TAYLOR ENGINEERING, INC.

# City of Punta Gorda Adaptation Plan Update

This report is an addendum to the 2009 City of Punta Gorda Adaptation Plan.

# Adaptation Plan Addendum
# City of Punta Gorda

Draft Report

Prepared for

City of Punta Gorda

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## ACRONYMS & ABBREVIATIONS

| | |
|---|---|
| AAA | Adaptation Action Area |
| ADCIRC | Advanced Circulation Model |
| AR5 | Fifth Assessment Report |
| BFE | Base Flood Elevation |
| BSI | Burnt Store Isles |
| CCS | Center for Climate Strategies |
| CFR | Code of Federal Regulations |
| CHHA | Coastal High Hazard Area |
| CHNEP | Charlotte Harbor National Estuary Program |
| CPA | Community Planning Act |
| CPI | Coastal Partnership Initiative |
| CRA | Community Redevelopment Agency |
| CWA | Clean Water Act |
| CZMS | Coastal Zone Management Subgroup |
| DDC | Depth Damage Curve |
| DEO | Department of Economic Opportunity |
| EPA | Environmental Protection Agency |
| ERP | Environmental Resource Permit |
| FAC | Florida Administrative Code |
| FAR | First Assessment Report |
| FCMP | Florida Coastal Management Program |
| FDEP | Florida Department of Environmental Protection |
| FDOT | Florida Department of Transportation |
| FEMA | Federal Emergency Management Agency |
| FFE | First Floor Elevations |
| FIRM | Flood Insurance Rate Map |
| FR | Federal Register |
| GIS | Geographic Information System |
| IPCC | Intergovernmental Panel on Climate Change |
| LAG | Lowest Adjacent Grade Elevations |
| LDR | Land Development Regulations |
| LiDAR | Light Detection and Ranging |
| LRTP | Long Range Transportation Plan |
| MLLW | Mean Lower Low Water |
| MHHW | Mean Higher High Water |
| NAVD88 | North American Vertical Datum of 1988 |
| NCA | National Climate Assessment |
| NCA4 | Fourth National Climate Assessment |
| NFIP | National Flood Insurance Program |
| NMFS | National Marine Fisheries Services |
| NOAA | National Oceanographic and Atmospheric Administration |
| NWP | Nationwide Permit |
| PGI | Punta Gorda Isles |

| | |
|---|---|
| **RAE** | Restore America's Estuaries |
| **RCP** | Representative Concentration Pathway |
| **RESTORE** | Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act |
| **RGP** | Regional General Permit |
| **RSM** | Regional Suitability Model |
| **SAGE** | Systems Approach to Geomorphic Engineering |
| **SAMP** | Special Area Management Plan |
| **SB** | Senate Bill |
| **SFHA** | Special Flood Hazard Area |
| **SPGP** | Statewide Programmatic General Permit |
| **SSH** | Sea Surface Height |
| **SWEL** | Storm Surge Stillwater Elevations |
| **SWFRPC** | Southwest Florida Regional Planning Council |
| **SWFWMD** | Southwest Florida Water Management District |
| **TNC** | The Nature Conservancy |
| **USACE** | US Army Corps of Engineers |
| **UN** | United Nations |
| **USGCRP** | US Global Change Research Program |
| **WMO** | World Meteorological Organization |

# 1.0 EXECUTIVE SUMMARY

In 2018, the City applied for NOAA's 2018-2019 Florida Resilient Coastlines: Resiliency Planning grant, administered by FDEP. The City received the formal executed grant award in January 2018 and contracted with Taylor Engineering, Inc. in February 2019 to conduct a vulnerability analysis for city-owned critical infrastructure and prepare an addendum to the 2009 climate adaptation plan with a living shoreline element. This report is the product of this contract.

A vulnerability assessment was conducted to address public infrastructure within City limits, with an emphasis on coastal flooding impacts to critical facilities and historic properties. The purpose of a vulnerability assessment is to help a municipality or community identify and prioritize structural and social assets that are likely to be impacted by future coastal flooding and sea level rise. Vulnerability assessments are broken into three components: exposure analysis, sensitivity analysis, and focus area identification and mapping. This analysis also forms the basis for complying with the "Peril of Flood" statute requirements as found in Section 163.3178(2)(f)(1-6), Florida Statutes. For purposes of this analysis, properties were sorted into three categories: general publicly owned, critical public facilities, and historic properties.

To evaluate the degree of exposure, 12 flood scenarios were considered resulting from a combination of 3 sea level rise scenarios and 3 storm surge events. The sea level rise scenarios include: Mean Higher High Water (MHHW) to simulate a low inundation, 1.5 ft for medium inundation, and 3 ft for high inundation. The City of Punta Gorda chose these thresholds because the 1.5 ft rise will most likely occur within the time horizon of the City's 2040 Comprehensive Plan or a homeowner's 30-year mortgage, while the 3 ft sea level rise is more suitable for planning capital improvement projects with a 50-year design life. The three tropical storm surge types analyzed were 25-year (4% annual chance) flood, 100-year (1% annual chance) flood, and 500-year (0.2% annual chance). The results of the exposure analysis are presented in Appendix A.

Upon preliminary completion of the vulnerability exposure analysis, the City engaged stakeholders and citizens to provide input in the next steps. A public workshop was held on April 5, 2019 and is summarized in Appendix D. Prior to the workshop, Taylor Engineering developed an online survey to solicit feedback, gauge public perception on sea level rise and the City's efforts to improve resiliency. The stakeholder input received during the workshop helped to inform and prioritize vulnerable regions (focus areas) for the development of adaptation strategies.

The following criteria were also used to identify Adaptation Focus Areas: parcel inundation at 3 ft of sea level rise, ratio of flooded acreage to non-flooded acreage at 3 ft of sea level rise, number of publicly owned parcels inundated, number of critical facilities inundated, and number of historic properties inundated. These criteria yielded three distinct adaptation focus areas for further investigation and narrowing of adaptation strategies. These three regions are the Downtown Focus Area, the Fire Station Focus Area, and the US 41 Commercial Focus Area.

For each Adaptation Focus Area, a variety of strategies for helping the City become more resilient are recommended. A matrix of adaptation strategies is illustrated in Appendix B. The adaptation strategy of creating living shorelines to protect Punta Gorda from dynamic wave action is described in detail in Appendix C.  Suggested changes to the City's comprehensive plan are in the final section.  Grants to pursue for funding adaptation strategies appear in Appendix E.

# 2.0 BACKGROUND

## 2.1 Location and History

The City of Punta Gorda is located in southwest Florida in Charlotte County. It lies along the south bank of the Peace River at the northern end of Charlotte Harbor. The City was founded in 1884 with, on the instructions of Colonel Isaac Trabue, every waterfront block designated as a park. This legacy serves the City to this day with a string of public waterfront parks connected by the 2.5 mile long Trabue Harborwalk promenade. Incorporated on December 7, 1887 after the arrival of the railroad and the construction of the Hotel Punta Gorda, the City thrived on winter seasonal visitors, agricultural trade, and commercial fishing.

