and older. The "80 years and older" category is a subset of the "65 years and older" category.

Why is it important?

Young children and older adults both are vulnerable segments of the population. Understanding the age profile of a community can help users determine the types of services likely to be needed.[1]

Children's developing bodies makes them particularly sensitive to health problems and environmental stresses.[1]

Childhood lays the foundations for lifelong health. Poor health during childhood increases the likelihood of problems throughout adulthood.[2]

Because so many factors of a child's life are determined during pregnancy, infancy, and early childhood, children in poverty are an especially vulnerable population. Lack of adequate care through the early phases of life is more prevalent in poor populations.[2]

Children spend more time outside and have a faster breathing rate than adults, so they are more at risk for respiratory problems related to ground level ozone, airborne particulates, wildfire smoke, and allergens. Allergens are associated with climate change due to changing plant communities and longer pollen seasons.[3, 4]

Because their immune systems are not fully developed, children are more sensitive to infectious diseases. Natural disasters can breach public water supplies, compromise sanitation, and spread illness. Children are more vulnerable to these hazards compared to adults.[3]

Older adults also are at increased risk of compromised health related to environmental hazards and climate change.

Age is the single greatest risk factor related to illness or death from extreme heat.[4]

The elderly are more likely to have pre-existing medical conditions or compromised mobility, which reduces their ability to respond to natural disasters.[3]

The likelihood of chronic disease increases with age.[1, 5]

Older adults are more susceptible to air pollution such as ground level ozone, particulate matter, or dust. Increased dust is associated with drought, wildfires, and high wind events.[3, 6]

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The Census provides documentation about changes in boundaries at this site: www.census.gov/geo/reference/boundary-changes.html

Educational Attainment

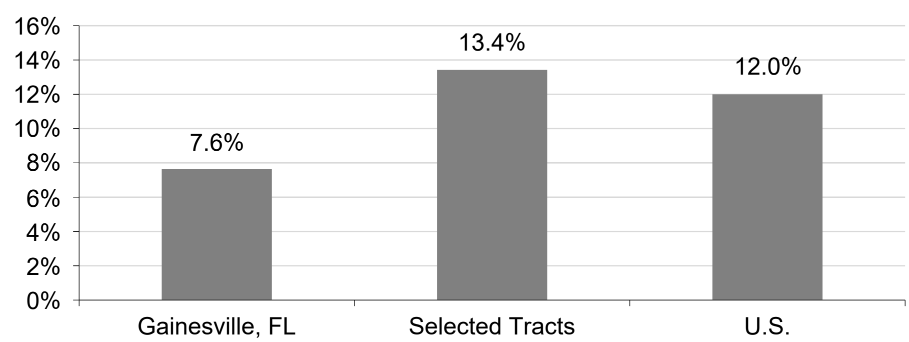
	Gainesville, FL	Selected Tracts	U.S.
Total Population 25 years or older, 2019*	70,797	26,815	220,622,076
No high school degree	5,410	3,599	26,472,261
No high school degree, percent	7.6%	13.4%	12.0%
No high school degree, change in percentage points**, 2010*-2019*	-3.6	-6.1	-3.0

**For example, if the value is 3% in 2010* and 4.5% in 2019*, the reported change in percentage points is 1.5.

High Reliability: Data with coefficients of variation (CVs) < 12% are in black to indicate that the sampling error is relatively small.
Medium Reliability: Data with CVs between 12 & 40% are in orange to indicate that the values should be interpreted with caution.
Low Reliability: Data with CVs > 40% are displayed in red to indicate that the estimate is considered very unreliable.

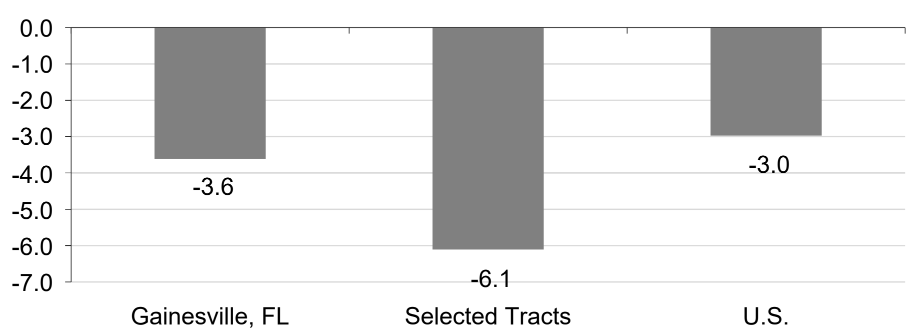
Population with Less than High School Education, Percent of Total, 2019*

- Selected Tracts has the largest share of people with less than a high school education (13.4%).



Population with Less than High School Education, Change in Percentage Points, 2010*-2019*

- The largest change in the share of people with less than a high school degree occurred in Selected Tracts, which went from 19.5% to 13.4%.



* ACS 5-year estimates used. 2019 represents average characteristics from 2015-2019; 2010 represents 2006-2010.

CITATION: U.S. Department of Commerce. 2020. Census Bureau, American Community Survey Office, Washington, D.C., reported by Headwaters Economics' Neighborhoods at Risk, headwaterseconomics.org/apps/neighborhoods-at-risk.

Educational Attainment

What do we measure on this page?

This page describes levels of educational attainment, which refers to the highest degree or level of schooling completed by people 25 years and over.

Why is it important?

High school completion is used as a proxy for overall socioeconomic circumstances. Lack of education is strongly correlated with poverty and poor health.

People without a high school degree are more than twice as likely to live in inadequate housing compared to those with some college education.[5]

A study in California found the lack of a high school degree was the factor most closely related to social vulnerability to climate change.[4]

Thirty-eight percent of Americans without a high school degree do not have health insurance, compared to 10 percent with a college degree.[7]

The rate of diabetes is much greater for those without a high school degree. Incidence of this disease is more than double the rate of those who attended education beyond high school.[5]

Binge drinking is most severe among those without a high school degree. This demographic group had the highest risk of binge drinking across all measured categories (such as income, race, ethnicity, or disability status).[5]

CHANGES IN BOUNDARIES: Data describing change over time can be misleading when geographic boundaries have changed.
The Census provides documentation about changes in boundaries at this site: www.census.gov/geo/reference/boundary-changes.html

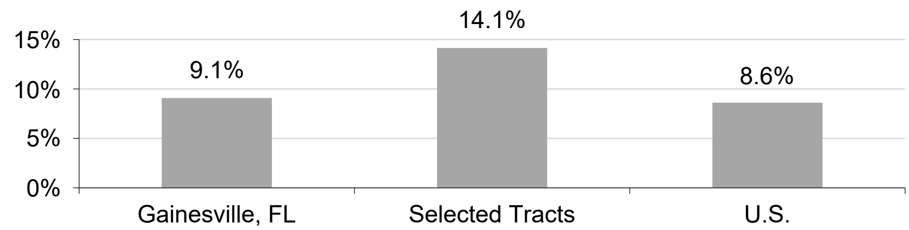
Potentially Vulnerable Households

	Gainesville, FL	Selected Tracts	U.S.
Total Occupied Households, 2019*	49,143	18,843	120,756,048
People > 65 years & living alone	1,611	541	4,527,381
Single female households	4,893	3,153	15,016,964
with children < 18 years	2,716	2,051	9,427,068
Households with no car	4,463	2,665	10,395,713
Percent of Total, 2019*			
People > 65 years & living alone	3.3%	2.9%	3.7%
Single female households	10.0%	16.7%	12.4%
with children < 18 years	5.5%	10.9%	7.8%
Households with no car	9.1%	14.1%	8.6%
Change in Percentage Points, 2010*-2019*			
For example, if the value is 3% in 2010* and 4.5% in 2019*, the reported change in percentage points is 1.5.			
People > 65 years & living alone	1.0	1.5	-0.8
Single female households	-2.0	-2.7	-0.2
with children < 18 years	-2.0	-3.3	0.0
Households with no car	-1.3	1.7	-77.3

High Reliability: Data with coefficients of variation (CVs) < 12% are in black to indicate that the sampling error is relatively small.
Medium Reliability: Data with CVs between 12 & 40% are in orange to indicate that the values should be interpreted with caution.
Low Reliability: Data with CVs > 40% are displayed in red to indicate that the estimate is considered very unreliable.

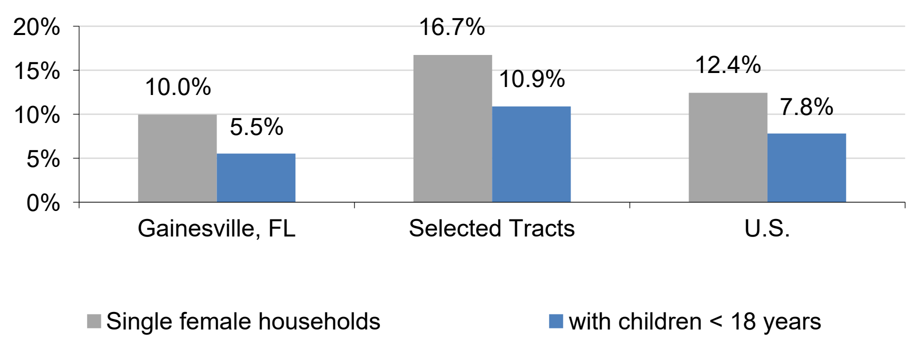
Households with No Car as a Percent of Total Households, 2019*

- The U.S. has the largest share of households with no car (3.7%).



Single Female Households as a Percent of Total Households, 2019*

- Selected Tracts has the largest share of single female households (16.7%).
- Selected Tracts has the largest share of single female households with children (10.9%).



* ACS 5-year estimates used. 2019 represents average characteristics from 2015-2019; 2010 represents 2006-2010.

CITATION: U.S. Department of Commerce. 2020. Census Bureau, American Community Survey Office, Washington, D.C., reported by Headwaters Economics' Neighborhoods at Risk, headwaterseconomics.org/apps/neighborhoods-at-risk.

Potentially Vulnerable Households

What do we measure on this page?

This page describes household types that are associated with increased hardship, including the elderly living alone, single female households, single female households with children, and households without a car.

Why is it important?

Older adults are more likely to have compromised health and are less able to overcome disease. Living alone exacerbates health risks, and many health outcomes are worsened by social isolation.

Social isolation is strongly linked to poor health such as premature death, smaller chances of survival after a heart attack, depression, and greater levels of disability from chronic diseases.[2]

People 65 and older are particularly vulnerable to heat-related illness,[4] which is exacerbated by social isolation.

Households headed by women face challenges related to income, education, and food security. These factors make it more difficult to respond to health, environmental, or climate risks.

Female-headed households are more likely to be living in poverty. This is most prevalent among black, Hispanic, and Native American households.[16]

In 2014, 35 percent of female-headed households were food insecure, compared to 14 percent of all households.[17]
Single mothers may be burdened by providing basic needs such as food and housing, which can make the urgency of other risks seem less important.[18]

Single-mother families are disproportionally exposed to hazardous levels of air pollution.[4]

Single mothers tend to be less educated and less affluent than the general population, which puts them at greater risk during natural disasters.[18]

Access to a car is linked with higher wages and more financial stability, and can help families relocate or evacuate in the event of emergencies.

People who own cars are more likely to be employed, work longer hours, and earn more than those who do not.[19]

Access to a car has measurable benefits for those receiving public assistance. Welfare recipients with access to a car were more likely to work more hours and get higher-paying jobs, and had a greater chance of leaving welfare.[20]

During emergencies, natural disasters, and extreme weather events, people who do not have a car are less likely to evacuate or have access to emergency response centers.[4]

During heat waves, people without a car are less able to go to community cooling centers or cooler areas.[4]

Pedestrian fatalities are more than twice as likely in poor urban neighborhoods than in wealthier parts of cities.[21]

CHANGES IN BOUNDARIES: Data describing change over time can be misleading when geographic boundaries have changed.
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Potentially Vulnerable People

	Gainesville, FL	Selected Tracts	U.S.
Total civilian noninstitutionalized population, 2019*	130,229	51,677	319,706,872
People w/ disabilities	13,211	6,032	40,335,099
People w/o health insurance	11,033	6,818	28,248,613

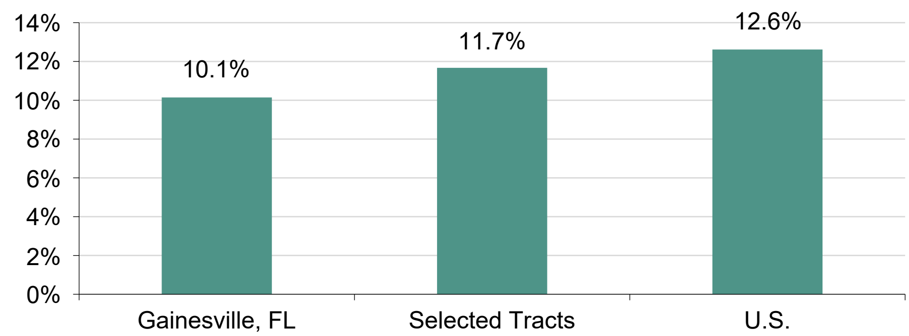
Percent of Total, 2019*

	Gainesville, FL	Selected Tracts	U.S.
Percent of people w/ disabilities	10.1%	11.7%	12.6%
Percent of people w/o health insurance	8.5%	13.2%	8.8%

High Reliability: Data with coefficients of variation (CVs) < 12% are in black to indicate that the sampling error is relatively small.
Medium Reliability: Data with CVs between 12 & 40% are in orange to indicate that the values should be interpreted with caution.
Low Reliability: Data with CVs > 40% are displayed in red to indicate that the estimate is considered very unreliable.

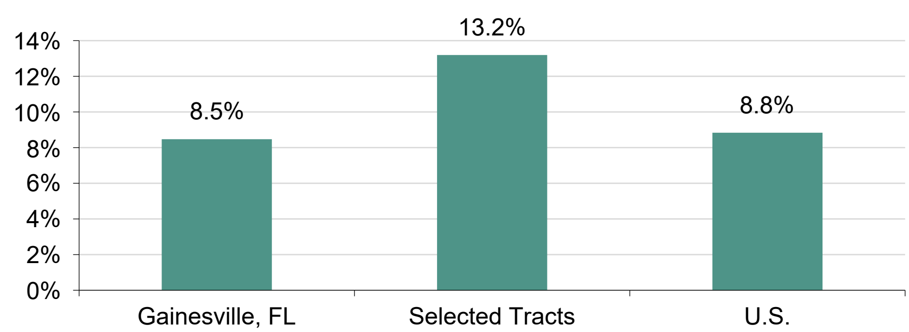
People with Disabilities, Percent of Total, 2019*

- The U.S. has the largest share of the noninstitutionalized population that is disabled (12.6%).



People without Health Insurance, Percent of Total, 2019*

- Selected Tracts has the largest share of the noninstitutionalized population without health insurance (13.2%).



* ACS 5-year estimates used. 2019 represents average characteristics from 2015-2019; 2010 represents 2006-2010.

CITATION: U.S. Department of Commerce. 2020. Census Bureau, American Community Survey Office, Washington, D.C., reported by Headwaters Economics' Neighborhoods at Risk, headwaterseconomics.org/apps/neighborhoods-at-risk.

Potentially Vulnerable People

What do we measure on this page?

This page describes groups of people that are associated with increased hardship, including people with disabilities and people without health insurance.

Why is it important?

Disabled people are subject to health complications that make environmental risks more consequential.

- Disabled people are less likely to have health insurance, compared to the non-disabled population.[5]
- Being confined to a bed raises heat mortality.[2]
- Extreme weather events or natural disasters may result in limited access to medical care. This is particularly consequential for those who already have compromised health.[3]

People who lack health insurance are disadvantaged by several different mechanisms. They may avoid or delay diagnoses, treatment, and/or medication and thus may increase their odds of poor health. They do not have a regular place of care, and they are not benefitting from the standard of care that is afforded many Americans.