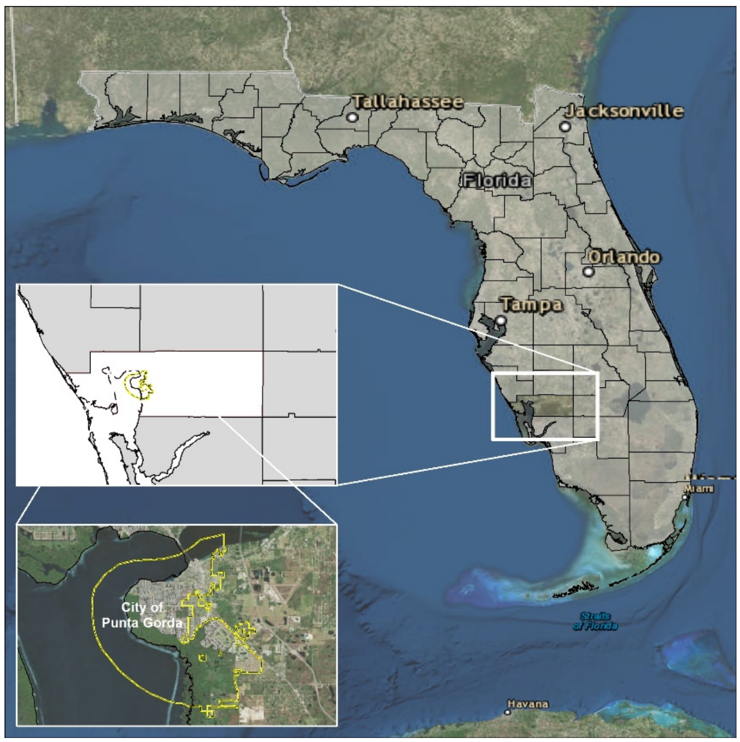



**Figure 2.1** Location of Charlotte County and the City of Punta Gorda

Punta Gorda's fortunes ebbed and flowed along with the national economy and Florida's real estate cycle of boom and bust through World War II. The Punta Gorda Army Airfield, site of the current Punta Gorda Airport, opened in 1943 to train pilots, housing 1,200 soldiers during its peak operating capacity. In the late 1950's another housing boom began in the area with the development of Punta Gorda Isles, a residential subdivision designed with canals connected to Charlotte Harbor. With nearly 55 miles of canals, each 100 feet wide and 17 feet deep, this development used dredged material from the canals to raise the elevation of the canal-front land for residential construction. This new housing development drew retirees from the north attracted by warm winters, recreational fishing, and boating. With a small-town feel, waterfront parks, a system of pathways for walking and bicycling, and a collection of independent shops and restaurants, Punta Gorda continues to benefit from the preservation of its rich and unique history.

With much of the City constructed on dredged material fill, the land is very low-lying with significant areas of wetland and open lands (state-owned conservation lands) principally on the between the west side of Punta Gorda Isles and Charlotte Harbor and along Alligator Creek. The City consists of nearly 32 square miles of land, much of which is generally flat and ranging from sea level to approximately fifteen feet above sea level. Due to the City's low elevations and its proximity to the Gulf of Mexico, Punta Gorda is at risk of flooding during extreme storms. A listing of Southwest Florida's historic floods caused by storm surge is shown in Table 2.1.

**Table 2.1** Significant Storm Surge at the Fort Myers NOAA Gauge **(FEMA 2014)**

| Event Name | Date | Surge at Fort Myers, FL unless otherwise noted (feet NAVD88) | Storm Intensity at Landfall |
|---|---|---|---|
| Tampa Bay Hurricane | 10/25/1921 | 7 ft above normal high tide[1] | Category 3 |
| Great Miami Hurricane | 9/18/1926 | 12.0[2] | Category 4 |
| Hurricane Donna | 9/11/1960 | 11.8[3] | Category 4 |
| Hurricane Alma | 6/09/1966 | 4.1 | Category 3 |
| Tropical Storm Gabrielle | 9/14/2001 | 3.3 | Tropical Storm |
| Hurricane Charley | 8/11/2004 | 8.2[4] | Category 5 |
| Hurricane Frances | 9/06/2004 | 3.0 | Category 2 |

[1] Monthly Weather Review (October 1921) at Punta Gorda, FL
[2] U.S. Weather Bureau report (1963), in Punta Rassa-Fort Myers area, referenced to MSL
[3] U.S. Weather Bureau report (1963) near Estero, FL, referenced to MSL
[4] FEMA high water mark report (2004) at Fort Myers Beach

Hurricane Charley is the most recent major hurricane (Category 3 or higher) to impact Punta Gorda, bringing 140 mph winds and 3 ft of storm surge, as measured by the Fort Myers tide gauge (NOAA 2019). This measured height of storm surge differs from that shown in Table 2.1; the 8.2 ft listed in the table above is a measured high water mark at Fort Myers Beach. Storm surge would likely decrease before reaching the Fort Myers tide gauge on the Caloosahatchee River, approximately 19 miles inland of the reported high water mark. Additionally, a FEMA high water mark is a measure of the highest water level observed and does not always equal that of the measured storm surge. Storm surge measured at a tide gauge is calculated by comparing the peak water level to the forecast astronomical tide.

Prior to Hurricane Charley, the region had not seen a major hurricane since 1960, when Hurricane Donna made landfall in Naples and tracked just east of Punta Gorda. After Hurricane Charley, the City's restoration efforts saw the rebuilding of many structures to new, more stringent building codes. These new building codes provide enhanced protection for structures against both flood and wind hazards. The historic downtown and the waterfront area revitalization after Hurricane Charley used more resilient and sustainable strategies than had been applied in the past. In 2009, the Southwest Florida Regional Planning Council (SWFRPC) and Charlotte Harbor National Estuary Program (CHNEP) produced Punta Gorda's first climate adaptation plan, funded by the Environmental Protection Agency (EPA).

## 2.2 2009 Climate Adaptation Plan Summary and Implementation Progress

The City of Punta Gorda has been planning for the impacts from climate change and sea level rise since commissioning the 2009 climate adaptation plan. The 2009 plan identified 54 vulnerabilities, ranked by citizens during a series of public workshops. The citizens also reached a consensus on adaptation actions for the City to implement which corresponded to the listed vulnerabilities. These adaptation steps, not in ranked order, are summarized in Table 2.2, from the 2009 Climate Adaptation Plan (SWFRPC-CHNEP 2009).

**Table 2.2** Summary of 2009 Plan Adaptations with Quantifiable Metrics and City Goals

| Adaptation | Proximal Monitoring Physical Measure | Secondary Measure | Responsible Entity Collecting Data | Primary Target Goal |
|---|---|---|---|---|
| **Seagrass protection and restoration** | Acres of seagrass in the Tidal Peace River segment | Quality of seagrass | SWFWMD/ CHNEP | CHNEP seagrass target (951 acres) for Tidal Peace River segment |
| **Xeriscaping and native plant landscaping.** | Percent of City responsible landscape in xeriscape | Percent of citizen responsible landscape in xeriscape | City of Punta Gorda | 25% by 2025 |
| **Explicitly indicating in the comprehensive plan which areas will retain natural shorelines.** | % natural shoreline | % natural shoreline restored | City of Punta Gorda | 50% |
| **Constraining locations for certain high risk infrastructure.** | Amount of TDR transferred Out of Environmental Sending Locations | amount of high risk infrastructure remaining in the Tropical Storm and Category 1 Storm Surge Zones | City of Punta Gorda | No high risk infrastructure remaining in the Tropical Storm and Category 1 Storm Surge Zones |
| **Restrict fertilizer use.** | Nitrogen concentrations and loads in River and Harbor | Reduction in nitrogen levels and loads in City canals | SWFWMD, Charlotte County, FMRI | Reduction in nitrogen in River and Harbor to achieve non-impairment per TMDL |
| **Promote green building alternatives through education, taxing incentives, green lending.** | Number of green buildings constructed | Estimated change in energy use in dollars and by energy audit methods | City of Punta Gorda | 25% increase for building, 25% decrease for energy use by 2025 |
| **Drought preparedness planning.** | Number of planning steps completed. | Number of use water restriction events | City of Punta Gorda | completed and implemented plan |