- Households living in poverty are more likely to be uninsured. More than one quarter of uninsured households live in poverty.[10]
- People with lower educational attainment are more likely to be uninsured.[5]
- People without health insurance are less likely to have a regular source of care, and less likely to receive preventive, primary, and specialty care services.[32,33] This risk is particularly evident among racial and ethnic minorities.[5]
- People without health insurance are more likely to use the hospital emergency department for standard health care needs.[5]
- About 25% of uninsured adults report having either delayed or gone without care in the past year because of costs.[23]
- Uninsured people are more likely to skip medications due to the costs, and some providers are less likely to prescribe medications to uninsured patients.[24]
- People who do not have health insurance suffer greater health consequences from air pollution compared to those with insurance.[4]

CHANGES IN BOUNDARIES: Data describing change over time can be misleading when geographic boundaries have changed.
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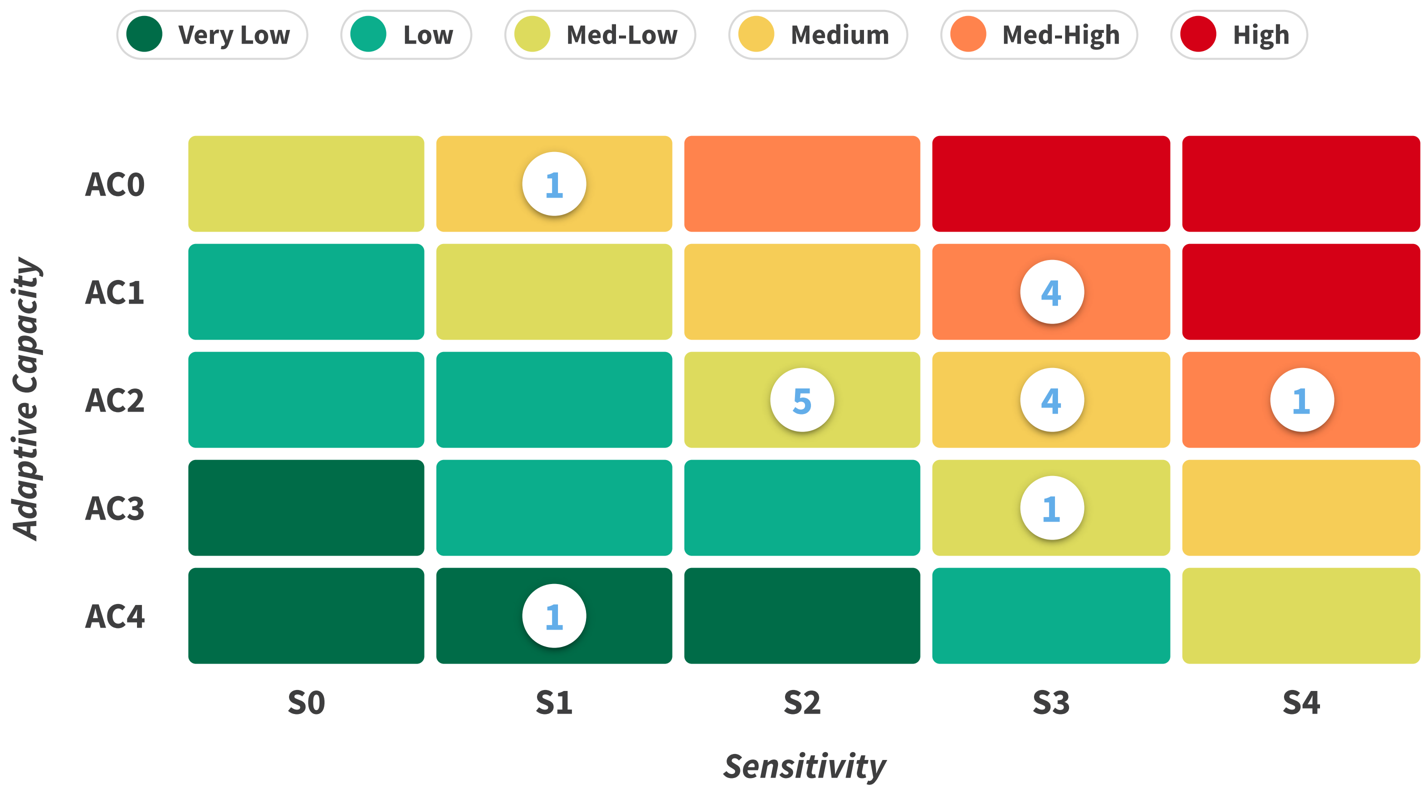
FLOODWISE GENERATED REPORT

FloodWise Communities Full Report: Gainesville, FL

Vulnerability matrix



Overview

System component	Vulnerability score	Sensitivity score	Adaptive capacity score
Levees	Medium Low	S2	AC2
Culverts	Medium Low	S2	AC2
Dry basins	Medium High	S3	AC1
Wet basins	Medium	S3	AC2
Floodwalls	Medium Low	S2	AC2

Floodplains	**Medium Low**	**S2**	**AC2**
Sediment traps	**Medium**	**S3**	**AC2**
Open ditch drains	**Medium Low**	**S2**	**AC2**
Underground pipes	**Medium High**	**S3**	**AC1**
Infiltration basins	**Very Low**	**S1**	**AC4**
Treatment facilities	**Medium**	**S3**	**AC2**
Pumps and Pump stations	**Medium Low**	**S3**	**AC3**
Roadways and Railroads	**Medium High**	**S3**	**AC1**
Natural stream channels	**Medium**	**S3**	**AC2**
Sewage overflow storage	**Medium**	**S1**	**AC0**
Catch basins or Stormdrains	**Medium High**	**S3**	**AC1**
Water and wastewater components	**Medium High**	**S4**	**AC2**

Setting the foundation

Weather and Climate

Which weather events, climate conditions, or natural hazards are of greatest concern? How might present and future conditions impact local stormwater system infrastructure and management?
Access your weather and climate data profiles here

Gainesville is getting hotter and wetter. According to the FloodWise Communities tool 2,910 properties are currently at risk of flooding and this will increase to 3,273 in 30 years. The majority of flooding occurs along the creek systems in the City. Erosion and sediment transport of the sandy stream bed is an existing issue that will worsen leading to stream bank failure, exposure of underground utilities and increased cost of maintaining sediment traps. As rainfall intensity-duration-frequency relationships change, the level of service for existing stormwater infrastructure will be reduced and floodplain limits will increase. Stormwater hydrology is influenced by karst geologic features, including stream to sink watersheds and small isolated watersheds/depression basins connected to active sinkholes and paleosinks. As sea level rises, there will likely be an impact to the groundwater table. As the groundwater table rises, the flood risk will increase. Future plans may explore the possibility of utilizing Payne's Prairie as a way of mitigating flooding within the closed watersheds. Flooding events and high intensity or long duration rainfall during periods with high groundwater are also of great concern to the wastewater infrastructure, primarily in the form of an infiltration of groundwater into the sewer collection system and from inflow sources. A rise in flooding also impacts pump stations, limiting access and ability to operate the stations during temporary power loss. These events are becoming more frequent during the rainy season and typically coincide with hurricane season.

Social & Economic Factors

Use Neighborhoods at Risk to identify and list which community members are more likely to experience negative weather and climate impacts based on socioeconomic factors. Why might these residents be most at-risk?

The community members most likely to experience negative weather and climate impacts based on socioeconomic factors include People of Color and people who live in poverty. It is worth mentioning that while these groups are not mutually exclusive; people of color are more likely to live in neighborhoods with concentrated poverty due to a long history of racial segregation in the United States. Gainesville has a high proportion of renters in our community, 62.7%, which is much higher than the national average (36%). Some low-income rental units in our community are older and do not meet current building code standards. Renters have less control in addressing substandard housing conditions and can be more susceptible to negative health outcomes associated with water-related disasters (e.g., exposure to mold and pollutants) and face greater barriers to accessing federal aid when compared to homeowners. These issues make renters one of the more vulnerable socioeconomic groups in our community. The number of rental units in the City of Gainesville reflects high student populations attending the University of Florida and Santa Fe College. The Gainesville FloodWise Team decided to use the national average of 36% to include neighborhoods at risk that house non-student populations. Similarly, more than 7.4% of our community members lack access to a car. We know from past hurricane seasons that these individuals tend to have greater difficulty evacuating or relocating. Their limited access to transportation also creates barriers to accessing food, water, services, and financial resources both pre- and post-disaster, compounding their disadvantages.

Use Neighborhoods at Risk to identify and list the most at-risk census tracts or areas in your community. Why are these areas at greater risk of experiencing negative weather and climate impacts when compared to others?

Thirteen census tracts in Gainesville have populations at greater risk of experiencing negative weather and climate impacts when compared to others. In these areas, more than 75% of housing units are rentals, more than 60% of the population includes people of color and Hispanics, more than 25% of families live in poverty, and close to 14% of households have no access to a vehicle. The area of the vulnerable tracts at risk within the municipal boundary is 23.5 ac or 36.3% of the municipal boundary (64.7 sq mi). The work group also analyzed census tracts that had a greater potential for experiencing exposure due to increasing temperature. Seventeen census tracts have tree cover less than 50%, the Gainesville average. Two tracts have greater than Gainesville's average of 35% impervious cover. Two tracts in the downtown area have less than 50% tree cover and greater than 35% impervious cover. One of these census tracts is also a neighborhood at risk due to socioeconomic factors.

List any man-made hazards (e.g., landfills, power plants, sewage treatment plants) that could pose increased risk to the local stormwater system, public infrastructure, buildings, people and services under typical or extreme weather and climate conditions. Are any of these sites located near the at-risk census tracts identified above?

The Florida Department of Environmental Protection's business portal was used to identify the solid waste facilities and contaminated sites. The portal identifies 82 Solid Waste facilities within the municipal boundary; 22 of those are within the 13 census tracts at risk (26.8%). The portal identifies 131 clean-up sites within the municipal boundary; 35 of those within the 13 census tracts at risk (26.7%). The City owns two WRF, Main Street (MSWRF) and Kanapaha. Both meet FDEP permit requirements. There are also two closed landfills that have been remediated by the City; one near MSWRF and one near the Airport. In addition, the City is responsible for remediating a brownfield site that is now operated as a stormwater park that includes walking trails, a children's playground, and educational signage.

Local Capacity

Based on local knowledge and experience, estimate local capacities for each of the following areas of stormwater management.

- Engineering & Infrastructure: 5
- Data & Modelling: 6
- Personnel: 7
- Funding: 5
- Administration: 7

Levees

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

The City of Gainesville maintains two levees. The City has experienced multiple hurricanes and weather events over the years, including Hurricanes Charley, Frances and Jeanne (2004), Tropical Storm Debby (2012), Hurricane Irma (2017) and Tropical Storm Elsa (2021). One of the levees was breached during Hurricane Irma as a result of an uprooted tree.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

Levee vegetation management is a key component to a maintaining the safety, structural integrity, and functionality of levee systems. Vegetation along the Anglewood Berm is currently mowed by Public Works Operations, however, there may be some tree coverage that requires assessment and possible removal. The Florida Park Berm was impacted by the uprooting of a tree during Hurricane Irma, and while repaired, has other sections of berm that need to be assessed and modified to maintain a minimum vegetation-free zone as recommended by the USACE. Due to urbanization and development prior to the State of Florida's implementation of stormwater regulations in 1982, the floodplain has expanded over time and may affect the existing levees and floodwall due to floodplain expansion over time. The levees and floodwall likely do not meet the original intended level of service.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

Extreme wet weather events will impact the level of service (LOS) provided by the levee systems. Many locations throughout Gainesville have a surficial groundwater table (GWT) due to the existence of an aquitard. It is anticipated that GWTs will rise due to an increase in weather events and total rainfall. As GWT rises, it will increase the base flow in the creeks and channels along the berm and levee systems. This will result in the reduction of hydraulic capacity and freeboard potentially affecting neighboring and downstream properties.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Yes. Urban growth and densification continue to occur within Gainesville. There are environmental buffers and stormwater regulations that control discharge from most new development; however, other factors such as inaccurate design assumptions contribute to the trend of increasing runoff. Additionally, current design standards are based on historic rainfall and not future predicted climate change and weather events.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

The two levees are outside of the 13 identified Tracts at Risk.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

It is unlikely that if compromised, it would affect a downstream tract at risk. Impact would be mostly in the immediate area.

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

Key public infrastructure would include the levees and floodwall and potentially downstream road crossings over creeks and channels. Flooding in many cases will impact ingress/egress.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S2: The component(s) will be somewhat affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Expand maintenance to implement a inspection and maintenance program for the levees to ensure their safety, structural integrity and functionality. Updated flood studies have been completed and serve as best available data. This includes a 2021 Hydrologic and Hydraulic Simulation of the Hail Sink Watershed (Hogtown Creek / Alachua Sink) where the three levees/floodwall are located. This study can be further refined to evaluate design modifications of the berms to improve their LOS. Grant Funding: Hazard Mitigation Grant Program (HMGP) funding has been received to address improvements for the Florida Park Berm and Mason Manor Wall. The Anglewood Berm has been identified in the Alachua County LMS priority projects list. In addition, HMGP funding has been utilized to purchase repetitive and substantial damaged homes. The City recently completed one (1) purchase and have two (2) in progress.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

If the asset cannot be adjusted to address the desired LOS, seek grant funding to purchase of adjacent properties identified to be at risk for flooding. Update FIRM maps in the areas of the Florida Park Berm and Mason Manor Wall to ensure homeowners have adequate flood insurance.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

Stormwater regulations and floodplain ordinance can be modified for future development to avoid new impacts. This could include implementation of FEMA's 100-year plus event for regulation of floodplains for new development. The 2021 Hydrologic and Hydraulic Simulation of the Hail Sink Watershed (Hogtown Creek / Alachua Sink) could be further refined to address LOS needs at both levees and the floodwall.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Existing easement limits and ability to increase height. Modifying the levees may involve land rights acquisition or easements and could be a significant effort in terms of staff and acquisition funds.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

It is anticipated that groundwater tables (GWT) will rise due to an increase in weather events and total rainfall. As GWT rises, it will increase the base flow in the creeks and channels along the levee/floodwall systems. This will result in the reduction of hydraulic capacity and freeboard potentially affecting adjacent properties.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

The main resource that is limiting for the City is funding for design and construction projects to address adaptability of critical assets. The City routinely leverages existing capital funding with grants funds and has received HMGP grants to make improvements at both the Florida Park Berm and Mason Manor Wall.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 6
- Data & Modelling: 3
- Personnel & Technical Assistance: 3
- Funding: 8
- Administration: 2

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC2: The component(s) are somewhat able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Culverts

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

The City has experienced multiple hurricanes and weather events over the years that have impacted the creek systems with significant erosion and sediment transport, including Hurricanes Charley, Frances and Jeanne (2004), Tropical Storm Debby (2012), Hurricane Irma (2017) and Tropical Storm Elsa (2021). Creeks and natural channels within the City are an integral part of the Stormwater system. Their continued natural function is paramount to reducing flood risk within our community. It is recognized that urbanization and development has resulted in erosion and sediment transport within the creek systems. This has led to sediment deposition at culvert crossings over the creeks and natural channels, diminishing the hydraulic capacity of the system.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

Due to urbanization and the sandy nature, the creek beds within the Gainesville area scour and erode in the upper reaches leading to the transport sediment downstream. Sediment deposition at culvert crossings, particularly in the lower reaches, diminish the hydraulic capacity of the system. The cost to remove sediment from culverts at roadway crossings and sediment traps is significant. Many culverts are reaching the end of their design life and require replacement. As these culverts get identified for replacement, the design will need to consider: 1) additional capacity due to change in flood patterns, 2) limitations that restrict flow creating impacts for upstream areas, and 3) improving LOS on city roadways.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

Extreme events increase erosion of the upper reaches of creeks and sediment deposition in the lower reaches. Extreme wet weather events may exceed the level of service (LOS) provided by existing culvert crossings. Design criteria for roadways currently requires a 10-year (10/60 minute) LOS. As flow increases in natural stream channels, culvert crossings will become a restriction and impact upstream flood areas.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Yes. Urban growth and densification continue to occur within Gainesville. There are environmental buffers and stormwater regulations that control discharge from most new development; however, other factors such as inaccurate design assumptions contribute to the trend of increasing runoff. Additionally, current design standards are based on historic rainfall and not future predicted climate change and weather events.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

To some degree. Where there are crossings, there is a risk for sediment to affect the hydraulic capacity of the creek and natural channel systems. There are crossings throughout the City including 13 census tracts identified as neighborhoods at risk. Twelve of the 13 tracts are in or partially in the downstream end of the watersheds and are potential recipients of sediment deposition that could diminish the hydraulic capacity the creek and natural channel systems.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

At risk would be properties affected by a reduction in the function of the creek and natural stream channel crossings. There are 1,602 culverts within the municipal Boundary (439 within the Tracts at Risk / 23.4% of total). There are 1,269 culverts crossing creeks / open channels within the municipal boundary (346 within the Tracts at Risk / 27%). There are 159 culvert crossings of creeks at a roadway (40 within the Tracts at Risk / 25.2%.

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

Key public infrastructure would include: 1) The road network could be directly affected by a loss of functionality within culvert crossings at creeks and natural channels. 2) Increase in number of public facilities impacted by flooding including roadway crossings. Flooding of roadways would prevent emergency vehicles ingress/egress through affected areas.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S2: The component(s) will be somewhat affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Culvert crossings have some capacity to adapt to weather events, particularly where they have been well maintained and sediment deposition has been routinely removed. Current stormwater regulations are in place that mitigate affects from development activities. Grant funding: Recently utilized USDA funding to correct damage from Hurricane Irma in 2017 (Emergency Watershed Program) at one (1) major roadway crossing.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

If adaptive capacity is maintenance related, the City could increase the inspection and maintenance frequency of culvert crossing. Emergency pump plans are in place for known Flood Prone Areas.

Additional pump plans could be created and implemented if necessary. Funding would play a role on how many temporary or permanent locations could be implemented.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

Existing watershed management plans (WMPs) can be used to develop modern flood models using updated data, assumptions and models. The City has an extensive geodatabase (GDB) of the stormwater infrastructure throughout its road network that could improve the level of detail in the flood model and allow staff to identify flooding or drainage issues based on undersized conveyance. Implement the use of future IDF curves for new culvert design. Design and construction of stormwater improvement projects to address the adaptive capacity could be implemented. Inventory undersized City culverts where relief structures could be added. Identify failing structures eligible or suitable for lining.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Inadequate designs for existing stormwater facilities. Excessive sedimentation that affect the culvert crossings hydraulic capacity.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

Of concern is the impact on the floodplain if the groundwater table rises as a result of climate change. A rise in the groundwater table will create a tailwater effect through the creek systems, which are mostly stream to sink watersheds. This will affect the stormwater conveyance systems including culvert crossings from performing and create localized flooding or overtopping of roadways when capacities are exceeded. In some cases, it will be difficult to add the needed capacity due to the width of the channel cross section and easement constraints. It may be necessary to purchase adjacent private property to increase culvert capacity.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

The main resource that is limiting for the City is funding for design and construction projects to address adaptability of critical assets. Capital funding is limited at this time. The City routinely leverages existing capital funding with grants funds.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 4
- Data & Modelling: 4
- Personnel & Technical Assistance: 4
- Funding: 8
- Administration: 2

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC2: The component(s) are somewhat able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Dry basins

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

The City has experienced multiple hurricanes and weather events over the years that have impacted the creek systems with significant erosion and sediment transport, including Hurricanes Charley, Frances and Jeanne (2004), Tropical Storm Debby (2012), Hurricane Irma (2017) and Tropical Storm Elsa (2021). Extreme weather events, as well as, rainfall departures in recent years that have exceeded normal wet years affecting pond performance for attenuation and recovery.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

The City is highly urbanized and much of its stormwater infrastructure is aged and constructed prior to statewide stormwater regulations were promulgated in 1982. Current design code requires the level of service for stormwater ponds to be the five 100-year critical events including the 24-hour event. Many of the stormwater ponds throughout the City do not meet this level of service. As a result, flood prone areas have been created that require active remedial measures such as pump operations. When hurricanes and tropical storms are predicted to impact Florida, department-wide storm preparations are initiated including emergency pump plans. Emergency pump plans are in place for known flood prone areas and involve an inspection and assessment to determine if a flood prone area or a stormwater basin needs to be pumped down prior to expected rainfall. Currently, only one stormwater basin is identified as a flood prone area that potentially requires pump operations. Public Works maintains three (3) stormwater pump stations; two (2) with permanent pumps and one with a portable pump. Additionally, four (4) 6-inch portable pumps are available for use during storm events. There are currently nine (9) Flood Prone Areas that have prepared emergency pump plans using portable pumps. The logistics to operate multiple pumping operations is significant and any additional locations would increase the resources needed.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

As mentioned previously, much of the City's stormwater infrastructure including dry basins is aged and constructed prior to statewide regulations and does not meet the current level of service. During an extreme weather event, pond capacity could be exceeded and will affect surrounding properties. Many locations throughout Gainesville have a surficial groundwater table (GWT) due to the existence of an aquitard. It is anticipated that GWTs will rise due to an increase in weather events and total rainfall. Many of the existing stormwater ponds/underground vault systems rely on infiltration to recover. As the GWT increases, infiltration within the ponds/vaults will be reduced. Further, once the GWT intercepts the pond bottom, storage is lost. Dry ponds will discharge more stormwater into the City's infrastructure and creek system. Most of the City's creek systems are considered stream to sink and therefore, volume sensitive. The increase in stormwater discharge will result an increase to the floodplain area and impact downstream and lower lying areas.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Yes. Urban growth and densification continue to occur within Gainesville. There are environmental buffers and stormwater regulations that control discharge from most new development; however, other factors such as inaccurate design assumptions contribute to the trend of increasing runoff. Additionally, current design standards are based on historic rainfall and not future predicted climate change and weather events.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

Yes. A significant portion of the City's stormwater infrastructure is old and undersized with a significant amount of development and urbanization occurring prior to the State of Florida's implementation of stormwater regulations in 1982. There are areas that lack stormwater ponds for attenuation and water quality treatment and areas served by ponds that do not meet the current LOS. A change in climate and extreme weather events will likely equate to more discharge of stormwater into the City's infrastructure and creek systems. Within the City, 13 census tracts were identified as neighborhoods at risk with 12 of the 13 tracts at or partially at the downstream end of the watersheds and the recipients of the increased runoff. Three (3) of the at risk tracts (Tracts 6, 7, and 8.06) in East Gainesville have residential areas were developed prior to 1982. It is noted that for nine (9) tracts, most of the development occurred during a time of stormwater regulation. However, as they are on the downstream end, they will be impacted by upstream urbanization and development. And, as previously noted, these watersheds are mostly stream to sink and volume sensitive. It is anticipated that floodplain will continue to expand due expected climate and weather changes.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

Thirteen (13) census tracts are identified as neighborhoods at risk. Using flood modeling data provided from First Street, the below table shows the area affected by the change in floodplain within the census tracts identified as neighborhoods at risk. There are 1,600 dry retention facilities within the municipal boundary (374 within the Tracts at Risk / 23.4% of total).

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

Key public infrastructure would include the City's stormwater management system, as well as, public and private roadway networks. Flooding could prevent residents from leaving their homes and prevent access by emergency vehicles and public transportation to affected areas.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S3: The component(s) will be affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Current stormwater regulations are in place that mitigate affects from development activities; however, reviewing staff need to ensure accurate design assumptions are made by the design engineer. The City could add emergency discharge drainage path if none exists to reduce impact to adjacent property.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

Emergency pump plans are in place for known Flood Prone Areas. Additional pump plans could be created and implemented if necessary. Funding would play a role on how many temporary or permanent locations could be implemented.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

Stormwater regulations and the EDCM can be modified for future development to avoid new impacts. The City's proposed 2021 Engineering Design & Construction Manual (EDCM) includes a criteria that New Class III and IV critical facilities, as defined by the Florida Building Code, shall be located outside of areas with a floodplain subject to a 0.2% or greater chance of flooding (or 500 year flood). In addition, the EDCM could be updated to incorporate technical criteria and design assumptions that mitigate extreme weather and climate change when data on those events becomes better established and becomes standard practice. Existing watershed management plans (WMPs) can be used to develop modern flood models using updated data, assumptions and models. The City has an extensive geodatabase (GDB) of the stormwater infrastructure throughout its road network that could improve the level of detail in the flood model.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Ensuring maintenance of floodplains and interconnected wetland systems. Inadequate designs for existing stormwater facilities. Existing private stormwater facilities that are not properly maintained or functional. Encroachment of development activities in adjacent land areas that would prevent expansion of stormwater facilities.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

It is anticipated that groundwater tables will rise due to an increase in weather events and total rainfall. Existing stormwater systems will begin to fail, affecting neighboring and downstream properties.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

The main resource that is limiting for the City is funding for design and construction projects to address adaptability of critical assets. Capital funding is limited at this time. The City routinely leverages existing capital funding with grants funds.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 2
- Data & Modelling: 3
- Personnel & Technical Assistance: 3
- Funding: 8
- Administration: 2

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC1: The component(s) are minimally able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Wet basins

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

The City has experienced multiple hurricanes and weather events over the years that have impacted the creek systems with significant erosion and sediment transport, including Hurricanes Charley, Frances and Jeanne (2004), Tropical Storm Debby (2012), Hurricane Irma (2017) and Tropical Storm Elsa (2021). Extreme weather events can affect a wet pond's performance for attenuation.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

"The City is highly urbanized and much of its stormwater infrastructure is aged and constructed prior to statewide stormwater regulations were promulgated in 1982. Current design code requires the level of service for stormwater ponds to be the five 100-year critical events including the 24-hour event. Many of the stormwater ponds throughout the City do not meet this level of service. As a result, flood prone areas have been created that require active remedial measures such as pump operations. When hurricanes and tropical storms are predicted to impact Florida, department-wide storm preparations are initiated including emergency pump plans. Emergency pump plans are in place for known flood prone areas and involve an inspection and assessment to determine if a flood prone area or a stormwater basin needs to be pumped down prior to expected rainfall. Currently, only one stormwater basin is identified as a flood prone area that potentially requires pump operations. Public Works maintains three (3) stormwater pump stations; two (2) with permanent pumps and one with a portable pump. Additionally, four (4) 6-inch portable pumps are available for use during storm events. There are currently nine (9) Flood Prone Areas that have prepared emergency pump plans using portable pumps. The logistics to operate multiple pumping operations is significant and any additional locations would increase the resources needed.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

As mentioned previously, much of the City's stormwater infrastructure including wet basins is aged and constructed prior to statewide regulations and does not meet the current level of service. During an extreme weather event, pond capacity could be exceeded and will affect surrounding properties. Many locations throughout Gainesville have a surficial groundwater table (GWT) due to the existence of an aquitard. It is anticipated that GWTs will rise due to an increase in weather events and total rainfall. A higher GWT would result in premature discharge through the control structures, typically set for the seasonal high or normal groundwater table (SHGWT or NGWT). The ponds will discharge more stormwater into the City's infrastructure and creek system. Most of the City's creek systems are considered stream to sink and therefore, volume sensitive. The increase in stormwater discharge will result an increase to the floodplain area and impact downstream and lower lying areas. Higher GWTs in general will affect the service life and capacity of the underground pipe components, adding to base flow in receiving waterbodies affecting tailwater conditions at outfalls.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Yes. Urban growth and densification continue to occur within Gainesville. There are environmental buffers and stormwater regulations that control discharge from most new development; however, other factors such as inaccurate design assumptions contribute to the trend of increasing runoff. Additionally, current design standards are based on historic rainfall and not future predicted climate change and weather events.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

Yes. A significant portion of the City's stormwater infrastructure is old and undersized with a significant amount of development and urbanization occurring prior to the State of Florida's implementation of stormwater regulations in 1982. There are areas that lack stormwater ponds for attenuation and water quality treatment and areas served by ponds that do not meet the current LOS. A change in climate and extreme weather events will likely equate to more discharge of stormwater into the City's infrastructure and creek systems. Within the City, 13 census tracts were identified as neighborhoods at risk with 12 of the 13 tracts at or partially at the downstream end of the watersheds and the recipients of the increased runoff. Three (3) of the at risk tracts (Tracts 6, 7, and 8.06) in East Gainesville have residential areas were developed prior to 1982. It is noted that for nine (9) tracts, most of the development occurred during a time of stormwater regulation. However, as they are on the downstream end, they will be impacted by upstream urbanization and development. And, as previously noted, these watersheds are mostly stream to sink and volume sensitive. It is anticipated that floodplain will continue to expand due expected climate and weather changes.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

Thirteen (13) census tracts are identified as neighborhoods at risk. Using flood modeling data provided from First Street, the below table shows the area affected by the change in floodplain within the census tracts identified as neighborhoods at risk. There are 296 wet detention facilities identified within the municipal boundary (131 within the Tracts at Risk / 44.3% of total). There are 31 wet detention facilities identified within the within Tracts at Risk / 10.5% of total).

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

Key public infrastructure would include the City's stormwater management system, as well as, public and private roadway networks. Flooding could prevent residents from leaving their homes and prevent access by emergency vehicles and public transportation to affected areas.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S3: The component(s) will be affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Current stormwater regulations are in place that mitigate affects from development activities; however, reviewing staff need to ensure accurate design assumptions are made by the design engineer. Control structures of existing wet ponds may be able to be adjusted to mitigate for extreme weather and climate changes. The City could add emergency discharge drainage path if none exists to reduce impact to adjacent property.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

Emergency pump plans are in place for known Flood Prone Areas. Additional pump plans could be created and implemented if necessary. Funding would play a role on how many temporary or permanent locations could be implemented.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

Stormwater regulations and the EDCM can be modified for future development to avoid new impacts. The City's proposed 2021 Engineering Design & Construction Manual (EDCM) includes a criteria that New Class III and IV critical facilities, as defined by the Florida Building Code, shall be located outside of areas with a floodplain subject to a 0.2% or greater chance of flooding (or 500 year flood). In addition, the EDCM could be updated to incorporate technical criteria and design assumptions that mitigate extreme weather and climate change when data on those events becomes better established and becomes standard practice. Existing watershed management plans (WMPs) can be used to develop modern flood models using updated data, assumptions and models. The City has an extensive geodatabase (GDB) of the stormwater infrastructure throughout its road network that could improve the level of detail in the flood model.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Ensuring maintenance of floodplains and interconnected wetland systems. Inadequate designs for existing stormwater facilities. Existing private stormwater facilities that are not properly maintained or functional. Encroachment of development activities in adjacent land areas that would prevent expansion of stormwater facilities.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

It is anticipated that groundwater tables will rise due to an increase in weather events and total rainfall. Existing stormwater systems will begin to fail, affecting neighboring and downstream properties.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

The main resource that is limiting for the City is funding for design and construction projects to address adaptability of critical assets. Capital funding is limited at this time. The City routinely leverages existing capital funding with grants funds.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 2
- Data & Modelling: 3
- Personnel & Technical Assistance: 3
- Funding: 8
- Administration: 2

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC2: The component(s) are somewhat able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Floodwalls

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

The City of Gainesville maintains one floodwall. The City has experienced multiple hurricanes and weather events over the years, including Hurricanes Charley, Frances and Jeanne (2004), Tropical Storm Debby (2012), Hurricane Irma (2017) and Tropical Storm Elsa (2021). The floodwall was breached and flanked during Irma.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

Due to urbanization and development prior to the State of Florida's implementation of stormwater regulations in 1982, the floodplain has expanded over time and may affect the existing levees and floodwall due to floodplain expansion over time. The levees and floodwall likely do not meet the original intended level of service.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

Extreme wet weather events will impact the level of service (LOS) provided by the levee systems. Many locations throughout Gainesville have a surficial groundwater table (GWT) due to the existence of an aquitard. It is anticipated that GWTs will rise due to an increase in weather events and total rainfall. As GWT rises, it will increase the base flow in the creeks and channels along the berm and levee systems. This will result in the reduction of hydraulic capacity and freeboard potentially affecting neighboring and downstream properties.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Yes. Urban growth and densification continue to occur within Gainesville. There are environmental buffers and stormwater regulations that control discharge from most new development; however, other factors such as inaccurate design assumptions contribute to the trend of increasing runoff.

Additionally, current design standards are based on historic rainfall and not future predicted climate change and weather events.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

The floodwall is outside of the 13 identified Tracts at Risk.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

It is unlikely that if compromised, it would affect a downstream tract at risk. Impact would be mostly in the immediate area.

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

Key public infrastructure would include the levees and floodwall and potentially downstream road crossings over creeks and channels. Flooding in many cases will impact ingress/egress.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S2: The component(s) will be somewhat affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Expand maintenance to implement a inspection and maintenance program for the floodwall to ensure their safety, structural integrity and functionality. Updated flood studies have been completed and serve as best available data. This includes a 2021 Hydrologic and Hydraulic

Simulation of the Hail Sink Watershed (Hogtown Creek / Alachua Sink) where the three levees/floodwall are located. This study can be further refined to evaluate design modifications of the berms to improve their LOS. Grant Funding: Hazard Mitigation Grant Program (HMGP) funding has been received to address improvements for the Florida Park Berm and Mason Manor Wall. The Anglewood Berm has been identified in the Alachua County LMS priority projects list. In addition, HMGP funding has been utilized to purchase repetitive and substantial damaged homes. The City recently completed one (1) purchase and have two (2) in progress.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

If the asset cannot be adjusted to address the desired LOS, seek grant funding to purchase of adjacent properties identified to be at risk for flooding. Update FIRM maps in the areas of the Florida Park Berm and Mason Manor Wall to ensure homeowners have adequate flood insurance.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

Stormwater regulations and floodplain ordinance can be modified for future development to avoid new impacts. This could include implementation of FEMA's 100-year plus event for regulation of floodplains for new development. The 2021 Hydrologic and Hydraulic Simulation of the Hail Sink Watershed (Hogtown Creek / Alachua Sink) could be further refined to address LOS needs at both levees and the floodwall.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Existing easement limits and ability to increase height. Modifying the floodwall may involve land rights acquisition or easements and could be a significant effort in terms of staff and acquisition funds.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

It is anticipated that groundwater tables (GWT) will rise due to an increase in weather events and total rainfall. As GWT rises, it will increase the base flow in the creeks and channels along the levee/floodwall systems. This will result in the reduction of hydraulic capacity and freeboard potentially affecting adjacent properties.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

The main resource that is limiting for the City is funding for design and construction projects to address adaptability of critical assets. The City routinely leverages existing capital funding with grants funds and has received HMGP grants to make improvements at both the Florida Park Berm and Mason Manor Wall.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 6
- Data & Modelling: 3
- Personnel & Technical Assistance: 3
- Funding: 8
- Administration: 2

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC2: The component(s) are somewhat able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Floodplains

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

The City has experienced multiple hurricanes and weather events over the years that have impacted the creek systems with significant erosion and sediment transport, including Hurricanes Charley, Frances and Jeanne (2004), Tropical Storm Debby (2012), Hurricane Irma (2017) and Tropical Storm Elsa (2021). Urbanization and development have directly influenced watersheds within the City by increasing runoff during storm events and reducing groundwater recharge. Most of the City's creek systems are considered stream to sink and therefore, volume sensitive. The increase in stormwater discharge will result an increase to the floodplain area. Natural stream channels, open ditch channels, and underground storm pipe make up the majority of the stormwater conveyance system. The increase in runoff affects the City's aged infrastructure as well, creating localized flooding when its capacity is exceeded. When hurricanes and tropical storms are predicted to impact Florida, department-wide storm preparations are initiated including emergency pump plans. Emergency pump plans are in place for known flood prone areas and involve an inspection and assessment to determine if a flood prone area or a stormwater basin needs to be pumped down prior to expected rainfall. Public Works maintains three (3) permanent pump stations; two (2) with permanent pumps and one with a portable pump. Additionally, four (4) 6-inch portable pumps are available for use during storm events. There are currently nine (9) Flood Prone Areas that have prepared emergency pump plans using portable pumps. The logistics to operate multiple pumping operations is significant.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

Due to urbanization and development prior to the State of Florida's implementation of stormwater regulations in 1982, the floodplain has expanded over time. Urbanization and development have directly influenced watersheds within the City by increasing runoff during storm events and reducing groundwater recharge. Most of the City's creek systems are considered stream to sink and therefore, volume sensitive. The increase in stormwater discharge will result an increase to the floodplain area. Natural stream channels, open ditch channels, and underground storm pipe make up the majority of the stormwater conveyance system. The increase in runoff affects the City's aged infrastructure as well, creating localized flooding when its capacity is exceeded. Past encroachment of development in floodplain fringe areas has occurred in part due to FIRM maps that are not up to date for all areas within the City. Some areas of the existing FIRM maps use topography, hydrology and hydraulic data over 50 years old.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

An increase in extreme weather events and change in climate conditions will negatively affect the floodplain. Extreme wet weather events will likely tax the level of service (LOS) provided by the stormwater management system. Design criteria for roadways currently requires a 10-year (10/60 minute) LOS. Stormwater ponds are currently designed for the 100-year / 24-hour event. As mentioned previously, much of the City's stormwater infrastructure is aged and constructed prior to statewide regulations and does not meet the current level of service. Many locations throughout Gainesville have a surficial groundwater table (GWT) due to the existence of an aquitard. It is anticipated that GWTs will rise due to an increase in weather events and total rainfall. Many of the existing stormwater ponds/underground vault systems rely on infiltration to recover. As the GWT rises, infiltration within the ponds/vaults will be reduced. These systems will discharge more stormwater into the City's infrastructure and creek system. Most of the City's creek systems are considered stream to sink and therefore, volume sensitive. The increase in stormwater discharge will result an increase to the floodplain area. Higher GWTs may also affect the stormwater conveyance system and its level of service. Higher GWTs could affect tailwater conditions at outfalls, as well as, cause open drainage systems to be wetter and more difficult to maintain.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Yes. Urban growth and densification continue to occur within Gainesville. There are environmental buffers and stormwater regulations that control discharge from most new development; however, other factors such as inaccurate design assumptions contribute to the trend of increasing runoff. Additionally, current design standards are based on historic rainfall and not future predicted climate change and weather events.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

Yes. A significant portion of the City's stormwater infrastructure is old and undersized with a significant amount of development and urbanization occurring prior to the State of Florida's implementation of stormwater regulations in 1982. A combination of open and closed system drainage is utilized throughout the city. There are areas that lack stormwater ponds for attenuation and water quality treatment. Most of the runoff will eventually reach the creek systems. Within the City, 13 census tracts were identified as neighborhoods at risk with 12 of the 13 tracts at or partially at the downstream end of the watersheds and the recipients of the increased runoff. It is noted that for nine (9) tracts, most of the development occurred during a time of stormwater regulation. However, as they are on the downstream end, they will be impacted by upstream urbanization and development. And, as previously noted, these watersheds are mostly stream to sink and volume sensitive. It is anticipated that floodplain will continue to expand due to expected climate and weather changes.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

Thirteen (13) census tracts are identified as neighborhoods at risk. Using flood modeling data provided from First Street, the below table shows the area affected by the change in floodplain within the census tracts identified as neighborhoods at risk. The 2021 Total Floodplain Area within Municipal Boundary is 9.2 sq mi (2.4 sq mi within Tracts at Risk /25.9% of total). The Total Floodplain Area within Municipal Boundary for 2036 and 2051 is 10.1 sq mi (2.6 sq mi within Tracts at Risk / 26.1% of total).