The vulnerabilities listed by the citizens, categorized into eight major areas of climate change vulnerability, are listed below in order of priority:

1. Fish and Wildlife Habitat Degradation
2. Inadequate Water Supply
3. Flooding
4. Unchecked or Unmanaged Growth
5. Water Quality Degradation
6. Education and Economy and Lack of Funds
7. Fire
8. Availability of Insurance

Over the past decade since the initial adoption of the climate adaptation plan, the City has undertaken actions outlined in the report to increase resilience for the City and its infrastructure. These actions include participating in collaborative public private partnerships, policy changes, and maintenance and acquisition of greenspace. Several of the adaptations recommended in the 2009 plan have been achieved or shown significant progress over the last decade:

- Sea grass acreage has increased from 247 acres to 391 acres (a 58% increase) which is 41% of the goal of 951 acres (reported by City staff in February 2019).
- On June 6, 2012, the City of Punta Gorda adopted a fertilizer ordinance stricter than the state standard and has been implementing and enforcing it. A decrease in both nitrogen and phosphorus in the Punta Gorda canal system has been recorded since the introduction of the fertilizer ordinance.

Other progress specific to coastal resilience and closely related to the 2009 plan's adaptation strategies are noted in the City's 2018 grant application for the Florida Resilient Coastlines Program as follows:

- Collective partnership with Charlotte Harbor National Estuary Program (CHNEP), The Nature Conservancy (TNC), and others for creation of a pilot living shoreline project to restore oyster reef along the City's Harborwalk, as a public private partnership
- Reducing tidal flooding with upgrades to the City's stormwater management system, installing tidal flex valves in historic downtown
- Providing support to The Nature Conservancy for the creation of a Coastal Resilience Decision Support Tool
- Helping with the University of Florida Conservation Clinic on Sea Grant Sea Level Rise Outreach Project

A summary of the City's progress implementing the adaptations from the 2009 climate adaptation plan is illustrated in Table 2.3.

**Table 2.3** Summary of Implementation Progress - 2009 Climate Adaptation Plan

| Vulnerabilities | Adaptations | February 2019 Status |
|---|---|---|
| 1. Fish and Wildlife Habitat Degradation | 1. Seagrass protection and restoration | In Progress |
| 2. Inadequate Water Supply | 2. Xeriscaping and native plant landscaping | In Progress |
| 3. Flooding | 3. Explicitly indicating in the comprehensive plan which areas will retain natural shorelines | In Progress |
| 4. Unchecked or Unmanaged Growth | 4. Constraining locations for certain high risk infrastructure | In Progress |
| 5. Water Quality Degradation | 5. Restrict fertilizer use | Completed |
| 6. Education and Economy and Lack of Funds | 6. Promote green building alternatives through education, taxing incentives, green lending | In Progress |
| 7. Fire | 7. Drought preparedness planning | Not yet underway |
| 8. Availability of Insurance | 8. Implementation of the other adaptations, particularly 3 and 4 | In Progress |

In 2018, the City applied for NOAA's 2018-2019 Florida Resilient Coastlines: Resiliency Planning grant, administered by FDEP. The City received the formal executed grant award in January 2018 and contracted with Taylor Engineering, Inc. in February 2019 to conduct a vulnerability analysis for city-owned critical infrastructure and prepare an addendum to the 2009 climate adaptation plan with a living shoreline element. All work performed as part of the climate plan update was completed prior to grant expiration on June 30, 2019.

## 2.3 Legislative Basis for Climate Adaptation Planning

Interest in, and concerns about, climate change have been discussed within the scientific community for several decades. The evolution of that concern into more formal public policy and eventually legislation arguably can be traced to the United Nations (UN) and World Meteorological Organization (WMO) establishing the Intergovernmental Panel on Climate Change (IPCC) in 1988. By the third IPCC report in 2001 the emphasis had moved from scientific assessment to potential impacts of climate change and the necessity for adaptation strategies.

During this time the United States began to address climate change primarily through participation in the international treaties and accords and with legislation addressing various underlying climate factors such as greenhouse gas emissions. There is still no single, unified U.S. national policy for responding to the impacts of climate change. Various federal agencies have prepared and published individual agency guidance on sea level change and climate adaptation. For example, the National Oceanic and Atmospheric Administration (NOAA) recommendations for local government are summarized in Adapting to Climate Change: A

Planning Guide for State Coastal Managers (NOAA 2010). Existing national legislation such as the National Flood Insurance Act of 1968 and the Coastal Zone Management Act of 1972 have not been amended to specifically address adaptation to climate change although grant programs administered under those Acts are now funding such state and local planning efforts.

According to the Florida Department of Environmental Protection, Florida Resilient Coastlines Program's Florida Adaptation Planning Guidebook (FDEP 2018), Florida's first organized adaptation planning effort was the Southeast Florida Climate Leadership Summit in 2009. The Florida legislature passed the Community Planning Act (CPA) in 2011. Although not required, local governments could identify and develop an Adaptation Action Area (AAA) to address the impacts of sea level rise and in doing so, qualify for grant assistance. In 2013 the Florida Department of Economic Opportunity (DEO) began a 5-year effort titled Community Resiliency Initiative: Planning for Adaptation to Sea Level Rise to examine the statewide framework and best practices for integrating climate adaptation into existing local and state-wide planning processes.

Experience and results from the initial group of local planning grants under this DEO effort led to passage of SB 1094 in 2015, which is known as the "Peril of Flood" statute. This law requires consideration of future flood risk from storm surge and sea level rise in local government comprehensive plans. Specifically, Florida Statute Section 163.3178(2)(f)1 now includes sea level rise as one of the causes of flood risk that must be addressed in the "…redevelopment principles, strategies, and engineering solutions" to reduce flood risk (Florida Legislature 2015).

The City of Punta Gorda is responding to these requirements and to the general public welfare though updates to the Coastal Management Element of its 2040 Comprehensive Plan. The Coastal Management Element contents drive other Plan elements including Future land Use, Conservation, Recreation and Open Space, Infrastructure and Transportation. Implementing policies and requirements contained in the City's Land Development Regulations (LDR) include provisions for Soil Conservation; Transfer of Development Rights; and, Flood Hazard Areas.

## 2.4 Sea Level Rise Trend in Punta Gorda

Figure 2.2 compares the global sea level trends to the local sea level trends in Southwest Florida. The closest NOAA tidal gauge to Punta Gorda is located in Fort Myers at the City's Yacht Basin, on the Caloosahatchee River 0.25 miles east of the US 41 bridge. This tidal gauge provides a close approximation for Punta Gorda's water level trends due to its riverine location within a similar proximity to the Gulf of Mexico as downtown Punta Gorda. The Fort Myers gauge (Station ID NO: 8725520) has measured monthly mean water levels since 1965 and hourly water levels since 1969 (NOAA 2019). Stations with datasets longer than 40 years are preferred for calculating sea level trends, as seasonal variability and multi-decadal variability is reduced with a longer duration dataset. The global sea level rise trend data originate from the Fourth National Climate Assessment.