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

Key public infrastructure would include: 1) Road network crossings could be directly affected by a loss of functionality. 2) Emergency pump operations would be impacted if there was not a positive outfall to pump to. 3) Increase in number of public facilities impacted by flooding. Based on a vulnerability assessment of Public Critical Assets, there are 39 potentially impacted by flooding using the 2021 First Street flood model. The critical assets can be broken into the following types: Bridges, Communications Facility, Community Center, Conservation Land, Emergency Medical Services, Fire Station, Parks, and Public Housing. By 2051, there are 44 public critical assets potentially impacted by flooding, adding types Health Care Facility, Historical/Cultural Asset, and State Government to the aforementioned types.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S2: The component(s) will be somewhat affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Current stormwater regulations and floodplain ordinance are in place that mitigate affects from development activities. This includes land development code requiring redevelopment projects to provide stormwater management to address water quality and quantity. This means that a site built before stormwater regulations must provide for stormwater, which typically will result in a reduction of runoff downstream. Updated flood studies are available as best available data including: 1) 2021 Lake Forest Creek Watershed 2) 2021 Hydrologic and Hydraulic Simulation of the Hail Sink Watershed (Hogtown Creek / Alachua Sink) 3) 2005 HEC-RAS study for Tumblin Creek 4) 2004 HEC-RAS study for Sweetwater. Grant funding. Recently utilized Hazard Mitigation Grant Program (HMGP) funding to purchase repetitive and substantial damaged homes. Recently completed one (1) purchase and have two (2) in progress.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

Storm preparation and post-storm event activities include: 1) Sandbagging. 2) Damage assessment and emergency response. 3) Creation of flood map for each event to record damages. 4) Assessment of repetitive loss insurance reports. Emergency pump plans are in place for known Flood Prone

Areas. Additional pump plans could be created and implemented if necessary. Funding would play a role on how many temporary or permanent locations could be implemented.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

Stormwater regulations and floodplain ordinance can be modified for future development to avoid new impacts. This could include implementation of FEMA's 100-year plus event for regulation of floodplains for new development. The City's proposed 2021 Engineering Design & Construction Manual includes new criteria that New Class III and IV critical facilities, as defined by the Florida Building Code, shall be located outside of areas with a floodplain subject to a 0.2% or greater chance of flooding (or 500 year flood). Existing watershed management plans (WMPs) can be used to develop modern flood models using updated data, assumptions and models. The Lake Forest Creek Watershed Management Plan, completed in 2021, could be further updated to include the 100-year plus event. The City has an extensive geodatabase (GDB) of the stormwater infrastructure throughout its road network that could improve the level of detail in the flood model. Continue to purchase properties adjacent to floodplain to maintain open space and recreation and prevent encroachment by development.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Ensuring maintenance of floodplains and interconnected wetland systems. Inadequate designs for existing stormwater facilities. Existing private stormwater facilities that are not properly maintained or functional. Past encroachment of development in floodplain fringe areas has occurred in part due to FIRM maps that are not up to date for all areas within the City. Some areas of the existing FIRM maps use topography, hydrology and hydraulic data over 50 years old.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

It is anticipated that groundwater tables will rise due to an increase in weather events and total rainfall. Existing stormwater systems will begin to fail, affecting neighboring and downstream properties.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

The main resource that is limiting for the City is funding for design and construction projects to address adaptability of critical assets. Capital funding is limited at this time. The City routinely leverages existing capital funding with grants funds.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 2
- Data & Modelling: 4
- Personnel & Technical Assistance: 4
- Funding: 8
- Administration: 2

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC2: The component(s) are somewhat able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Sediment traps

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

The City has experienced multiple hurricanes and weather events over the years, including Hurricanes Charley, Frances and Jeanne (2004), Tropical Storm Debby (2012), Hurricane Irma (2017) and Tropical Storm Elsa (2021). The City of Gainesville operates 55 sediment traps including 5 larger units at Duck Pond, Depot Park, NW 8th Ave @ Hogtown Creek, Sweetwater Branch and Tumblin Creek. Runoff from hurricanes and other extreme events can overwhelm or bypass sediment traps reducing their efficiencies.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

Sediment traps are maintained at least annually, but may need more frequent maintenance. Frequency of maintenance can be limited by budget limitations. Sediment traps have flow capacity limits and can be overwhelmed by high intensity, short duration events. Debris management is often an issue. Debris and trash that bypass the sediment traps move downstream and lead to clogging at culverts and transport of the material to natural areas.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

Extreme wet weather events will impact effectiveness and level of service (LOS) provided.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Yes. Urban growth and densification continue to occur within Gainesville. There are environmental buffers and stormwater regulations that control discharge from most new development; however, other factors such as inaccurate design assumptions contribute to the trend of increasing runoff. Additionally, current design standards are based on historic rainfall and not future predicted climate change and weather events.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

While only five (5) out of the 55 units are in a Track at Risk, 34 units can potentially be bypassed with debris and trash moving downstream to ten (10) of the 13 Tracts at Risk.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

Thirteen (13) census tracts are identified as neighborhoods at risk. The below table shows the number of sediment traps that affect a neighborhood at risk. There are 55 units within Municipal Boundary. There are 5 units within Tracts at Risk. There are 34 units that have potential to impact a Tract at Risk.

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

Key public infrastructure would include the larger instream sediment traps including Duck Pond, Depot Park, NW 8th Ave @ Hogtown Creek, Sweetwater Branch and Tumblin Creek. If these systems were overwhelmed, sediment deposition may occur in areas that would require removal from areas difficult to access.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S3: The component(s) will be affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Expand the maintenance program to implement more frequent inspection and service. Develop maintenance schedules for each sediment trap to ensure timely maintenance is performed and at a frequency that prevents bypass of debris and trash.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

Increase maintenance frequency, particularly at the larger units located in Duck Pond, Depot Park, NW 8th Ave @ Hogtown Creek, Sweetwater Branch and Tumblin Creek.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

The City maintains equipment and personnel with skill necessary to clean sediment traps. Increase maintenance frequency.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Most sediment traps and baffle boxes will have limits on the range of flow it can accommodate.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

Many of the inline sediment traps in the City's road network are older and could have limited efficiency during extreme wet weather events. Sediment and trash that move past the sediment traps will affect aquatic life and ecosystems in downstream receiving waters like Paynes Prairie and Bivens Arm.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

The main resource that is limiting for the City is funding for design and construction projects to address adaptability of critical assets. Capital funding is limited at this time. The City routinely leverages existing capital funding with grants funds.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 6
- Data & Modelling: 3
- Personnel & Technical Assistance: 4
- Funding: 8
- Administration: 2

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC2: The component(s) are somewhat able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Open ditch drains

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

The City has experienced multiple hurricanes and weather events over the years that have impacted the natural stream channels and open ditch channels, including Hurricanes Charley, Frances and Jeanne (2004), Tropical Storm Debby (2012), Hurricane Irma (2017) and Tropical Storm Elsa (2021). Some of the open ditch channels are sometimes the result of straightened natural stream channels and are more susceptible to damage by erosion. Open ditch channels, usually lined with vegetation, are susceptible to erosion when permissible velocities within the channel are exceeded leading to sediment transport and deposition downstream. In addition, natural hazards such as down trees or clogging vegetative debris can quickly diminish the channels hydraulic capacity.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

The City is highly urbanized and much of its stormwater infrastructure is aged and constructed prior to statewide stormwater regulations were promulgated in 1982. Most of the City's infrastructure does not meet current required level of service (LOS) for stormwater management systems. Budget limitations minimize the ability to upgrade the channels with a lining material other than sod (i.e. riprap, concrete). Upgrades by replacing the channels with pipe is more cost prohibitive. Replacing channels with pipes would reduce the amount of infiltration that can occur and would likely affect water quality. Open ditch channels within neighborhoods can be problematic. They are often considered a nuisance by the resident, particularly if not functioning well. Poor drainage through these channels leads to wet conditions, mosquitoes, impact to the resident's ability to use the back yard. Erosion of open ditch channels that expand and extend outside of existing easements prevent access to maintenance, which can worsen conditions and lead to steeper banks and erosion. Maintenance practices such as deepening of ditches can result in steepening banks, which leads to further erosion. Debris management is often an issue. Trash and debris that resident dispose in channels lead to clogging at culverts and transport of the material to natural areas.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

An increase in extreme weather events and change in climate conditions will negatively affect the open ditch channels. Extreme wet weather events will likely tax the level of service (LOS) provided by the stormwater management system. Design criteria for roadways currently requires a 10-year (10/60 minute) LOS. Stormwater ponds are currently designed for the 100-year / 24-hour event. As mentioned previously, much of the City's stormwater infrastructure is aged and constructed prior to statewide regulations and does not meet the current level of service. Many locations throughout Gainesville have a surficial groundwater table (GWT) due to the existence of an aquitard. It is anticipated that GWTs will rise due to an increase in weather events and total rainfall. As GWT rises, the likelihood that it will intercept the bottom of the channels increases. Maintaining channels that routinely hold water become more challenging and costly. Increased vegetation can result reducing the ability to move water efficiently downstream. Any freeboard within the channels can be lost causing water to overflow into adjacent properties.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Yes. Urban growth and densification continue to occur within Gainesville. There are environmental buffers and stormwater regulations that control discharge from most new development; however, other factors such as inaccurate design assumptions contribute to the trend of increasing runoff. Additionally, current design standards are based on historic rainfall and not future predicted climate change and weather events.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

Yes. A significant portion of the City's stormwater infrastructure is old and undersized with a significant amount of development and urbanization occurring prior to the State of Florida's implementation of stormwater regulations in 1982. A combination of open and closed system drainage is utilized throughout the city. There are areas that lack stormwater ponds for attenuation and water quality treatment. Most of the runoff will eventually reach the creek systems. Within the City, 13 census tracts were identified as neighborhoods at risk with 12 of the 13 tracts at or partially at the downstream end of the watersheds and the recipients of the increased runoff. It is noted that for nine (9) tracts, most of the development occurred during a time of stormwater regulation and are served primarily by underground pipe systems. Three (3) of those tracts (Tracts 6, 7, and 8.06) have older subdivisions that utilize open ditch channels and underground pipes to convey stormwater. In addition, it must be noted that much of the City's early development located within the center of the municipal boundary was constructed before stormwater regulations and represents a significant part of the City's aged and undersized infrastructure.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use [Neighborhoods at Risk] to help answer this question.

At risk would be properties affected by a reduction in the function of the channels. There are approximately 201 miles of open channels within the City's municipal boundary with 76.9 miles located within Tracts at Risk / 38.2% % of total.

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and

natural hazards? If so, why?

Key public infrastructure would include road networks, which could be directly affected by a loss of functionality within the open ditch channels.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S2: The component(s) will be somewhat affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Open ditch channels have some capacity to adapt to weather events, particularly where they have been well maintained. Current stormwater regulations are in place that mitigate affects from development activities. Grant funding: Recently utilized USDA funding to correct damage from Hurricane Irma in 2017 (Emergency Watershed Program) at four (4) locations.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

If adaptive capacity is maintenance related, the City could increase the inspection and maintenance frequency of maintained open ditch channels. Emergency pump plans are in place for known Flood Prone Areas. Additional pump plans could be created and implemented if necessary. Funding would play a role on how many temporary or permanent locations could be implemented.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

Stormwater regulations and floodplain ordinance can be modified for future development to avoid new impacts. This could include implementation of FEMA's 100-year plus event for regulation of floodplains for new development. Existing watershed management plans (WMPs) can be used to develop modern flood models using updated data, assumptions and models. The City has an extensive geodatabase (GDB) of the stormwater infrastructure throughout its road network that could improve the level of detail in the flood model. Design and construction of stormwater improvement projects to address the adaptive capacity could be implemented.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Inadequate designs for existing stormwater facilities. Existing private stormwater facilities that are not properly maintained or functional. These systems likely discharge more than they were designed to thus diminishing the overall capacity of the stormwater conveyance system. Some segments of open channel systems do not have adequate access or easements.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

Of concern is the impact on channel capacity if the groundwater table rises as a result of climate change leading to additional channels not providing the LOS needed. There are existing channels experiencing this issue already. Existing stormwater systems will begin to fail, affecting neighboring and downstream properties.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

The main resource that is limiting for the City is funding for design and construction projects to address adaptability of critical assets. Capital funding is limited at this time. The City routinely leverages existing capital funding with grants funds.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 5
- Data & Modelling: 4
- Personnel & Technical Assistance: 4
- Funding: 8
- Administration: 2

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC2: The component(s) are somewhat able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Underground pipes

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

The City has experienced multiple hurricanes and weather events over the years that have impacted the creek systems with significant erosion and sediment transport, including Hurricanes Charley, Frances and Jeanne (2004), Tropical Storm Debby (2012), Hurricane Irma (2017) and Tropical Storm Elsa (2021). There have also been short, intense storms that have overwhelmed the stormwater infrastructure's capacity along the multiple roadways, causing temporary flooding of streets and nuisance flooding. Debris swept into the stormwater conveyance system can create clogging or blockages, diminishing capacity.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

The City is highly urbanized and much of its stormwater infrastructure is aged and constructed prior to statewide stormwater regulations were promulgated in 1982. Most of the City's infrastructure does not meet current required level of service (LOS) for stormwater management systems. Budget limitations prevent upgrades to the undersized and aged infrastructure. The development community has been resistant to upgrading infrastructure as new projects are proposed. Many pipes are reaching the end of their design life and require replacement. As these pipes get identified for replacement, the design will need to consider: 1) additional capacity as many pipes are less than the current standard of 15-inches minimum, 2) limitations that restrict flow creating impacts for upstream areas, and 3) improving LOS on city roadways.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

An increase in extreme weather events and change in climate conditions will negatively affect the underground pipes. Extreme wet weather events will likely tax the level of service (LOS) provided by the stormwater management system. Design criteria for roadways currently requires a 10-year (10/60 minute) LOS. Stormwater ponds are currently designed for the 100-year / 24-hour event. As mentioned previously, much of the City's stormwater infrastructure is aged and constructed prior to statewide regulations and does not meet the current level of service. Many locations throughout Gainesville have a surficial groundwater table (GWT) due to the existence of an aquitard. It is anticipated that GWTs will rise due to an increase in weather events and total rainfall. Higher GWTs likely affect underground pipes in service life and capacity, adding to base flow in receiving waterbodies affecting tailwater conditions at outfalls. Corrugated metal pipes not previously in the GWT will be subject to increase corrosion rates. Infiltration at pipe joints could cause a loss in pipe capacity.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Yes. Urban growth and densification continue to occur within Gainesville. There are environmental buffers and stormwater regulations that control discharge from most new development; however, other factors such as inaccurate design assumptions contribute to the trend of increasing runoff. Additionally, current design standards are based on historic rainfall and not future predicted climate change and weather events.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

Yes. A significant portion of the City's stormwater infrastructure is old and undersized with a significant amount of development and urbanization occurring prior to the State of Florida's implementation of stormwater regulations in 1982. A combination of open and closed system drainage is utilized throughout the city. There are areas that lack stormwater ponds for attenuation and water quality treatment. Most of the runoff will eventually reach the creek systems. Within the City, 13 census tracts were identified as neighborhoods at risk with 12 of the 13 tracts at or partially at the downstream end of the watersheds and the recipients of the increased runoff. It is noted that for nine (9) tracts, most of the development occurred during a time of stormwater regulation and are served primarily by underground pipe systems that meet the LOS criteria. Three tracts (Tracts 6, 7, and 8.06) are comprised of older subdivisions that utilize a combination of open ditch channels and underground pipes and likely do not meet the LOS criteria. In addition, it must be noted that much of the City's early development located within the center of the municipal boundary was constructed before stormwater regulations and represents a significant part of the City's aged and undersized infrastructure.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

From an underground pipe perspective, at risk would be properties affected by a reduction in the function of the pipes. There are 344 miles of underground pipe within the municipal boundary (90.3 miles within the Tracts at Risk / 26.3% of total).