Figure 2.2 shows the monthly mean water level in meters, referenced to the North American Vertical Datum of 1988 (NAVD88). The trendlines shown on the graphic for the Fort Myers data illustrate the sea level rise rates. The year 1992 shows a "tipping point" in the dataset, where both local and global sea level rise accelerated. The difference between the global and local sea level rise is due to changes in Earth's gravitational field and rotation from melting of land ice in the Antarctic, land subsidence, and changing wind and ocean circulations. Although the post-1992 local sea level rise rate is approximately 40% more than the global rate during the same time period, the local rate includes regional sea surface height (SSH) changes caused by interannual climatic variability such as El Niño (NOAA 2017). Other variations in local sea level can be caused by vertical land movement (VLM), either subsidence or uplift. In Southwest Florida, VLM does not significantly affect local sea level rise as the subsidence trend is less than 1 inch per century (Houston 2019). The local sea level linear trend from 1965 to 2018 is 3.1 mm per year, which is equivalent to 1.02 ft over 100 years (NOAA 2019). The global sea level linear trend during this time period is also 3.1 mm per year (IPCC 2013). Due to the similarity in these trends, the IPCC and NCA4 projections are the best available future sea level projections to use for Punta Gorda.

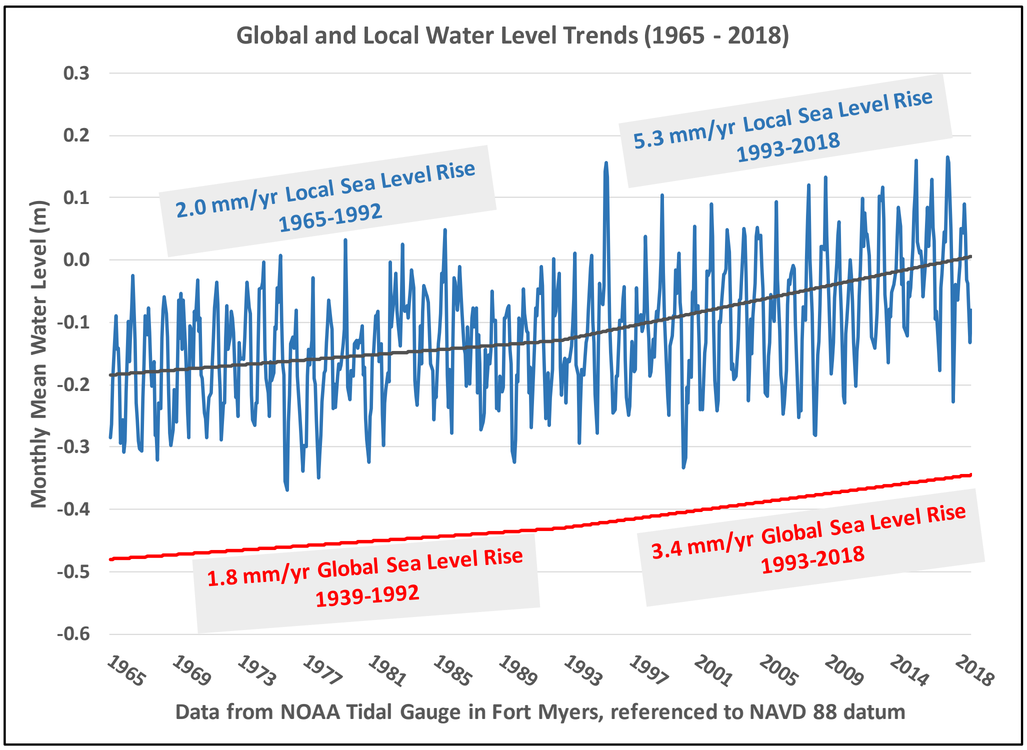



**Figure 2.2** Global and Local Sea Level Trends in Southwest Florida

The sea level rise projections used to establish the City's vulnerability thresholds originate from two credible source documents, the 2013 Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) and the 2018 US Global Change Research Program (USGCRP) Fourth National Climate Assessment Report (NCA4). The IPCC published its First Assessment Report (FAR) in 1990 and has published updated reports within 5 to 7 years of each previous report. The IPCC does not carry out research nor does it monitor climate related data. The lead authors of IPCC reports assess currently available information about climate change from a variety of published sources. The previous IPCC working group's assessment report was published in 2013. The IPCC's Sixth Assessment Report is expected to be publicly available in 2021. The IPCC's working groups and subsequent reports are well-respected in the international scientific community. The sea level rise projections in the IPCC AR5 are based on future projections of greenhouse gas quantities in Earth's atmosphere. The projections, called Representative Concentration Pathways (RCP), are future scenarios related to the concentration of carbon dioxide in the atmosphere. The AR5 report included four scenarios: RCP 2.6, RCP 4.5, RCP 6.0, and RCP 8.5. The RCP numbers denote radiative forcing in units of Watt per $m^2$ of sunlight (IPCC 2013).

The second set of sea level rise projections used to establish the City's vulnerability thresholds originated from the USGCRP NCA4, released in November 2018. The first NCA was published in 2000, the second NCA in 2009 and the third was released in 2014. The USGCRP consists of 13 federal agencies, with NOAA serving as the lead agency for the NCA4 report. The report is based on an assessment of the peer-reviewed scientific literature, with ongoing participation of scientists and federal and non-federal stakeholders. The NCA4 report's sea level rise projections included six scenarios, created by NOAA: Low, Intermediate-Low, Intermediate, Intermediate-High, High, and Extreme, as shown in Figure 2.3.

Figure 2.3 is a graphic from the 2018 USGCRP NCA4 showing the historic sea level trend, six sea level scenarios, and the IPCC AR5 sea level rise projections. Vertical bars on the right side of the graphic are the RCP from the 2013 IPCC AR5 report. Vertical lines above the RCP bars show a possible increase in Antarctic contribution due to new ice sheet data available in 2016 after the IPCC AR5 report was published (USGCRP 2018). The figure does not show RCP 6.0 because its sea level rise range is similar to RCP 4.5.

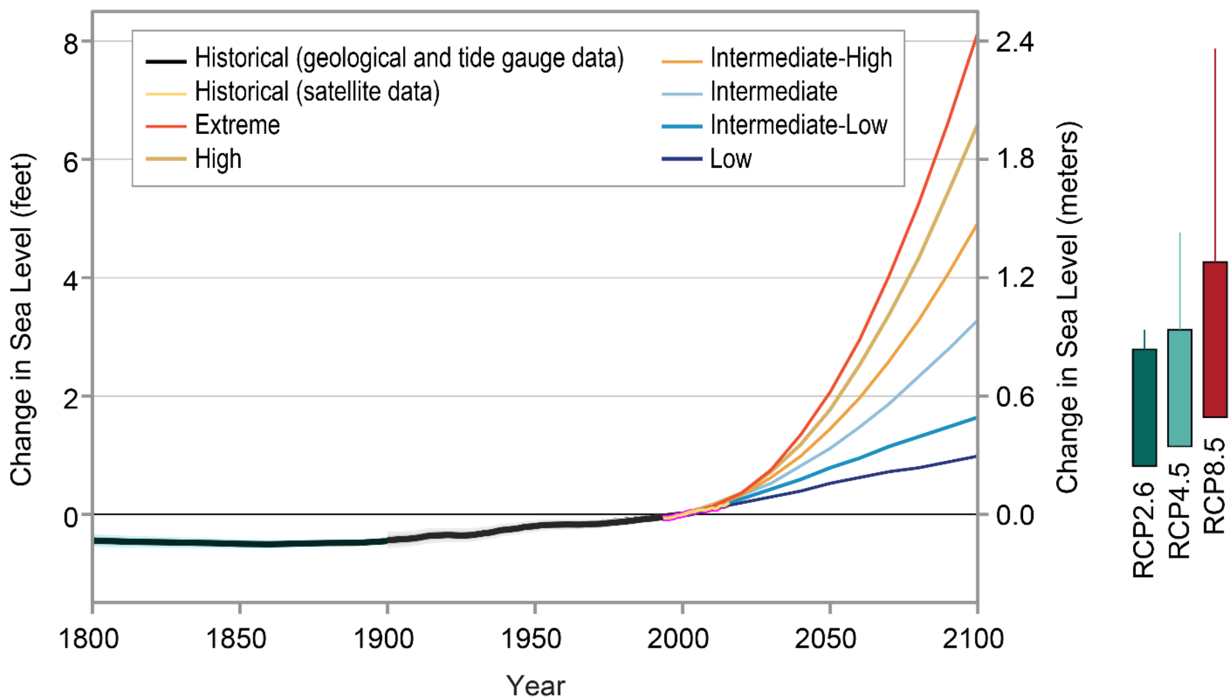



**Figure 2.3** 2013 IPCC and 2018 US National Climate Assessment Sea Level Projections and Historical Data
(USGCRP 2018)

# 3.0 VULNERABILITY ASSESSMENT

In February 2019, the City contracted with Taylor Engineering to perform a vulnerability assessment of public infrastructure within City limits, with a focus on coastal flooding impacts to critical facilities and historic properties. The term ‘vulnerability’ is often interchangeable with ‘risk’ when measuring hazard impacts, however the NOAA definition of vulnerability is “The potential for loss of or harm/damage to exposed assets largely due to complex interactions among natural processes, land use decisions, and community resilience.” (FDEP 2018). The purpose of a vulnerability assessment is to help a municipality or community identify and prioritize which structural and social assets are likely to be impacted by future coastal flooding and sea level rise. Performance of a vulnerability assessment also forms the basis for complying with the “Peril of Flood” statute requirements as found in Section 163.3178(2)(f)(1-6), Florida Statutes. Using the best available sea level rise projections and flood inundation scenarios, Taylor Engineering evaluated the City’s vulnerability under 12 different flooding scenarios.

## 3.1 Methodology

This analysis uses a Geographic Information System (GIS)-based assessment of the City’s public infrastructure with respect to sea level rise projections and tropical storm surge stillwater elevations (SWEL). The elevations of publicly owned buildings were compared to future sea level rise thresholds and storm surge inundation depths.

The City of Punta Gorda chose flooding thresholds for this vulnerability analysis of 1.5 ft and 3 ft sea level rise. These thresholds were chosen because the 1.5 ft rise will most likely occur within the time horizon of the City’s 2040 Comprehensive Plan or a homeowner’s 30-year mortgage, while the 3 ft sea level rise is more suitable for planning capital improvement projects with a 50-year design life. Figure 3.1 illustrates these thresholds relative to the global sea level rise scenarios discussed in Section 2.4. The zero ft horizontal line on the graphic coincides with the year 2000, which US federal agencies adopted as a benchmark for measuring sea level change (NOAA 2017). The Extreme scenario predicts 1.5 ft sea level rise by 2040 and 3 ft rise by 2060. The Intermediate-Low scenario predicts 1.5 ft of sea level rise by 2090 and 3 ft rise after 2100, beyond the range of this graphic (USGCRP 2018).

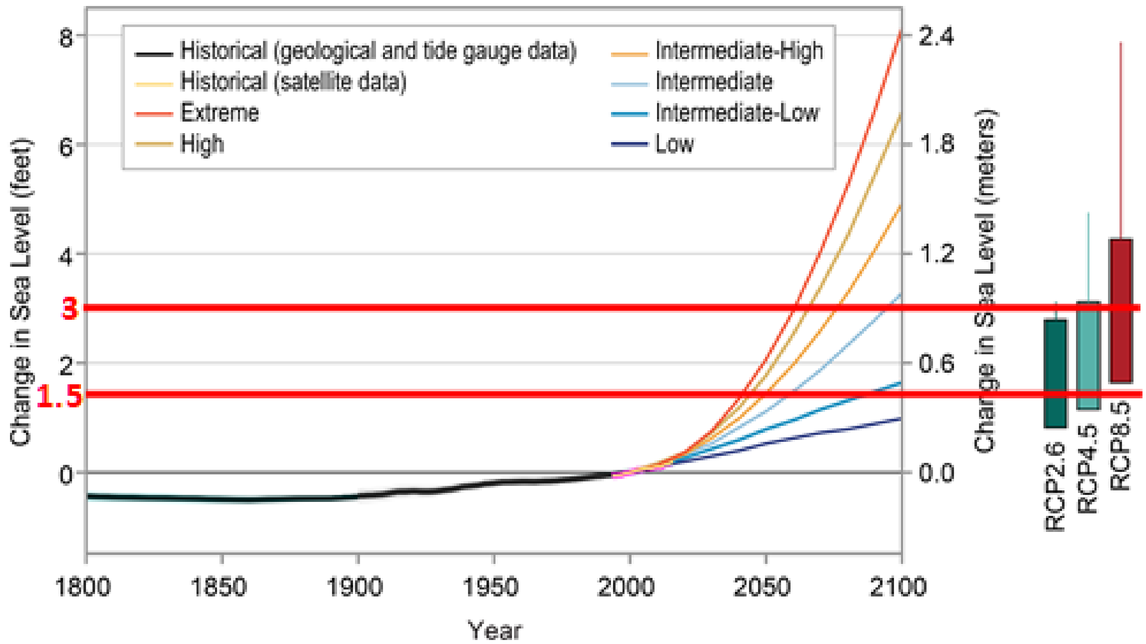



**Figure 3.1** 2013 IPCC and 2018 US National Climate Assessment Sea Level Projections and Historical Data

*(Fourth National Climate Assessment, annotated to show Punta Gorda's thresholds of 1.5 ft and 3 ft)*

For comparison of sea level scenarios, the Charlotte County-Punta Gorda 2035 Long Range Transportation Plan used sea level rise heights of 0.5 meter (1.6 ft) by 2050 and 1 meter (3 ft) by 2100. This plan also evaluated the 100 yr (1%) tropical storm surge inundation (Charlotte County-Punta Gorda Metropolitan Planning Organization 2010). Punta Gorda's 2009 climate adaptation plan used sea level rise scenarios between the years 2000 and 2050 of 5 inches with 90% probability, 9 inches with a 50% probability, and 16 inches with 5% probability. The plan looks at sea level rise between 2000 and 2100 of 10 inches with 90% probability, 20 inches with a 50% probability, and 36 inches with 5% probability (SWFRPC-CHNEP 2009). The 2009 plan also analyzed habitat and land use losses for seven different sea level rise scenarios.

## 3.2 Datasets

To conduct a 'best practices' vulnerability assessment, the following data should be included: a) building location, b) first floor elevations (FFE), c) lowest adjacent grade elevations (LAG), d) replacement value, and e) year built. The year the structure was built helps to inform as to which building codes applied (e.g. pre- or post-Hurricane Charley). The replacement value is typically sourced from the County Property Appraiser's database; however, this information may not be accurate for all assets as some parcels are assigned a $0 improved value, even though the parcel has buildings. One example of this was observed for the City's Historic Park.