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

Key public infrastructure would include road networks, which would be directly affected by a loss of functionality within the underground pipes. Lack of efficient conveyance would result in flooding and prevent emergency vehicles ingress/egress through affected areas.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S3: The component(s) will be affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Current stormwater regulations are in place that mitigate affects from development activities. Capital improvement and resurfacing projects involving roadways can help address old infrastructure to improve its stormwater LOS. A number of pipes have been lined to extend the life of the pipes. Grant funding such as the Resilient Florida grant and the Building Resilient Infrastructure and Communities (BRIC) grant can potentially applied for to assist with improving the resiliency of the storm sewer system.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

If adaptive capacity is maintenance related, the City could increase the inspection and maintenance frequency of maintained pipes. Emergency pump plans are in place for known Flood Prone Areas.

Additional pump plans could be created and implemented if necessary. Funding would play a role on how many temporary or permanent locations could be implemented.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

Stormwater regulations and floodplain ordinance can be modified for future development to avoid new impacts. For example, instead of a 10-year LOS for conveyance systems, a 25-year LOS could be considered. Design and construction of stormwater improvement projects to address the adaptive capacity could be implemented. Existing watershed management plans (WMPs) can be used to develop modern flood models using updated data, assumptions and models. The City has an extensive geodatabase (GDB) of the stormwater infrastructure throughout its road network that could improve the level of detail in the flood model and allow staff to identify flooding or drainage issues based on undersized conveyance.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Stormwater regulations and floodplain ordinance can be modified for future development to avoid new impacts. For example, instead of a 10-year LOS for conveyance systems, a 25-year LOS could be considered. Existing watershed management plans (WMPs) can be used to develop modern flood models using updated data, assumptions and models. The City has an extensive geodatabase (GDB) of the stormwater infrastructure throughout its road network that could improve the level of detail in the flood model and allow staff to identify flooding or drainage issues based on undersized conveyance.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

Of concern is the impact on pipe capacity if the groundwater table rises as a result of climate change. Existing stormwater systems will begin to fail, affecting neighboring and downstream properties. Upgrading storm sewer systems may involve land rights acquisition or easements. This could be a significant effort in terms of staff and acquisition funds. Conflicts with existing utilities within the road right-of-way may also limit the ability to upgrading storm sewer systems.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

The main resource that is limiting for the City is funding for design and construction projects to address adaptability of critical assets. Capital funding is limited at this time. The City routinely leverages existing capital funding with grants funds.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 5
- Data & Modelling: 4
- Personnel & Technical Assistance: 4
- Funding: 8
- Administration: 2

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC1: The component(s) are minimally able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Infiltration basins

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

Sinkholes periodically appear in the infiltrating wetlands that require the systems be temporarily shut down.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

None.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

Increasing rainfall intensity will possibly affect the infiltrating wetlands because appearance of sinkholes tend to follow extreme rain events.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

No.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

The infiltrating wetlands functionality is unrelated to census tracts. All infiltrating wetlands are in the same census tract 22.19

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

The recharge wetlands have low vulnerability to storm events and climate conditions. With the exception of the Kanapaha Middle School Hybrid wetland, none of the wetlands receive stormwater other than the rain that falls directly onto the basin. The Kanapaha Middle School wetland receives stormwater from the middle school property in addition to reclaimed water. However, that basin has an exceptionally high perc rate and a significant amount of excess capacity. Visual observations of the basin after major storm events that caused flooding elsewhere showed little or no accumulation of stormwater in this basin. In addition, if there ever is a concern about the capacity of this basin, as a mitigation step we can shut off the reclaimed water flow in advance of a major storm event to maximize available capacity. If compromised by sinkholes, they can be shut off without impacting anyone.

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

No.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S1: The component(s) will be minimally affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

The reclaimed water flows to the basins is controlled by water level sensors which shut off the reclaimed water flow when the water level reaches a level set-point which is approximately 6 to 12 inches of water depth in the basins, leaving the remaining basin depth as freeboard.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

The infiltrating wetlands are expected to be able to adjust. They can be shut down until repaired if a sinkhole forms.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

Additional infiltrating wetlands are planned to be constructed to increase capacity. This will increase the flexibility of reclaimed water disposal and ensure that shutdown of any single infiltrating wetland will not be a problem while sinkholes or other issues are fixed.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

The infiltrating wetlands are sited in the western part of the system where the geology allows for higher percolation rates. The same geology does increase the likelihood of sinkhole formation.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

None.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

Not at this time.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 1
- Data & Modelling: 2
- Personnel & Technical Assistance: 2
- Funding: 1
- Administration: 1

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC4: The component(s) can adjust to projected weather and climate conditions in a beneficial way

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Treatment facilities

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

Past hurricanes and high intensity rainfall events during the wet season as well as extended periods of high groundwater affect the treatment facility operations.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

Aging infrastructure, budget constraints, maintaining a skilled labor force currently affect the treatment facilities.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

Generally, increasing rainfall intensities mean more frequent and higher flows that need to be conveyed through the plant. If the water conveying and treatment systems are not sized to handle the higher flow rates, overflows from the basins will occur and treatment systems will not function properly. Overflows and reductions in treatment effectiveness can result in non-compliance. During heavy storms with increased lightning and wind, damage to system components can occur or utility electrical power can be interrupted, causing equipment failures or outages. Each of the treatment plants is unique and could be impacted differently by increasing rainfall frequency and flooding. Increased flooding and higher flood elevations will have another impact on the Main Street facility. The facility is in close proximity and discharges to Sweetwater Branch. More frequent flooding will impact the facilities ability to discharge as well as increases the streambank erosion near critical treatment basins. Increased erosion will require substantial investments to protect the facility from being undermined.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Aging infrastructure will continue, both in the system – allowing increased inflow and infiltration to reach the treatment facilities; and at the treatment facilities – requiring operational shutdowns for repair, renewal, and rehabilitation. Continued investment will be important to deal with aging infrastructure. Staffing levels could also become an issue as experienced long-time staff retire and unfilled positions linger. There may not be opportunities to transfer institutional knowledge resulting in some difficulty operating the system during atypical emergency conditions. Regulatory changes could make existing treatment systems obsolete.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

The treatment facility functionality is unrelated to census tracts, but more related to facility age and site constraints. The Main Street Facility was constructed in 1930, while the Kanapaha Facility was constructed in the 1970s. The Murphree Water Treatment Facility was constructed in 1975.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

If the Main Street Facility becomes compromised, wastewater may back up into the collection system upstream and primarily affect census tract 7. Of significance, this tract's demographics include 75% of the population being people of color and Hispanics, 15% of households with no car and 42% the housing units being rentals. Some businesses near the Main Street Facility are expected to be most impacted because of proximity. If the Kanapaha Facility becomes compromised, wastewater will overflow into natural areas such as Lake Kanapaha located in the census tract 22.19. Of significance, this tract's demographics include 55% of the population being people of color and Hispanics, 9% of households with no car and 65% of housing units that are rentals. Residents of the area are not expected to experience wastewater backups or loss of service. They may possibly experience some odors. If the Murphree Facility becomes compromised all residents in the water service area will be affected by an outage and boil water notice.

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

Wastewater backups in the Main Street Facility collection system could occur near Depot Park. There could be some foul smells along roadways near this park. The Kanapaha Facility is located near a community park and The University of Florida Training, Research and Education for Environmental Occupations (TREEO) Facility. If significant bypass operations occur, there could be some foul odors detectable to park visitors and workers at TREEO. Yes, especially life/safety facilities, such as hospitals and long-term care if they do not have water.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S3: The component(s) will be affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

The two wastewater treatment plants are designed for contingencies such that the plants could stay functional even if some parts fail. Backup generators are always available in the event of an outage.

Both facilities benefit from back-up generator power availability. Additionally, an Inter-plant transfer pumping station may be configured to transfer some flow between facilities. At Main Street, there is not ability to store or equalize water from the collection system and the facility is currently operated at 90% of the rated daily capacity. Once the plant is over its hydraulic capacity, operators start bypassing the most limiting hydraulic restrictions which include the bar screens and filters. At Kanapha, the plant has more available capacity and there are more built-in options to help mitigate higher flow events. The headworks have more redundancy and allow partial bypassing. The plant also has a large storage basin to divert water into during emergency events. Additionally, Kanapaha is not located near nor does it discharge to a waterway. While Kanapaha can mitigate more frequent higher flow events, these events can present significant challenges and impact the plant's overall performance similar to the Main Street facility. The water treatment plant is designed for contingencies such that the plant could stay functional even if some parts fail. Backup generator power is always available in the event of an outage.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

Existing contracts with septic haulers allow for quick mobilization to collect and convey wastewater before it spills out of manholes. Environmental inspectors can put up advisories in areas where sewer system overflows occur and monitor and test until any safety hazards are gone. Operators are always on site at the water treatment plant to troubleshoot any problems.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

The staffing can be increased for predicted inclement weather conditions. Treatment chemicals and generator fuels can be proactively stocked. Spare parts for critical components can be kept on hand for emergencies.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

At Main Street, there is not ability to store or equalize water from the collection system and the facility is currently operated at 90% of the rated daily capacity. Once the plant is over its hydraulic capacity, operators start bypassing the most limiting hydraulic restrictions which include the bar screens and filters. The upstream collection system would surcharge and overflow if the bar screens are not bypassed and the treatment basins would overflow if the filters are not bypassed. While bypassing does not necessarily result in non-compliance it does have a tremendous impact on the plant's performance. Age of equipment and availability of staff time to complete mitigation work affect adaptability at all facilities.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

The budget constraints make it a challenge to construct upgrades that would allow the treatment facilities to function normally during hurricanes or prolonged flooding conditions. Damage or failure of wastewater treatment plants could have a range of impacts. There could be a risk of waterborne illness. In the event of a sewer spill, the City could be responsible for millions of dollars in fines. Water quality impacts due to pollution could have ripple effects on habitat or species in the affected area if water is released back into the environment or flooding of wastewater spills into the surrounding environment. Chronic inundation could pose a threat to access and plant longevity.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

The planned upgrade at the Main Street facility has a budget shortfall of about $20 million dollars that staff are actively looking for grant funding to make up the difference and avoid any rate impacts.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 3
- Data & Modelling: 3
- Personnel & Technical Assistance: 3
- Funding: 10
- Administration: 3

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC2: The component(s) are somewhat able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Pumps and Pump stations

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

The City has experienced multiple hurricanes and weather events over the years, including Hurricanes Charley, Frances and Jeanne (2004), Tropical Storm Debby (2012), Hurricane Irma (2017) and Tropical Storm Elsa (2021). The City of Gainesville operates multiple permanent and temporary pump stations. In addition, there are several permanent and temporary pump stations operated by private entities including one HOA.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

The City of Gainesville operates three stormwater pump stations; two (2) permanent and one (1) with a portable pump. Public Works Operations staff exercise the pump stations regularly to ensure they are in good working order. PUMP STATION AGE OF PUMP (YRS) Anglewood 28 Featherwood/Foxgrove 36 SW Industrial Park 12 Four (4) 6-inch portable pumps are maintained by the City Fleet Department and receive routine maintenance that will extend their life. Public Works moves the portable pumps between the SW Industrial Park pump station and the nine (9) flood prone areas identified in the Drainage Operations Manual. There are also seven (7) private and two (2) temporary pump stations operated by private entities. These locations include one permanent pump system at Clear Lake operated by an HOA; one in Gwen Oaks Subdivision and two at SiVance. Public Works staff is developing pumping plans for each of the nine emergency pump sites. Documentation will preserve institutional knowledge and allow staff to determine if sufficient hose and couplings are available to install hose for emergency pumping as tropical storms approach.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

Flooding generally occurs when soil conditions are saturated and the area receives sustained rainfall over several days. The City has recently experienced flooding in new locations due to high intense rain events over shorter time periods. We expect the number of emergency pump sites to increase as weather patterns continue to change. It may become necessary to purchase additional pumps and hose and to train more staff to implement emergency pumping.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Yes. Urban growth and densification continue to occur within Gainesville. There are environmental buffers and stormwater regulations that control discharge from most new development; however, other factors such as inaccurate design assumptions contribute to the trend of increasing runoff. Additionally, current design standards are based on historic rainfall and not future predicted climate change and weather events.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

Yes. The City implements emergency pump operations at seven (7) flood prone areas in the 13 census tracts identified as neighborhoods at risk. Several low cost multi-family residential units are concentrated near the University of Florida campus in an area where isolated depression basins are located. During extreme rainfall events, the basins fill and flood adjacent buildings and roadways. There are four (4) privately-operated pump stations located within the 13 tracts.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use [Neighborhoods at Risk] to help answer this question.

If one or more of the portable pumps were to malfunction during a flood event, ingress/egress could be limited over several days and flood damage could occur to buildings and contents of residents at high risk. The permanent and portable pump stations also protect single-family homes serving populations at risk. Within the City, 13 census tracts were identified as neighborhoods at risk with 12 of the 13 tracts at or partially at the downstream end of the watersheds and the potential recipients of the increased runoff. Five tracts (Tracts 7, 15.15, 15.19, 15.22, and 19.02) contain 11 of the pump operations. There are: 10 total Permanent Pump Stations (3 City-owned); 11 total Temporary Pump Stations (9 City-owned); 4 Permanent Pump Stations within Tracts at Risk (2 City-owned); and 7 Temporary Pump Stations within Tracts at Risk (5 City-owned).

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

Key public infrastructure impacted include public and private roadway networks. Flooding could prevent residents from leaving their homes and prevent access by emergency vehicles and public transportation to affected areas.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S3: The component(s) will be affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Operation of three (3) stormwater pump stations; two (2) permanent and one (1) with a portable pump. The City owns four (4) six-inch portable pumps that are available for use during storm events.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

Portable generators can temporarily provide power to permanent pump stations when power is lost. If the permanent pumps break down during a storm event, the portable pumps can replace the permanent pump for a short period. The City would need to rent or purchase additional portable pumps to provide additional redundancy.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

The City maintains personnel with skill necessary to perform most pump repair. Rent additional portable pump units to have on hand before a tropical storm moves into the area.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

There may not be a pumping solution for every localized flooding condition. Engineering analysis must occur, before implementing a new pumping plan.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

The City can purchase or rent additional portable pump station equipment as needed. The City would not be able to build additional permanent pump stations without a lengthy planning and budgeting process.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

The two older permanent pump stations are single pump stations. The City should consider upgrading to a duplex pump station to provide redundancy in case one of the pumps fails during a flood event. Grant funding may be necessary for those upgrades. The City routinely leverages existing capital funding with grants funds.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 6
- Data & Modelling: 4
- Personnel & Technical Assistance: 4
- Funding: 8
- Administration: 2

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC3: The component(s) are mostly able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Roadways and Railroads

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

The City has experienced multiple hurricanes and weather events over the years that have impacted the creek systems with significant erosion and sediment transport, including Hurricanes Charley, Frances and Jeanne (2004), Tropical Storm Debby (2012), Hurricane Irma (2017) and Tropical Storm Elsa (2021). Urbanization and development have directly influenced watersheds within the City by increasing runoff during storm events and reducing groundwater recharge. Most of the City's creek systems are considered stream to sink and therefore, volume sensitive. The increase in stormwater discharge will result an increase to the floodplain area. Natural stream channels, open ditch channels, and underground storm pipe make up the majority of the stormwater conveyance system. The increase in runoff affects the City's aged infrastructure as well, creating localized flooding when its capacity is exceeded. When capacity is exceeded, culvert crossings of channels at roadways can create flooding conditions that force a road closure.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

The City is highly urbanized and much of its stormwater infrastructure is aged and constructed prior to statewide stormwater regulations were promulgated in 1982. Much of the City's infrastructure does not meet current required level of service (LOS) for stormwater management systems. Reduced LOS caused by increased flow or a blockage of the conveyance system is often observed at culvert crossings of a roadway. Many culverts are reaching the end of their design life and require replacement. As these culverts get identified for replacement, the design will need to consider: 1) additional capacity due to change in flood patterns, 2) limitations that restrict flow creating impacts for upstream areas, and 3) improving LOS on city roadways.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

An increase in extreme weather events and change in climate conditions will negatively affect the open ditch channels. Extreme wet weather events will likely tax the level of service (LOS) provided by the stormwater management system. Design criteria for roadways currently requires a 10-year (10/60 minute) LOS. Stormwater ponds are currently designed for the 100-year / 24-hour event. As mentioned previously, much of the City's stormwater infrastructure is aged and constructed prior to statewide regulations and does not meet the current level of service.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Yes. Urban growth and densification continue to occur within Gainesville. There are environmental buffers and stormwater regulations that control discharge from most new development; however, other factors such as inaccurate design assumptions contribute to the trend of increasing runoff. Additionally, current design standards are based on historic rainfall and not future predicted climate change and weather events.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

A significant portion of the City's stormwater infrastructure serving the transportation network is old and undersized with a significant amount of development and urbanization occurring prior to the State of Florida's implementation of stormwater regulations in 1982. A combination of open and closed system drainage is utilized throughout the city. There are areas that lack stormwater ponds for attenuation and water quality treatment. Most of the runoff will eventually reach the creek systems. Within the City, 13 census tracts were identified as neighborhoods at risk with 12 of the 13 tracts at or partially at the downstream end of the watersheds and the recipients of the increased runoff. It is noted that for nine (9) tracts, most of the development occurred during a time of stormwater regulation and are served primarily by stormwater collection and conveyance systems that meet the LOS criteria. Four (4) tracts (Tracts 6, 7, 8.06 and 19.02) are comprised of older developments and may not meet the LOS criteria. In addition, it must be noted that much of the City's early development located within the center of the municipal boundary was constructed before stormwater regulations and represents a significant part of the City's aged and undersized infrastructure.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

Thirteen (13) census tracts are identified as neighborhoods at risk. Using flood modeling data provided from First Street, the below table shows the area affected by the change in floodplain within the census tracts identified as neighborhoods at risk. The length of roadways potentially impacted by the 2021 First Street Flood Model is 127.5 miles (46.1 miles within Tracts at Risk / 36.1% of total). The length of roadways potentially impacted by the 2036 and 2051 First Street Flood Models is 139.5 miles (49.8 miles within Tracts at Risk / 35.7% of total).