To evaluate estimated damage and vulnerability, we compared the projected elevation of various coastal flood scenarios to building's FFE to assess the risk exposure, sensitivity, and adaptive capacity of these assets. However, based on detailed review of the County Property Appraiser's and City-provided data, much of this information for publicly owned buildings was not available. The FFE and LAG was provided for twenty-two City-owned buildings; FFE data only for two other

City properties was provided. The data from the elevation certificates provided by the City is summarized in Table A-1 in Appendix A. Approximate FFE's were collected for 13 additional buildings deemed critical for this assessment. The following datasets were available and provided information for our analysis:

- 2007 SWFWMD topographic LiDAR (3.8 ft horizontal & 0.6 ft vertical accuracy)
- ArcMap World Imagery basemap
- Google Earth Pro satellite imagery
- County Property Appraiser records
- County elevation certificates
- City elevation certificates
- City floodproofing certificates
- City flood location questionnaires
- City stormwater system locations
- National Register of Historic Places
- State Historic Preservation Office master site file of historic structures
- Taylor Engineering site measurements of building First Floor Elevations
- NOAA tide gauge, Fort Myers, water level observations, 1965-2018
- FEMA stillwater elevations from proposed Flood Insurance Rate Map Study

## 3.3 Assumptions

For many buildings in this study, the first floor elevations were not available in the available data. Accurate first floor elevation for structures is a critical input to this vulnerability analysis. To fill in the data gaps, we performed a limited topographic assessment of the City- and County-owned buildings to obtain these first floor elevations. This effort did not include Charlotte County school properties or Punta Gorda Housing Authority properties due to the large number of structures on each property. For these assets, we estimated first floor elevations based on the lowest adjacent grade. The building footprint outlines were compared with topographic data to determine the lowest adjacent grade that coincided with the building outline. With City staff approval, we assumed that first floor elevations were one foot above each building's lowest adjacent grade.

## 3.4 Asset Categories

This study sorted properties into three categories for analysis: general publicly owned, critical public facilities, and historic properties. The publicly owned properties were selected based on their ownership, as listed in the Charlotte County Property Appraiser's database. The properties in this category included the following ownership: City of Punta Gorda, CRA of City of Punta Gorda, Punta Gorda Housing Authority, Charlotte County, and Charlotte County School Board. The properties in the critical facilities category were listed in the 2015 Charlotte County Local Mitigation Strategy report as either County Essential Services or City Critical Facilities. The historic properties are those buildings either designated by the National Register of Historic Places or listed by the Florida State Historic Preservation Office as eligible for historic designation.

## 3.5 Flood Scenarios Modeled

The exposure analysis considered 12 flood scenarios formed from combinations of three sea level rise scenarios and three storm surge flooding types. The flood scenarios are listed in Table 3.1 below.

**Table 3.1** Flood Scenarios Used for City's Vulnerability Analysis

| # | Flood Scenario | | |
|---|---|---|---|
| 1 | 2019 water level (MHHW) | | |
| 2 | 1.5 ft sea level rise | | |
| 3 | 3 ft sea level rise | | |
| 4 | 2019 water level (NAVD88) | + | 4% annual chance flood |
| 5 | 2019 water level (NAVD88) | + | 1% annual chance flood |
| 6 | 2019 water level (NAVD88) | + | 0.2% annual chance flood |
| 7 | 1.5 ft sea level rise | + | 4% annual chance flood |
| 8 | 1.5 ft sea level rise | + | 1% annual chance flood |
| 9 | 1.5 ft sea level rise | + | 0.2% annual chance flood |
| 10 | 3 ft sea level rise | + | 4% annual chance flood |
| 11 | 3 ft sea level rise | + | 1% annual chance flood |
| 12 | 3 ft sea level rise | + | 0.2% annual chance flood |

The three sea level rise states were Mean Higher High Water (MHHW) to simulate a low inundation, 1.5 ft for medium inundation, and 3 ft for high inundation. The three tropical storm surge types analyzed were 25-year (4% annual chance) flood, 100-year (1% annual chance) flood, and 500-year (0.2% annual chance). Each sea level rise state was also analyzed with no storm surge flooding. The MHHW scenario, defined as "the average of the higher high water heights of each tidal day observed over the National Tidal Datum Epoch" represents today's nuisance, chronic, or sunny day flooding, also called 'king tides' (NOAA 2019). The occurrence of nuisance flooding will continue to increase with sea level rise and can be further influenced by the tides and onshore winds.

## 3.6 Inundation Modeling

The GIS-based vulnerability analysis compared the elevation of various inundation scenarios using both a simple bathtub model and a modified bathtub model. A bathtub model simply identifies all areas under a target elevation as potentially flooded, regardless of hydrologic connectivity. The bathtub model was used for the 50-year (2% annual chance) flood shown for comparison of the four different SWEL flood boundaries (Figure A-19). The modified bathtub model, used for all other scenarios, applies a hydrologic connectivity filter to remove isolated inundated areas not connected to a major waterway. The City's stormwater infrastructure GIS layer was used to inform these hydrologic connections in the model.

Several flood inundation scenarios were evaluated using SWEL data, created as part of a Flood Insurance Rate Map study. The SWEL represents the storm surge (not including waves or wave runup) calculated using an ADCIRC computer model analysis which runs hundreds of historic storms over a given topography and bathymetry. For this analysis, the 25-year (4% annual chance) flood, 100-year (1% annual chance) flood, and 500-year (0.2% annual chance) flood inundation scenarios were chosen and analyzed with and without sea level rise. The 1% and 0.2% annual chance floods were initially the only two SWEL datasets modeled and showed relatively little difference in the horizontal flood extent (Figures A-10 and A-13).

The 25-year (4% annual chance) scenario was added in order to achieve a more refined result for inclusion in the climate adaptation plan addendum (Figure A-7). Analysis of the water level data from the NOAA tidal gauge at Fort Myers, Florida showed no storm surge instances greater than a 23-year return period for the region (NOAA, 2019). A listing of the ten highest monthly water levels and associated return periods for the tide gauge is shown in Table 3.2. The storm surge caused by Hurricane Charley ranks #6 on the list, with an 11-year return period. Hurricane Donna does not appear on this list as the storm occurred in 1960, before the Fort Myers tide gauge began recording data in 1965.

**Table 3.2** Ten Highest Water Levels and Return Periods from Fort Myers Tide Gauge

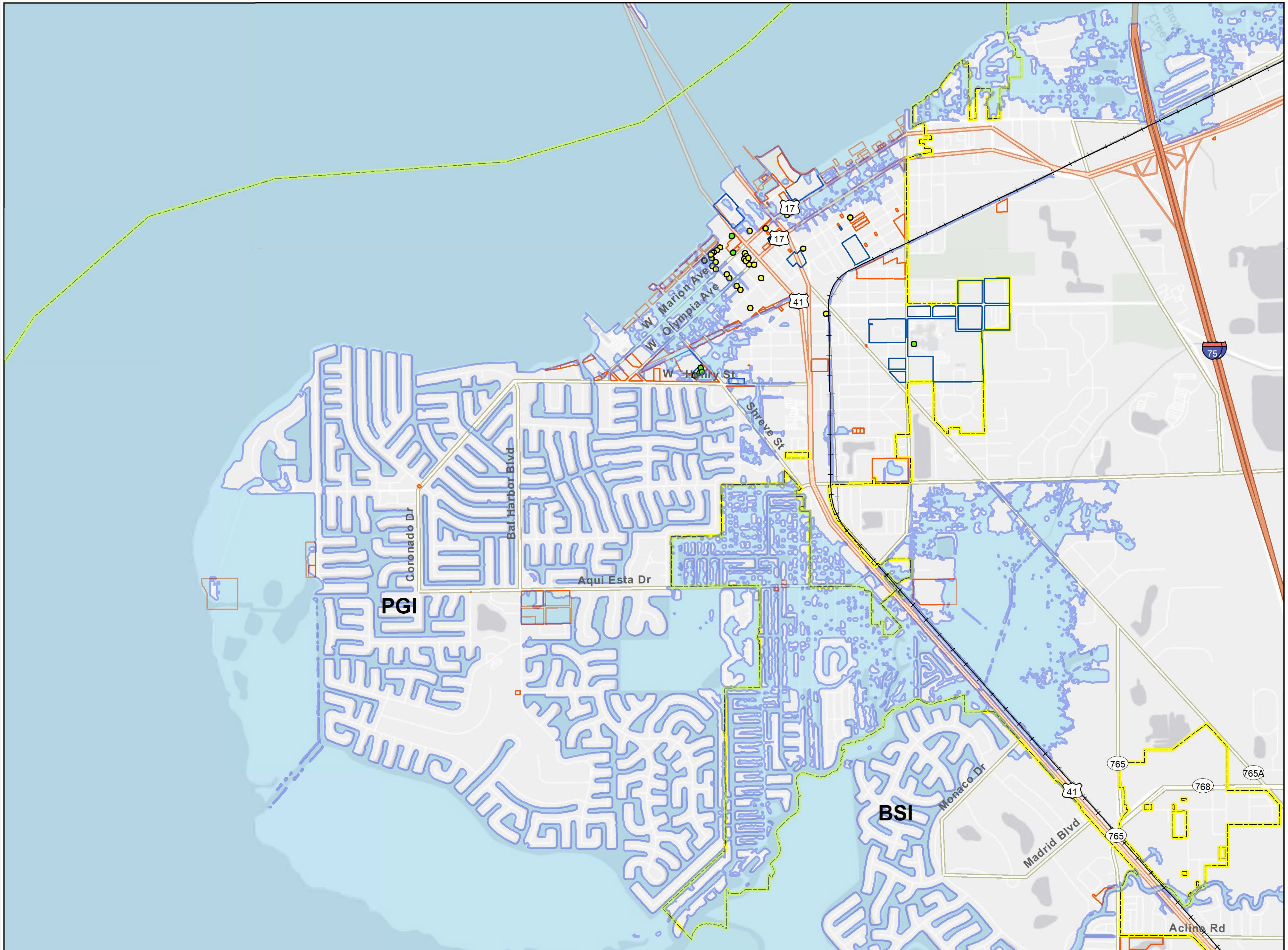
| Rank | Year | Month | Water Level (ft NAVD) | Return Period (Yrs) |
|---|---|---|---|---|
| 1 | 1988 | 11 | 3.68 | 23 |
| 2 | 2001 | 9 | 3.59 | 21 |
| 3 | 1982 | 6 | 3.58 | 21 |
| 4 | 1974 | 6 | 3.36 | 16 |
| 5 | 2017 | 9 | 3.32 | 16 |
| 6 | 2004 | 8 | 3.12 | 11 |
| 7 | 1985 | 8 | 3.05 | 10 |
| 8 | 1996 | 10 | 2.97 | 9 |
| 9 | 2004 | 9 | 2.96 | 9 |
| 10 | 2012 | 6 | 2.92 | 9 |

## 3.7 Workshop Input

During a public workshop held on April 5, 2019, the thirteen participants were asked to review a list of ten vulnerable historic properties and ten publicly owned properties. These vulnerable assets were determined by comparing the first-floor elevation of each building with the associated parcel's flood inundation depth for each flood scenario. This preliminary list of vulnerable properties was prepared in advance of the workshop, then categorized into historic and publicly owned properties within City limits. The workshop attendees were asked to identify which properties on each list were most important to protect. They also added several "write-in candidates" of properties which were not listed, but that the participants felt were important to protect. The tallies of the participant's votes for the properties reviewed and added during the workshop are presented in Appendix D of this report.

## 3.8 Results of Modeled Flood Scenarios

Maps illustrating the City's inundation during several flood scenarios are included in Appendix A. Figure 3.2 is an example of one of the maps shown in Appendix A. This map illustrates the extent of flood inundation within the city limits with 3 ft of sea level rise.Each of the flood scenarios shown in the Appendix is drawn in two versions, one similar to Figure 3.2 which shows the flooding within the city limits and one similar to Figure 3.3 which is zoomed in to the downtown area.




Taylor Engineering, Inc.
1800 2nd Street, Suite 714
Sarasota, FL 34236
CERTIFICATE OF AUTHORIZATION # 4815

**FIGURE 3.2**
**3 FT OF SEA LEVEL RISE IN THE CITY OF PUNTA GORDA**

3 FT SLR

**Historic Buildings**
- PRIVATE
- PUBLIC

**Parcel Ownership**
- Charlotte County
- City of Punta Gorda

**Corporate Boundaries**
- City of Punta Gorda

0 2,500 5,000
FEET

N

CHARLOTTE COUNTY, FL

Disclaimer: This figure is not intended to show the exact location of flooding and does not account for all variables affecting future flooding such as ground water impacts, changing precipitation patterns, future construction, or erosion. As such, actual future flooding may differ from this graphic. This graphic should be used strictly as a planning reference tool and not for navigation, permitting, insurance rating, or other legal or regulatory purposes.