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

Key public infrastructure would include: 1) The road network could be directly affected by a loss of functionality within culvert crossings at creeks and natural channels. 2) Increase in number of public facilities impacted by flooding including roadway crossings. Flooding of roadways would prevent emergency vehicles ingress/egress through affected areas.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S3: The component(s) will be affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

No answer

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Culvert crossings have some capacity to adapt to weather events, particularly where they have been well maintained and sediment deposition has been routinely removed. Current stormwater regulations are in place that mitigate affects from development activities.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

If adaptive capacity is maintenance related, the City could increase the inspection and maintenance frequency of culvert crossing. Emergency pump plans are in place for known Flood Prone Areas. Additional pump plans could be created and implemented if necessary. Funding would play a role on how many temporary or permanent locations could be implemented.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

Existing watershed management plans (WMPs) can be used to develop modern flood models using updated data, assumptions and models. The City has an extensive geodatabase (GDB) of the stormwater infrastructure throughout its road network that could improve the level of detail in the flood model and allow staff to identify flooding or drainage issues based on undersized conveyance. Implement the use of future IDF curves for new culvert design. Design and construction of stormwater improvement projects to address the adaptive capacity could be implemented. Inventory undersized City culverts where relief structures could be added. Modify stormwater regulations to require development to make improvements in adjacent right-of-ways.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Ensuring maintenance of floodplains and interconnected wetland systems. Inadequate designs for existing stormwater facilities. Excessive sedimentation that affect the culvert crossings hydraulic capacity. Existing private stormwater facilities that are not properly maintained or functional.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

Of concern is the impact on the floodplain if the groundwater table rises as a result of climate change. A rise in the groundwater table will create a tailwater effect through the creek systems, which are mostly stream to sink watersheds. This will affect the stormwater conveyance systems including culvert crossings from performing and create localized flooding or overtopping of roadways when capacities are exceeded. In some cases, it will be difficult to add the needed capacity due to the width of the channel cross section and easement constraints. It may be necessary to purchase adjacent private property to increase culvert capacity.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

The main resource that is limiting for the City is funding for design and construction projects to address adaptability of critical assets. Capital funding is limited at this time. The City routinely leverages existing capital funding with grants funds.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 7
- Data & Modelling: 3
- Personnel & Technical Assistance: 4
- Funding: 8
- Administration: 3

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC1: The component(s) are minimally able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

No answer

Natural stream channels

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

The City has experienced multiple hurricanes and weather events over the years that have impacted the creek systems with significant erosion and sediment transport, including Hurricanes Charley, Frances and Jeanne (2004), Tropical Storm Debby (2012), Hurricane Irma (2017) and Tropical Storm Elsa (2021). Creeks and natural channels within the City are an integral part of the Stormwater system. Their continued natural function is paramount to reducing flood risk within our community. This system also includes some channelized stream sections. This system also covers public and private ownership. Urbanization and development within the City has directly influenced the creek by increasing runoff during storm events and by reducing groundwater recharge. The creek systems are affected. The slope of the creek beds in the upper reaches and headwaters are steep and are downcutting. The upper reaches tend to have incised channels and narrow floodplains. The lower reaches of Hogtown are not as steep and typically see sediment deposition and wider floodplains. A plan to address this issue was generated by the US Army Corps of Engineers under the Preliminary Restoration Plan for Hogtown Creek (2002) . “The Plan” was developed to restore and protect the creek and its tributaries and habitats.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

Due to urbanization and the sandy nature, the creek beds within the Gainesville area scour and erode in the upper reaches leading to the transport sediment downstream. The erosion process has resulted in deeply incised stream segments that are isolated from their historic floodplains. Continued down cutting and stream bank sluffing widens the stream channel and threatens some adjacent buildings. Sediment deposition in the lower reaches causes loss in hydraulic capacity natural channels and roadway crossings. Excessive sedimentation results in habitat smothering and a reduction in the stream condition index values within the impacted steam systems. In addition, the cost to remove sediment from culverts at roadway crossings and sediment traps is significant. Downcutting and erosion of stream channels that expand and extend outside of existing easements prevent access to maintenance, which can worsen conditions and lead to steeper banks and erosion.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

Extreme events increase erosion of the upper reaches of creeks and sediment deposition in the lower reaches.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Yes. Urban growth and densification continue to occur within Gainesville. There are environmental buffers and stormwater regulations that control discharge from most new development; however, other factors such as inaccurate design assumptions contribute to the trend of increasing runoff. Additionally, current design standards are based on historic rainfall and not future predicted climate change and weather events.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

Yes. A significant portion of the City's stormwater infrastructure is old and undersized with a significant amount of development and urbanization occurring prior to the State of Florida's implementation of stormwater regulations in 1982. A combination of open and closed system drainage is utilized throughout the city, but there are areas that lack stormwater ponds for attenuation and water quality treatment. Most of the runoff will eventually reach the creek systems. Within the City, 13 census tracts were identified as neighborhoods at risk. Twelve (12) of the 13 tracts are in or partially in the downstream end of the watersheds and the recipients of the increased runoff. Floodplain extents have increased over time, and with expected climate and weather changes, they will likely continue to increase.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

At risk would be those properties affected by a reduction in the natural function of the creeks and natural channels. There are approximately 90 miles of natural stream channels within the City's municipal boundary. Thirteen (13) census tracts were identified as neighborhoods at risk. Approximately 35% of the natural stream channels are within the tracts considered to be a neighborhood at risk.

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

Key public infrastructure would include: 1) Road network crossings of the creeks and natural channels that could be directly affected by a loss of functionality within the creeks and natural channels. 2) Sediment traps and basins utilized by the City to remove sediment from stormwater runoff. 3) Public infrastructure and buildings adjacent to eroded stream channels.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S3: The component(s) will be affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

The natural stream channels have some capacity to adaptive to weather events, particularly where stream corridors are heavily vegetated with trees and shrubs that have not been undercut by erosion. Current stormwater regulations and floodplain ordinance are in place that mitigate affects from development activities. The City contracted with Wolf Enterprises, Inc. to complete a Preliminary Erosion and Sedimentation Assessment for Hogtown Creek in 2002. Hogtown Creek, including its primary tributary, account for approximately 35% of the area within City's municipal boundary. As a result of the 2002 Assessment, the City entered into a Letter of Intent to implement a Preliminary Restoration Plan for Hogtown Creek (2002) generated by the US Army Corps of Engineers (Corps). "The Plan" was developed to restore and protect the creek and its tributaries and habitats. Part of the Plan included development of a Fluvial Geomorphologic Assessment, which was completed by Wolf Enterprises in 2003. The Plan also identified a preliminary estimate of project construction cost for stream stabilization, removal of invasive/exotic species and riparian restoration. Stream stabilization proposed a combination of 100 large structures and weirs, 80 small structures and weirs, and 5 acres of vegetation removal and replanting. Implementation of the Plan was estimated at over $3M.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

If adaptive capacity is maintenance related, the City could increase the inspection and maintenance frequency of maintained culvert crossings. The City inspects culvert crossings and natural stream channels and removes debris that can impacts the capacity of a stream channel. Continued and increased erosion and sediment transport would affect culvert crossings under roadways and sediment traps. The City can remove sediment and debris from roadway crossings, but are limited by funding. To facilitate a higher level of service of these assets, more funding would be needed.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

Stormwater regulations and floodplain ordinance can be modified for future development to avoid new impacts. This could include implementation of FEMA's 100-year plus event for regulation of floodplains for new development. Implementation of the Plan in Hogtown Creek would provide for grade control in the upper reaches to prevent downcutting and channel incision, as well as, erosion leading to sediment transport. Implementation in the lower reaches would focus on grade control to prevent sediment export and maintain the existing bed gradient.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Ensuring maintenance of floodplains and interconnected wetland systems. Control over key areas / land rights to implement the Plan. Excessive sedimentation resulting in habit smothering and a reduction in the stream condition index values within impacted steam systems. Activities in and around buildings that encroach or are in close proximity may affect the natural stream channel's ability to adjust.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

Extreme weather events could directly affect the ecosystem within the stream channels. Implementation of the Plan would not be able to restore the streams to a natural, undisturbed condition. Encroachment of buildings in close proximity to stream channels is a constraint. Adaptation could be limited. System may fail before one can adapt. Private land acquisition has encroached into stream corridors and limit the City's ability to implement stream stabilization. Acquiring land rights for implementation of the Plan would be a significant effort in terms of staff and acquisition funds.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

The main resource that is limiting for the City is funding for design and construction projects to address adaptability of critical assets. Capital funding is limited at this time. The City routinely leverages existing capital funding with grants funds.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 6
- Data & Modelling: 4
- Personnel & Technical Assistance: 4

- Funding: 8
- Administration: 2

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC2: The component(s) are somewhat able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Sewage overflow storage

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

Periods of drought and high temperatures indirectly affect the sewage overflow storage functionality since it is used as a temporary holding location to supplement nighttime reclaimed water supplies.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

High irrigation rates during the spring and summer limit the available capacity of the sewage overflow storage at Kanapaha water reclamation facility, since it is used as a temporary holding location to supplement nighttime reclaimed water supplies.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

Increasingly hot temperatures during the irrigation seasons will cause residents to demand more reclaimed water. The increased demand may lead to using more of the sewage overflow storage capacity during the day when wastewater is plentiful so that it is available at night to supplement the treatment process and produce more reclaimed water at peak irrigation times.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Budget constraints may continue to delay the construction of a reclaimed water storage tank that would eliminate the impact on this sewage overflow storage capacity.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

The sewage overflow storage functionality is unrelated to census tracts.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

This will affect operations at the Kanapaha treatment facility. If the sewer overflow storage cannot be used, then irrigation customers will be mildly affected. These residents are located in census tracts 22.19 and 22.20.

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

No.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S1: The component(s) will be minimally affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

None.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

Messaging to use less irrigation water can help alleviate that indirect effect on the sewage overflow storage capacity.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

None.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Budgetary and site constraints limit expanding the storage capacity.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

If there is significant area inundation it could take up some of the sewage overflow storage capacity.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

Not at this time.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 5
- Data & Modelling: 1
- Personnel & Technical Assistance: 1
- Funding: 8
- Administration: 3

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC0: The component(s) are not able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Catch basins or Stormdrains

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

The City has experienced multiple hurricanes and weather events over the years that have impacted the creek systems with significant erosion and sediment transport, including Hurricanes Charley, Frances and Jeanne (2004), Tropical Storm Debby (2012), Hurricane Irma (2017) and Tropical Storm Elsa (2021). There have also been short, intense storms that have overwhelmed the stormwater infrastructure's capacity along the multiple roadways, causing temporary flooding of streets and nuisance flooding. Debris swept into the stormwater conveyance system can create clogging or blockages, diminishing capacity.

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

The City is highly urbanized and much of its stormwater infrastructure is aged and constructed prior to statewide stormwater regulations were promulgated in 1982. Most of the City's infrastructure does not meet current required level of service (LOS) for stormwater management systems. Budget limitations prevent upgrades to the undersized and aged infrastructure. The development community has been resistant to upgrading infrastructure as new projects are proposed. Road design has improved substantially over the years and now incorporates systematic design requirements such as roadway geometry, inlet capacity, hydraulic efficiency, maintenance accessibility, etc. The storm drains serving many of the City's old road network system do not the same level of design and as a result do not function as effectively in accepting storm flow. Additionally, many older inlets are formed or built in place, sometimes with inferior materials. As these inlets get identified for replacement, the design will need to consider additional capacity and improving LOS on city roadways.

Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

An increase in extreme weather events will negatively affect the storm drains. Design criteria for roadways currently requires a 10-year (10/60 minute) LOS. As mentioned previously, much of the City's stormwater infrastructure is aged and constructed prior to statewide regulations and does not meet the current level of service. Road design has improved substantially over the years and now incorporates systematic design requirements such as roadway geometry, inlet capacity, hydraulic efficiency, maintenance accessibility, etc. The storm drains serving many of the City's old road network system do not the same level of design and as a result do not function as effectively in accepting storm flow.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Yes. Urban growth and densification continue to occur within Gainesville. There are environmental buffers and stormwater regulations that control discharge from most new development; however, other factors such as inaccurate design assumptions contribute to the trend of increasing runoff. Additionally, current design standards are based on historic rainfall and not future predicted climate change and weather events.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

Yes. A significant portion of the City's stormwater infrastructure is old and undersized with a significant amount of development and urbanization occurring prior to the State of Florida's implementation of stormwater regulations in 1982. A combination of open and closed system drainage is utilized throughout the city. There are areas that lack stormwater ponds for attenuation and water quality treatment. Most of the runoff will eventually reach the creek systems. Within the City, 13 census tracts were identified as neighborhoods at risk with 12 of the 13 tracts at or partially at the downstream end of the watersheds and the recipients of the increased runoff. It is noted that for nine (9) tracts, most of the development occurred during a time of stormwater regulation and are served primarily by stormwater collection and conveyance systems that meet the LOS criteria. Four (4) tracts (Tracts 6, 7, 8.06 and 19.02) are comprised of older developments and may not meet the LOS criteria. In addition, it must be noted that much of the City's early development located within the center of the municipal boundary was constructed before stormwater regulations and represents a significant part of the City's aged and undersized infrastructure.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

At risk would be roadways and adjacent properties affected by inefficient capture of runoff during extreme weather events. There are 14,908 Total Structures within the municipal boundary (3,951 within the Tracts at Risk / 26.5% of total).

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

Key public infrastructure would include road networks, which would be directly affected by the lack of efficiency by the storm drains as extreme weather events. Flooding would prevent emergency vehicles ingress/egress through affected areas.

Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S3: The component(s) will be affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Current stormwater regulations are in place that mitigate affects from development activities. Capital improvement and resurfacing projects involving roadways can help address old infrastructure to improve its stormwater LOS. Grant funding such as the Resilient Florida grant and the Building Resilient Infrastructure and Communities (BRIC) grant can potentially applied for to assist with improving the resiliency of the storm sewer system.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

If adaptive capacity is maintenance related, the City could evaluate increasing the inspection and maintenance frequency of maintained storm drains. Emergency pump plans are in place for known Flood Prone Areas. Additional pump plans could be created and implemented if necessary. Funding would play a role on how many temporary or permanent locations could be implemented.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

Stormwater regulations and floodplain ordinance can be modified for future development to avoid new impacts. For example, instead of a 10-year LOS for conveyance systems, a 25-year LOS could be considered. Design and construction of stormwater improvement projects to address the adaptive capacity could be implemented. Existing watershed management plans (WMPs) can be used to develop modern flood models using updated data, assumptions and models. The City has an extensive geodatabase (GDB) of the stormwater infrastructure throughout its road network that could improve the level of detail in the flood model and allow staff to identify flooding or drainage issues based on undersized conveyance.

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Inadequate designs for existing stormwater facilities. Existing private stormwater facilities that are not properly maintained or functional. These systems likely discharge more than they were designed to thus diminishing the overall capacity of the stormwater conveyance system.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

As mentioned previously, road design has improved substantially over the years and now incorporates systematic design requirements such as roadway geometry, inlet capacity, hydraulic efficiency, maintenance accessibility, etc. The storm drains serving many of the City's old road network system do not the same level of design and as a result do not function as effectively in accepting storm flow. Upgrading storm sewer systems may involve land rights acquisition or easements. This could be a significant effort in terms of staff and acquisition funds. Conflicts with existing utilities within the road right-of-way may also limit the ability to upgrading storm sewer systems.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

The main resource that is limiting for the City is funding for design and construction projects to address adaptability of critical assets. Capital funding is limited at this time. The City routinely leverages existing capital funding with grants funds.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 4
- Data & Modelling: 4
- Personnel & Technical Assistance: 4
- Funding: 8
- Administration: 2

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC1: The component(s) are minimally able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

Water and wastewater components

Sensitivity assessment

Current Stressors

List any past or present weather events, climate conditions, or natural hazards that affect how the component currently functions.

The wastewater collection system includes approximately 700 miles of underground gravity sewer mains with over 15,000 manholes and 175 wastewater lift stations with approximately 156 miles of force mains. To facilitate gravity flow, gravity sewers are often constructed in low lying areas, which make them susceptible to flooding impacts. High rain events cause inflow and infiltration of stormwater into the wastewater collection system which can cause the capacity of sewer system to be exceeded causing sanitary sewer overflows (SSOs). Inflow is caused by stormwater flooding of streets and other areas where gravity sewers are present. Stormwater can enter through manhole lids and sewer cleanouts. Infiltration is caused by increased groundwater table which can cause groundwater to enter the sewer system through cracks or other imperfections in piping and manholes. Storm related inflow and infiltration can cause SSOs from the gravity collection system due to capacity of the system being overwhelmed. In addition, the capacity of lift stations can be overwhelmed. GRU has several lift stations that pump into common force mains. High rains cause multiple lift stations to pump simultaneously which increases backpressures in the force mains, reducing the ability of the lift stations to pump. In addition, high force main pressures increase the risk of breakage of force mains. High flows during storm events can also affect operations at water reclamation facilities. If flows go beyond peak flow capacities of the treatment plants, this could result in incomplete treatment causing permit violations. Weather events affecting the system include hurricanes and other named storms but also includes high rain events and prolonged periods of rain that cause surface flooding. Events that cause flooding of streets and low lying areas stress the wastewater collection system since it is not possible to completely eliminate inflow and infiltration of stormwater into the wastewater system. Where flooding occurs or is predicted to occur in streets, impacts on the wastewater system also occur since manholes are generally located in streets. High rain and wind events can also cause uprooting and falling trees which can cause damage to underground pipes and to locations where sewer pipe crosses creeks above ground. Creek bank erosion can impact gravity sewers and the Main Street Water Reclamation Facility (MSWRF). Sweetwater Branch creek is located directly adjacent to MSWRF. The creek is an urban creek which receives high runoff flows and is highly incised. The creek bank adjacent to MSWRF is highly eroded, and erosion is ongoing due to high creek flows during routine rain events. High rain events significantly exacerbate and accelerate this erosion. Shoring of the creek bank will be required to prevent MSWRF from being undermined. Gainesville's urban creeks, Sweetwater Branch, Hogtown Creek and their tributaries have gravity sewers located along them. Erosion of creek banks also threatens to undermine gravity sewers at these locations

List any existing non-weather and climate stressors (e.g., budget limitations, aging infrastructure, population growth) that currently affect the component.

• Customers discharging oils and grease, flushable wipes, rags and other substances that clog the sewer system • Aging infrastructure • Population Growth • Budget Limitations

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Future Stressors

Which projected weather events, climate conditions, or natural hazards will likely negatively impact the component in the future? Why?

• Increased frequency and severity of high rainfall events and associated flooding • Expansion of areas prone to flooding • Ongoing erosion of creek banks All of these factors and events currently impact the system. As these become more severe and more frequent, the impacts to the wastewater system will increase if adaptation steps are not taken.

Are there anticipated non-weather and climate stressors that could negatively impact the component in the future? If so, how will they affect this component?

Aging Infrastructure – As piping ages it is more susceptible to failure and more susceptible to increased inflow and infiltration. Mechanical equipment must also be maintained and replaced. GRU has an ongoing program to inspect and replace aging infrastructure. Population growth – Results in increased flow to the system. In addition, in areas where population density is increasing, SSOs can impact more people. Also great population means more people potentially discharging grease, flushable wipes and other things that clog the sewer system.

Interactions

Are there census tracts or areas within your community where the component(s) routinely function less effectively compared to other areas? What factors contribute to these differences?

The two main factors affecting variability in performance of areas of the system are flooding and age of infrastructure. Areas prone to flooding occur in multiple locations in the system and are linked to local geology, topography, development patterns, and adequacy of stormwater infrastructure. There is not a significant correlation with census tracts. Much of the worst problems occur in moderate and higher income areas. Age of the system also plays a role. Areas with older gravity sewers that have not been lined yet tend to have more inflow and infiltration. Also older force mains in some cases were sized smaller than what is optimal for current and future development, thus reducing pumping capacity. Older force mains may be constructed of materials that are more susceptible to corrosion than newer lines made of PVC or HDPE.

If the component(s) are compromised due to extreme weather events, climate conditions, or natural hazards, who is most likely to be impacted and why? Use Neighborhoods at Risk to help answer this question.

Residents in the vicinity of an SSO are the most impacted. Small scale SSOs generally have very little impact on residents. Large SSOs resulting from major force main break or from major flooding events can cause streets to be blocked and/or can get into creeks. In certain circumstances SSOs can cause sewer backups in homes or cause yards to be flooded with sewage which can cause property impacts and threaten health if exposure is not avoided. Residents most vulnerable are those in low lying areas near creeks.

Are there public infrastructure, buildings, or critical services that are more likely to be negatively impacted by sensitivity of the component(s) to extreme weather events, climate conditions, and natural hazards? If so, why?

Wastewater service may be interrupted. Water service may be interrupted if water main breaks occur

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Assessment

Based on your assessment, how sensitive are the component(s) to future weather events, climate conditions, and natural hazards?

S4: The component(s) will be greatly affected by projected weather and climate conditions

Optional: Use this space to list the data and considerations that informed this sensitivity ranking.

Survey of Utility Staff Literature Review of Climate Change Impacts on Water and Wastewater Systems Experience During Recent Hurricanes Irma (2017) and Tropical Storm Elsa (2021)

Adaptive capacity assessment

Assets

Which existing assets can help the component(s) adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Vacuum trucks that haul sewage. A transfer pump station that can reduce pressure in a critical force main. All major pump stations have onsite backup power generation to maintain functionality in the event of an outage. A few portable pumps and generators can be moved to affected facilities if access roads are not also flooded. Water pipes are a networked system, so redundancy overall is quite high for the water distribution system.

If the component(s) are unable to adjust, which assets are readily available to respond to public infrastructure, buildings, people, and services that are negatively impacted by this component's adaptive capacity?

Hauling trucks provided by service contractors, repair crews, and inspectors who can notice about health hazards and monitor spills.

Which existing assets can be leveraged to proactively increase the adaptive capacity of the component(s) and/or the public infrastructure, building, people, and services that depend on this component?

Portable generators and pumps may be deployed where helpful. Messaging to reduce sanitary loads (e.g. requests for customers to limit showers and baths, limit dishwasher and washing machine use, etc.) While it would be impractical to design the wastewater collection system for extreme weather events, it is important to pursue alternative solutions. These solutions include, but are not limited to, coordination with the local stormwater utility to prevent flood conditions, continued diligence in the maintenance of the wastewater collection system, optimizing flows in the collection system to provide relief for flood prone areas, implementing I/I reduction strategies, as well as providing protectionary measures for customers (such as cleanouts with a pop-off to protect from internal flooding).

Constraints

Which constraints currently limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, natural hazards and their impacts?

Flooding would not have a severe impact on underground pressure pipes, but erosion could compromise the functionality of the system. Some major gravity sewers are along creeks which are very susceptible to bank erosion. It is difficult to find alternative conveyances for the wastewater. Wastewater pipes are not a networked system, so this system has less overall redundancy.

Are there anticipated constraints that could limit how well the component(s) can adjust to and mitigate extreme weather events, climate conditions, and natural hazards in the future? If so, how will they affect this component?

Increasing construction costs. Workforce retention in key engineering departments that plan and oversee upgrade projects. Reduction in available sites/routes for future projects and system upgrades. Chronic inundation could decrease accessibility of the pipes. For example portions of the collection system have been under water since inundation in 2017 after Hurricane Irma. It is not possible to access those gravity sewers for inspection to know their condition.

Needs and Opportunities

Are there resources that your community currently does not have that are needed to help the component(s) readily adjust to future conditions?

Additional budget to accelerate projects. Utility staff are actively seeking grant funding for $39 million dollars in wastewater projects. Many of these projects would increase pipe carrying capacities and eliminate bottlenecks More training, efficient engineering and the use of successful and multifaceted best practices are needed.

Based on identified assets, constraints, and needs, estimate how easy or hard it would be to access resources to increase the adaptive capacity of the component(s) for each of the following areas.

- Engineering & Construction: 2
- Data & Modelling: 2
- Personnel & Technical Assistance: 2
- Funding: 8
- Administration: 5

Assessment

Based on your assessment, how readily can the component(s) adjust to future weather events, climate conditions, and natural hazards?

AC2: The component(s) are somewhat able to adjust to projected weather and climate conditions

Optional: Use this space to list the data and key considerations that informed this adaptive capacity ranking.

No answer

APPENDIX C – REFERENCES

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APPENDIX D – FLOODWISE CUSTOMIZED WEATHER AND CLIMATE DATA PROFILE

FLOODWISE COMMUNITIES

Weather and Climate in Gainesville, Florida

Overview

Despite being far enough from the Florida coast to not be threatened by storm surges or high tides, Gainesville has experienced several flood events due to heavy rain and tropical storms, such as Hurricane Irma in 2017. Several of the creeks that run through Gainesville are vulnerable to overflowing and flooding waterfront properties, notably along Hogtown Creek and Sweetwater Branch, both of which run around the edge of the city's center. If climate change makes torrential rain a greater threat to Gainesville, the flood risks that these creeks present to the city could increase and thus require management.

Gainesville and the rest of North Florida are already seeing increases in temperature and rainfall due to climate change, hence the need to take action against the consequent rise in flood risk. Key statistics about recent and future climate change in Gainesville are given in the *Quick Climate Facts* table (right); see the following pages for further details.

Climate Change Along the Gulf Coast

The Gulf Coast has seen increased temperatures and decreased average rainfall, but occurring in heavier downpours, in recent decades. The region's coastal wetlands and low-lying cities are especially vulnerable to the challenges presented by climate change, such as reduced freshwater supply, more active hurricane seasons, and increased tidal flooding from sea level rise.

As global temperature increases continue, adapting to these challenges will be essential for the sustainability of communities along the Gulf Coast. Further details can be found in the *Climate of the Gulf Coast States* report, prepared by FloodWise Communities.

Quick Climate Facts

	Current (1991-2020)	Future (2071-2100)
TEMPERATURE	***It's getting hotter…*** **+2.2°F** *increase of average annual temperature* **12 nights** *above 75°F each year (average)* **14 days** *above 95°F each year (average)*	***Future temperatures could be even higher…*** **Winter:** *6 to 9°F warmer* **Spring:** *6 to 8°F warmer* **Summer:** *5 to 9°F warmer* **Autumn:** *6 to 11°F warmer* **>73 extra days** *above 95°F each year*
RAINFALL	***It's getting wetter…*** **+2.9 in** *increase of average annual rainfall* **3 days** *of heavy rainfall (>2 in) each year (average)*	***Cooler seasons could become wetter…*** **Winter:** *-1 to +5 in* **Spring:** *-1 to +5 in* **Summer:** *-5 to +3 in* **Autumn:** *-2 to +1 in* **0 to +2 extra days** *of heavy rainfall each year*

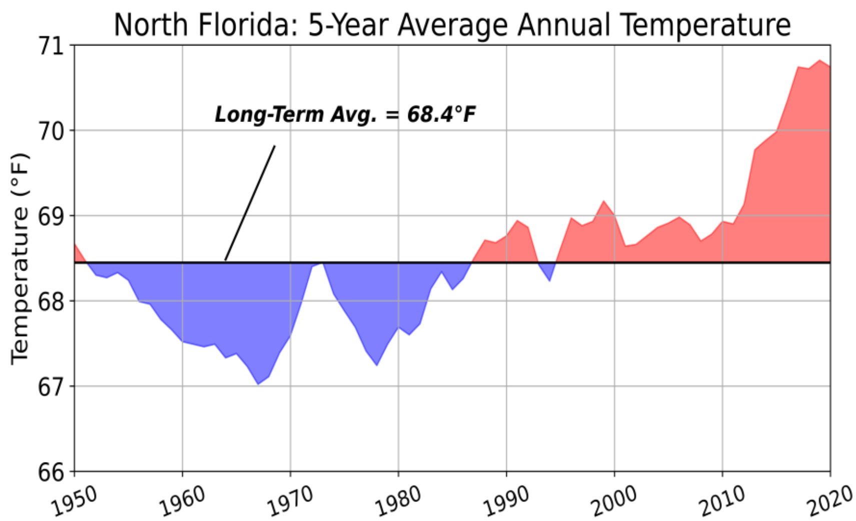
Data sources: SC-ACIS; NA-CORDEX.

Key Details

- **Average temperatures in Gainesville increased by 2.2°F between 1991 and 2020.**
- **Higher emissions scenarios could raise temperatures by between 5.6 and 8.4°F by 2100.**
- **Gainesville's has gained almost 3 inches of average annual rainfall in the last 30 years.**
- **Although uncertain, Gainesville is likely to become wetter overall in the years to come.**
- **Flood risk in Gainesville is concentrated around creeks that run through the city.**

Temperature in Gainesville

Gainesville has a humid-subtropical climate, meaning that its summers are warm and its winters are mild. Temperatures in Gainesville have increased by 2.2°F since 1990, along with 14 more hot days (>95°F) and 12 more warm nights (>75°F) per year. North Florida overall has observed a similar warming trend (right), which notably accelerated in the 2010s. By 2100, low temperatures below 60°F outside of the winter months could be a rare occurrence, should these trends continue.



Data Source: SRCC.

Temperatures in North Florida have increased by over 2°F since the 1990s.

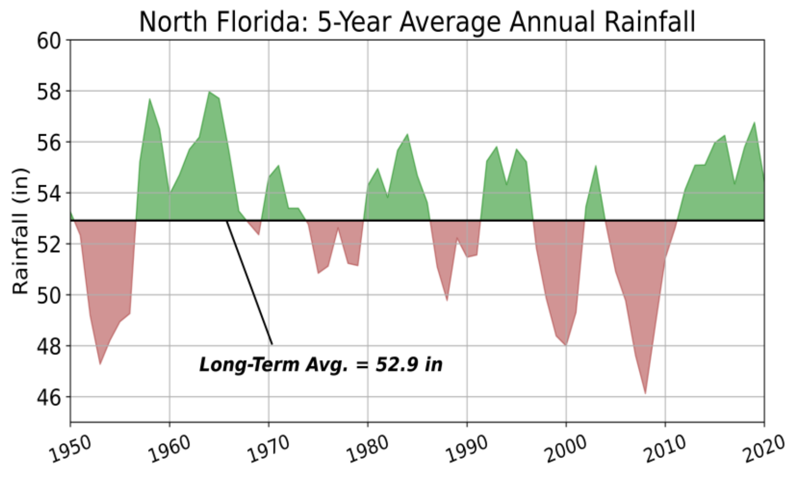
Historical and Projected Temperature - Gainesville

Variable	Historical Average: 1991-2020	Historical Change: 1991-2020	Mid-Century Projections: 2041-2070*		End-Century Projections: 2071-2100*	
			Min	Max	Min	Max
Annual Avg Temp.	69.5°F	+2.2°F	72.1°F	74.2°F	75.1°F	77.9°F
Winter Avg Temp.	57.1°F	+2.5°F	60.2°F	62.6°F	62.7°F	65.7°F
Spring Avg Temp.	69.0°F	+2.1°F	73.2°F	75.2°F	74.8°F	77.3°F
Summer Avg Temp.	81.0°F	+1.6°F	83.3°F	86.3°F	86.4°F	89.6°F
Autumn Avg Temp.	71.0°F	+2.6°F	73.3°F	76.6°F	77.0°F	82.3°F
Annual Avg High	80.8°F	+3.0°F	83.5°F	85.9°F	86.5°F	89.0°F
Annual Avg Low	58.3°F	+1.3°F	60.6°F	62.7°F	63.6°F	66.8°F
Hot Days (>95°F) per year	14 days	+12 days	38 days	91 days	87 days	135 days
Warm Nights (>75°F) per year	12 days	+12 days	40 days	91 days	93 days	135 days

Data sources: SC-ACIS; NA-CORDEX.
** Projections represent the range of highest and lowest projections from the NA-CORDEX climate models, driven by the RCP 8.5 emissions scenario.*

Rainfall in Gainesville

By far the wettest season in Gainesville is summer, receiving on average 20.6 in per year, thanks to frequent thunderstorms that form over Florida at this time of year. These rainfall events are sometimes heavy, with >2-in rains occurring on around 3 days each year. Gainesville and North Florida go through multi-annual dry and wet periods (right), with some of the driest periods happening since the late-1990s. The likeliest picture for climate change in Gainesville is increasing rainfall amounts, especially in winter and spring.



Data Source: SRCC.

Gainesville has gone through multi-annual cycles of dry and wet periods, with conditions likely becoming wetter overall in future.

Historical and Projected Rainfall - Gainesville

Variable	Historical Average: 1991-2020	Historical Change: 1991-2020	Mid-Century Projections: 2041-2070*		End-Century Projections: 2071-2100*	
			Min	Max	Min	Max
Annual Avg Rainfall	48.3 in	+2.9 in	45.4 in	56.5 in	48.6 in	59.0 in
Winter Avg Rainfall	8.8 in	-0.4 in	8.3 in	11.7 in	8.3 in	14.1 in
Spring Avg Rainfall	9.3 in	-1.0 in	9.7 in	12.3 in	8.4 in	14.5 in
Summer Avg Rainfall	20.6 in	+4.9 in	16.2 in	23.7 in	15.9 in	24.0 in
Autumn Avg Rainfall	9.5 in	-0.9 in	5.8 in	8.1 in	7.5 in	10.3 in
Avg Heavy Rain Days (>2-in) per year	3 days	-1 day	3 days	4 days	3 days	5 days

Data sources: SC-ACIS; NA-CORDEX.
** Projections represent the range of highest and lowest projections from the NA-CORDEX climate models, driven by the RCP 8.5 emissions scenario.*

Recent Severe Weather Events in Gainesville (Alachua County)

Event	Date	Notes
Hurricane Irma	Sep 2017	Passed as a tropical storm, 61mph wind gusts in Gainesville, plus over 12 inches of rain. Trees downed across the county and flood damage worst for homes with poor drainage.
Hurricane Matthew	Oct 2016	2 to 4 inches of rain and wind gusts up to 48mph were measured at Gainesville Regional Airport, causing minor wind damage to trees and Santa Fe College specifically.
Northeast Florida Storm Outbreak	May 2014	A line of thunderstorms across Northeast Florida produced 4 to 6 inches of rainfall in 24 hours. In Gainesville, a lightning strike set a large boat on fire.
Gainesville Thunderstorm	Jul 2000	Mostly affected Gainesville's north side. Trees and power lines downed by strong winds; over 4,000 people in Alachua County lost power. $150,000 in property damages.
Alachua County Floods	Mar 1998	Rainfall intensified due to the ongoing El Niño. More than 2,800 homes and 175 businesses were destroyed by the floodwaters across Alachua County.

Data sources: Flood Factor; NOAA NCEI Storm Events Database.

Flood Risk:
Around 2,910 (~9%) properties in Gainesville are at risk of flooding.

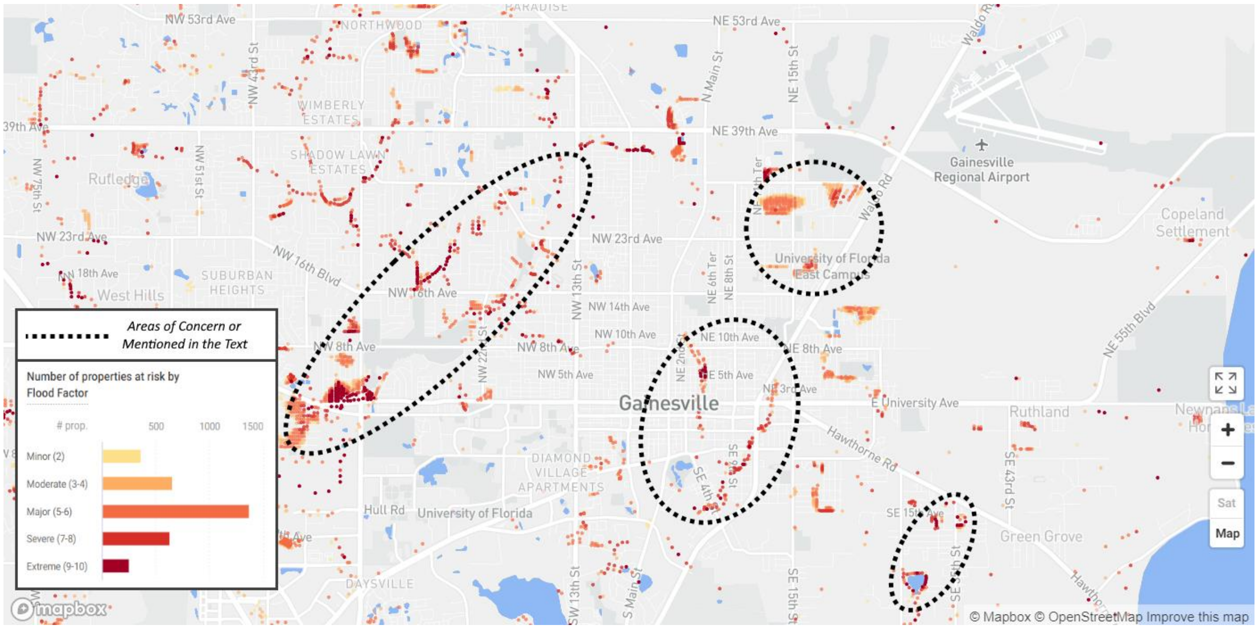


Image Source and more flood risk resources: FloodFactor

Gainesville is not surrounded by, nor does it contain, any large bodies of water, but many properties across the city are classed as being at major to extreme (orange to red) flood risk. The majority of these high flood risk properties are concentrated around the waterfronts of two creeks, being Hogtown Creek on the west side of the city's center, and Sweetwater Branch on the east side. Because Gainesville is not in proximity to a coastline, these creeks are most likely to overflow and flood surrounding properties during heavy rain events, such as thunderstorms or passing tropical storms/hurricanes. Small clusters of at-risk properties also exist around Calf Pond (south of Hawthorne Rd) and the University of Florida East Campus. In 30 years' time, environmental factors such as climate change will increase the number of properties at risk of flooding to around 3,273.

End of profile. Please visit https://floodwisecommunities.org for more information.

APPENDIX E – TABLES (NOT FOR PUBLIC DISTRIBUTION)

APPENDIX F – TABLES (AVAILABLE FOR PUBLIC DISTRIBUTION)

TABLE 6A & TABLE 6B LIST OF POTENTIALLY IMPACTED CULVERT CROSSINGS IN ROADWAYS AT CREEK CHANNELS

TABLE 6A LIST OF POTENTIALLY IMPACTED CULVERT CROSSINGS IN ROADWAYS AT CREEK CHANNELS (2021 FIRST STREET FLOOD MODEL)								
Facility ID	**Full Name**	**Material**	**Diameter**	**Pipe Height**	**Pipe Width**	**Barrel Count**	**Cross Section Shape**	**Administrative Area**
DGM_0001059	NW 27 TER	RCP	48 Inch			2	Circular	COG
DGM_0001213	SW 5 AVE	RCP	60 Inch	0	0	1	Circular	COG
DGM_0003147	NE 31 AVE	RCP	42 Inch	42	108	2	Box	COG
DGM_0003151	NW 30 PL	CMP	unknown	75	112	2	Box	COG
DGM_0003152	NW 23 AVE	RCP	unknown	144	120	2	Box	COG
DGM_0003745	NW 8 AVE	Asbestos Concrete Pipe		5	6	1	Box	COG
DGM_0004386	NE 40 TER	CMP	unknown	8	44	1	Elliptical	COG
DGM_0004498	NW 28 PL	CMP	36 Inch			2	Circular	COG
DGM_0004523	NE 8 AVE	RCP	unknown	96	36	1	Box	COG
DGM_0004568	NW 29 RD	Asbestos Concrete Pipe		120	120	2	Box	COG
DGM_0004787	NE 9 AVE	Asbestos Concrete Pipe	48 Inch	36	48	1	Box	COG
DGM_0004788	NE 7 AVE	Asbestos Concrete Pipe	66 Inch	48	72	1	Box	COG
DGM_0012310	NW 18 TER	RCP	30 inch			1	Circular	COG
DGM_0014202	SW 9 ST		unknown	84	21	1		COG
DGM_0014441	NE 25 ST	RCP	42 Inch	0	0	2	Circular	COG
DGM_0014965	SE 7 AVE		48 Inch	0	0	2	Circular	COG
DGM_0015191			unknown	18	29	1	Elliptical	COG
DGM_0015216	NW 31 BLVD		unknown			1		COG
DGM_0015341	NW 31 AVE					1		COG
DGM_0015357	NW 20 CT					1		COG
DGM_0015378	NE 46 TER	CMP	16 Inch	16	16	1		COG
DGM_0015381	NW 45 AVE		unknown	72	96	2	Box	COG
DGM_0015410	SW 14 AVE		unknown	47	71	2		COG
DGM_0015411	NE 15 ST		unknown	48	84	1	Box	COG
DGM_0015412	NE 4 AVE		unknown	48	76	1	Box	COG
DGM_0015413	NE 2 AVE		unknown	48	96	1	Box	COG

TABLE 6A LIST OF POTENTIALLY IMPACTED CULVERT CROSSINGS IN ROADWAYS AT CREEK CHANNELS (2021 FIRST STREET FLOOD MODEL)								
Facility ID	**Full Name**	**Material**	**Diameter**	**Pipe Height**	**Pipe Width**	**Barrel Count**	**Cross Section Shape**	**Administrative Area**
DGM_0015415	NE 5 AVE		unknown	60	72	1	Box	COG
DGM_0015429	NE 12 ST		36 Inch	0	0	2	Circular	COG
DGM_0015506	NW 16 TER	RCP	42 Inch			1	Circular	COG
DGM_0015519	NW 18 TER		unknown	96	96	1	Box	COG
DGM_0015521	NW 8 AVE		unknown	48	96	1	Box	COG
DGM_0015522	NW 11 RD		unknown	72	108	1	Box	COG
DGM_0015523	NW 8 AVE		unknown			1	Box	COG
DGM_0015524	NW 8 AVE		unknown	84	120	3	Box	COG
DGM_0015533	NW 16 ST		unknown			1		COG
DGM_0015566	NE 6 AVE		unknown	48	72	1	Box	COG
DGM_0015571	NW 36 AVE		unknown	15	18	1	Elliptical	COG
DGM_0015623	SE 2 PL		unknown	72	96	1	Box	COG
DGM_0015624	SE 4 AVE		unknown	48	108	1	Box	COG
DGM_0015626	SE 2 AVE		72 Inch	8	6	1	Box	COG
DGM_0015627	SE 5 AVE		72 Inch	0	0	2	Circular	COG
DGM_0015628	NE 5 ST		72 Inch	60	72	2	Box	COG
DGM_0021967	NE 19 ST	RCP	54 Inch			1	Circular	COG
DGM_0023332	E UNIVERSITY AVE		72 Inch	60	72	2	Box	COG
DGM_0025647	SW 5 AVE	RCP	40 inch			1	Circular	COG
DGM_0050677	NW 28 PL	CMP	36 Inch			2	Circular	COG
DGM_0015152	RUNWAY					1		COG / Airport
DGM_0002066	NW 43 ST	RCP	unknown	72	72	1	Box	Alachua County
DGM_0003153	NW 16 AVE	RCP	unknown	96	120	3	Box	Alachua County
DGM_0015574	NW 16 AVE		unknown	120	132	2	Box	Alachua County
DGM_0004009	NE 39 AVE	RCP	unknown	48	144	1	Box	FDOT
DGM_0004816	NW 34 ST	RCP		120	84	3	Box	FDOT
DGM_0004826	SE 11 ST	RCP		72	84	1	Box	FDOT
DGM_0004827	NW 39 AVE SR 222	RCP	unknown	84	96	2	Box	FDOT
DGM_0004990	NW 39 AVE SR 222	RCP		144	144	1	Box	FDOT
DGM_0005026	NW 39 AVE SR 222	RCP		84	84	1	Box	FDOT

TABLE 6A LIST OF POTENTIALLY IMPACTED CULVERT CROSSINGS IN ROADWAYS AT CREEK CHANNELS (2021 FIRST STREET FLOOD MODEL)								
Facility ID	**Full Name**	**Material**	**Diameter**	**Pipe Height**	**Pipe Width**	**Barrel Count**	**Cross Section Shape**	**Administrative Area**
DGM_0005240	E UNIVERSITY AVE	RCP		84	84	3	Box	FDOT
DGM_0005249	SE WILLISTON RD	RCP		96	132	2	Box	FDOT
DGM_0005251	NE 39 AVE	RCP	unknown	108	60	2	Box	FDOT
DGM_0007721	NE 4 ST	RCP	48 Inch	0	0	2	Circular	FDOT
DGM_0012654			84 Inch	7	9	1	Box	Other
DGM_0004439	NW 41 DR	CMP	36 Inch			1	Box	Private
DGM_0000621	NW 13 ST	RCP		96	72	1	Box	State of Florida
DGM_0003149	NW 13 ST	RCP		96	72	1	Box	State of Florida
DGM_0004571	NW 34 ST	RCP	42 Inch			2	Circular	State of Florida
DGM_0015367	NORTH-SOUTH DR					1		State of Florida
DGM_0015520	NW 13 ST		unknown	72	72	1	Box	State of Florida
DGM_0004414	NEWELL DR	RCP		36	96	1	Box	UF-State
DGM_0015365	CENTER DR					1		UF-State
DGM_0014204	SW 13 ST		unknown	8	4	1	Box	United States
DGM_0000675	NE 19 DR	CMP	72 Inch	42	72	1	Elliptical	

TABLE 6B LIST OF POTENTIALLY IMPACTED CULVERT CROSSINGS IN ROADWAYS AT CREEK CHANNELS (2036 AND 2051 FIRST STREET FLOOD MODEL)								
Facility ID	**Location**	**Material**	**Diameter**	**Pipe Height**	**Pipe Width**	**Barrel Count**	**Cross Section Shape**	**Administrative Area**
DGM_0002066	NW 43 ST	RCP		72	72	1	Box	Alachua County
DGM_0003153	NW 16 AVE	RCP		96	120	3	Box	Alachua County
DGM_0015574	NW 16 AVE			120	132	2	Box	Alachua County
DGM_0001059	NW 27 TER	RCP	48 Inch			2	Circular	COG
DGM_0001213	SW 5 AVE	RCP	60 Inch	0	0	1	Circular	COG
DGM_0003147	NE 31 AVE	RCP	42 Inch	42	108	2	Box	COG
DGM_0003151	NW 30 PL	CMP		75	112	2	Box	COG
DGM_0003152	NW 23 AVE	RCP		144	120	2	Box	COG
DGM_0003745	NW 8 AVE	Asbestos Concrete Pipe		5	6	1	Box	COG
DGM_0004386	NE 40 TER	CMP		8	44	1	Elliptical	COG
DGM_0004498	NW 28 PL	CMP	36 Inch			2	Circular	COG
DGM_0004523	NE 8 AVE	RCP		96	36	1	Box	COG
DGM_0004568	NW 29 RD	Asbestos Concrete Pipe		120	120	2	Box	COG
DGM_0004608	NE 10 AVE	RCP	30 inch	0	0	2	Circular	COG
DGM_0004787	NE 9 AVE	Asbestos Concrete Pipe	48 Inch	36	48	1	Box	COG
DGM_0004788	NE 7 AVE	Asbestos Concrete Pipe	66 Inch	48	72	1	Box	COG
DGM_0012310	NW 18 TER	RCP	30 inch			1	Circular	COG
DGM_0014202	SW 9 ST			84	21	1		COG
DGM_0014441	NE 25 ST	RCP	42 Inch	0	0	2	Circular	COG
DGM_0014965	SE 7 AVE		48 Inch	0	0	2	Circular	COG
DGM_0015160	NE 35 AVE		18 Inch			1	Circular	COG
DGM_0015191				18	29	1	Elliptical	COG
DGM_0015216	NW 31 BLVD					1		COG
DGM_0015341	NW 31 AVE					1		COG
DGM_0015351	NE 35 AVE					1		COG
DGM_0015352	NE 2 ST		48 Inch			2	Circular	COG
DGM_0015357	NW 20 CT					1		COG
DGM_0015378	NE 46 TER	CMP	16 Inch	16	16	1		COG

TABLE 6B LIST OF POTENTIALLY IMPACTED CULVERT CROSSINGS IN ROADWAYS AT CREEK CHANNELS (2036 AND 2051 FIRST STREET FLOOD MODEL)								
Facility ID	**Location**	**Material**	**Diameter**	**Pipe Height**	**Pipe Width**	**Barrel Count**	**Cross Section Shape**	**Administrative Area**
DGM_0015381	NW 45 AVE			72	96	2	Box	COG
DGM_0015410	SW 14 AVE			47	71	2		COG
DGM_0015411	NE 15 ST			48	84	1	Box	COG
DGM_0015412	NE 4 AVE			48	76	1	Box	COG
DGM_0015413	NE 2 AVE			48	96	1	Box	COG
DGM_0015415	NE 5 AVE			60	72	1	Box	COG
DGM_0015429	NE 12 ST		36 Inch	0	0	2	Circular	COG
DGM_0015506	NW 16 TER	RCP	42 Inch			1	Circular	COG
DGM_0015519	NW 18 TER			96	96	1	Box	COG
DGM_0015521	NW 8 AVE			48	96	1	Box	COG
DGM_0015522	NW 11 RD			72	108	1	Box	COG
DGM_0015523	NW 8 AVE					1	Box	COG
DGM_0015524	NW 8 AVE			84	120	3	Box	COG
DGM_0015533	NW 16 ST					1		COG
DGM_0015566	NE 6 AVE			48	72	1	Box	COG
DGM_0015571	NW 36 AVE			15	18	1	Elliptical	COG
DGM_0015623	SE 2 PL			72	96	1	Box	COG
DGM_0015624	SE 4 AVE			48	108	1	Box	COG
DGM_0015626	SE 2 AVE		72 Inch	8	6	1	Box	COG
DGM_0015627	SE 5 AVE		72 Inch	0	0	2	Circular	COG
DGM_0015628	NE 5 ST		72 Inch	60	72	2	Box	COG
DGM_0021967	NE 19 ST	RCP	54 Inch			1	Circular	COG
DGM_0023332	E UNIVERSITY AVE		72 Inch	60	72	2	Box	COG
DGM_0025647	SW 5 AVE	RCP	40 inch			1	Circular	COG
DGM_0050677	NW 28 PL	CMP	36 Inch			2	Circular	COG
DGM_0015152	RUNWAY					1		COG / Airport
DGM_0004009	NE 39 AVE	RCP		48	144	1	Box	FDOT
DGM_0004816	NW 34 ST	RCP		120	84	3	Box	FDOT
DGM_0004826	SE 11 ST	RCP		72	84	1	Box	FDOT
DGM_0004827	NW 39 AVE / SR 222	RCP		84	96	2	Box	FDOT
DGM_0004990	NW 39 AVE / SR 222	RCP		144	144	1	Box	FDOT
DGM_0005026	NW 39 AVE / SR 222	RCP		84	84	1	Box	FDOT

TABLE 6B LIST OF POTENTIALLY IMPACTED CULVERT CROSSINGS IN ROADWAYS AT CREEK CHANNELS (2036 AND 2051 FIRST STREET FLOOD MODEL)								
Facility ID	**Location**	**Material**	**Diameter**	**Pipe Height**	**Pipe Width**	**Barrel Count**	**Cross Section Shape**	**Administrative Area**
DGM_0005240	E UNIVERSITY AVE	RCP		84	84	3	Box	FDOT
DGM_0005249	SE WILLISTON RD	RCP		96	132	2	Box	FDOT
DGM_0005251	NE 39 AVE	RCP		108	60	2	Box	FDOT
DGM_0007721	NE 4 ST	RCP	48 Inch			2	Circular	FDOT
DGM_0014204	SW 13 ST			8	4	1	Box	FDOT
DGM_0012654			84 Inch	7	9	1	Box	Other
DGM_0004439	NW 41 DR	CMP	36 Inch			1	Box	Private
DGM_0000621	NW 13 ST	RCP		96	72	1	Box	State of Florida
DGM_0003149	NW 13 ST	RCP		96	72	1	Box	State of Florida
DGM_0004571	NW 34 ST	RCP	42 Inch			2	Circular	State of Florida
DGM_0015367	NORTH-SOUTH DR					1		State of Florida
DGM_0015520	NW 13 ST			72	72	1	Box	State of Florida
DGM_0015365	CENTER DR					1		UF-State
DGM_0004414	NEWELL DR	RCP		36	96	1	Box	UF-State
DGM_0000675	NE 19 DR	CMP	72 Inch	42	72	1	Elliptical	

TABLE 7 LIST OF POTENTIALLY IMPACTED GRU UTILITY FACILITIES – INCLUDING WATER, WASTEWATER, TELECOMMUNICATION, NATURAL GAS AND ELECTRIC FACILITIES

Layer Name	Impacted 2021	Impacted 2036	Impacted 2051	Impacted in Vulnerable Tract 2021	Impacted in Vulnerable Tract 2036	Impacted in Vulnerable Tract 2051
WWTP Structures	1	3	3	1	3	3
Sewer Gravity Mains	2448	2706	2704	186	416	414
Sewer Lift Stations	62	68	68	15	17	17
Sewer Manholes	1468	1722	1720	225	256	254
Telecommunication Cabinets	3	3	3	1	1	1
Telecommunication Towers	1	1	1	0	0	0
Energy Supply Buildings	6	9	9	0	0	0
Electric Substations	2	2	2	2	2	2
Electric Transmission Poles	101	107	107	30	32	32
Natural Gas Gate Stations	2	2	2	0	0	0
Natural Gas Regulator Stations	5	5	5	0	0	0
Totals	4,099	4,628	4,624	460	727	723