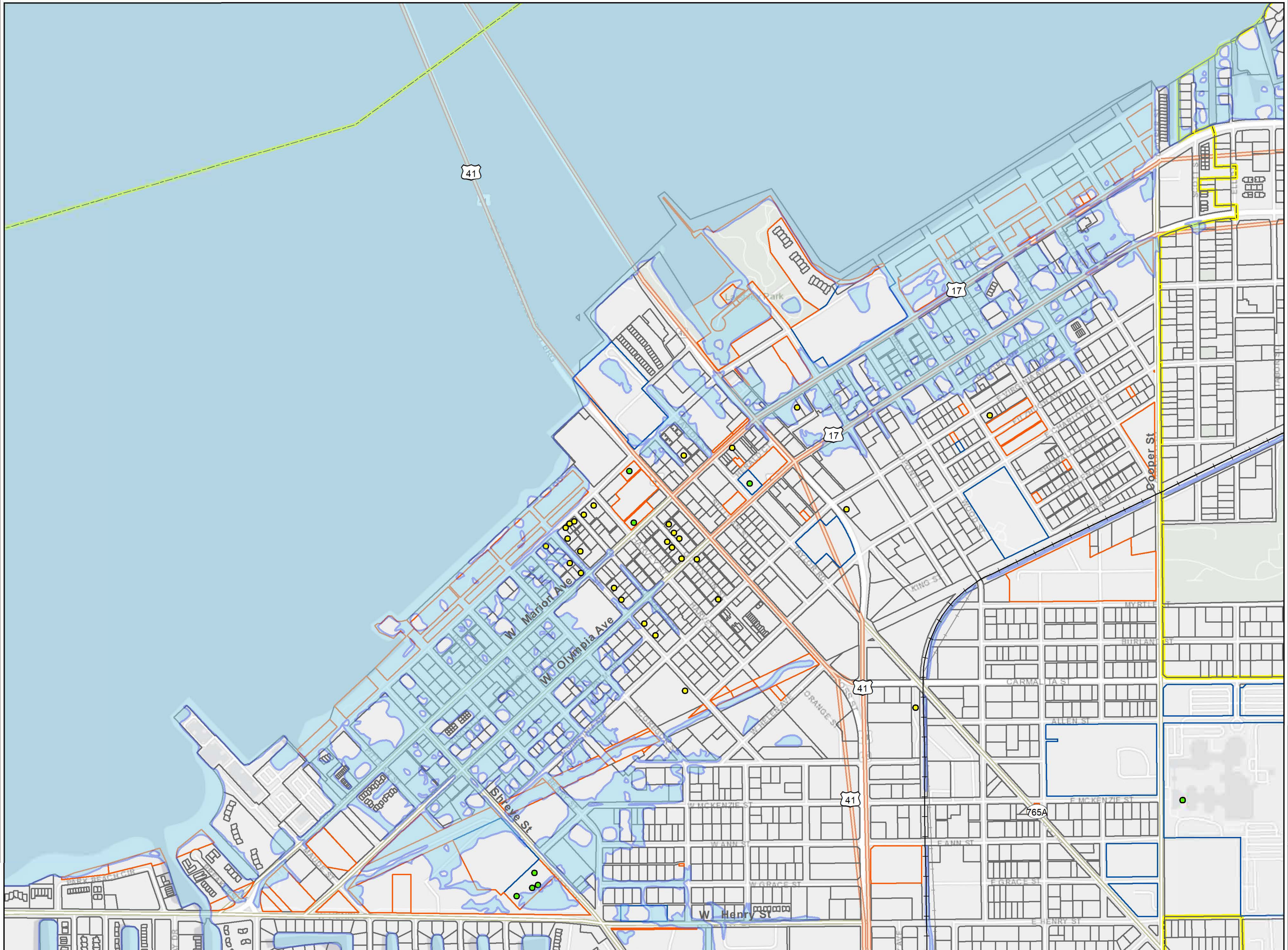



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**FIGURE 3.3**
**3 FT OF SEA LEVEL RISE IN THE CITY OF PUNTA GORDA**

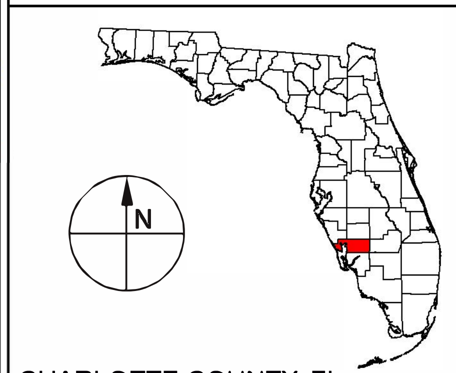
3 FT SEA LEVEL RISE

**Historic Buildings**
- PRIVATE
- PUBLIC

**Parcel Ownership**
- Charlotte County
- City of Punta Gorda
- Non Public

**Corporate Boundaries**
- City of Punta Gorda

0 500 1,000 1,500
FEET




CHARLOTTE COUNTY, FL

Disclaimer: This figure is not intended to show the exact location of flooding and does not account for all variables affecting future flooding such as ground water impacts, changing precipitation patterns, future construction, or erosion. As such, actual future flooding may differ from this graphic. This graphic should be used strictly as a planning reference tool and not for navigation, permitting, insurance rating, or other legal or regulatory purposes.

All 12 flood scenarios are summarized in Table 3.3. Appendix A provides maps of scenarios showing the greatest differences in flooding. Several scenarios with similar flooding extent area not mapped in the Appendix. The 4% annual chance storm surge stillwater level (SWEL) is the only SWEL scenario combined with the 1.5 ft and 3 ft sea level scenarios in Appendix A's maps. The extent of flooding at the combined 4% annual chance SWEL with 1.5 ft of sea level rise shows 68% of publicly owned acreage flooded. Combining the 4% annual chance SWEL with 3 ft of sea level rise indicates 71% of these properties inundated. The maps for the remaining four scenarios in Appendix A include the combined SWEL and sea level rise scenarios, which are similar in magnitude and do not show much differentiation of flooding extent. A comparative plot illustrating the amount of flooding due to four different annual chance SWEL scenarios shows the slight variations in flood extent (Figure A-19).

Table 3.3 summarizes the percentage of publicly owned land which would potentially flood in each scenario. Public acreage for this analysis totals 860 acres, which includes publicly owned parcels in the city limits, as well as the Shell Creek Reservoir and the Punta Gorda Water Treatment Plant, both outside city limits. Total acreage in the City of Punta Gorda is approximately 65,000 acres.

**Table 3.3** Percent of Public Property Flooded in the 12 Coastal Flooding Scenarios

| Flood Scenario | Publicly Owned Acreage Flooded | % Of Publicly Owned Acreage Flooded |
|---|---|---|
| MHHW (Nuisance Flooding) | 4.7 acres | 1% |
| 1.5' Sea Level Rise | 151.3 acres | 18% |
| 3.0' Sea Level Rise | 218.5 acres | 25% |
| 4% Annual Chance Flood | 459.5 acres | 53% |
| 1.5 ft SLR + 4% Annual Chance | 587.2 acres | 68% |
| 3 ft SLR + 4% Annual Chance | 607.9 acres | 71% |
| 1% Annual Chance Flood | 608.0 acres | 71% |
| 1.5 ft SLR + 1% Annual Chance | 614.4 acres | 71% |
| 0.2% Annual Chance Flood | 616.3 acres | 72% |
| 3 ft SLR + 1% Annual Chance | 617.5 acres | 72% |
| 1.5 ft SLR + 0.2% Annual Chance | 633.1 acres | 74% |
| 3 ft SLR + 0.2% Annual Chance | 728.8 acres | 85% |

Tables A-2 and A-3 identify the critical facilities and historic properties flooded under each of the twelve scenarios in tabular format. Figures A-1 through A-18 illustrate the inundation extent in graphical form.

# 4.0 ADAPTATION STRATEGIES

## 4.1 Range of Adaptation Strategies

Adaptation is defined by the IPCC as "the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects" (IPCC 2013). Adaptation strategies can be classified by a variety of categories depending on the climate threat. A common classification for adaptation options for sea level rise, originated by the IPCC's 1990 Coastal Zone Management Subgroup (CZMS), includes these three categories: (1) accommodate, (2) protect, and (3) (managed) retreat.

1) *Accommodate* – allows the land area to flood, reducing impacts to citizens without impeding the environment's natural systems. Examples are elevation of properties, wet floodproofing of structures, land-use planning, flood insurance, flood hazard mapping, and timely flood warnings to inform the public and encourage well-organized evacuations. An example of accommodate strategy used by Punta Gorda is shown below.


*Wet Floodproofing (Accommodate Strategy) at Laishley Park*

2) *Protect* – stops the land area from flooding up to a specified threshold, reducing impacts to citizens while changing the environment's natural systems. Examples are living shorelines, seawalls, beach and dune nourishment, and stormwater management.

3) *(Managed) Retreat* – permits the land area to flood, reducing impacts to citizens by removing them from the coastal flood zones. Examples are government buyouts of repetitive loss properties, development controls, zoning changes, and land-use planning.

Communities can use a combination of these planned adaptation strategies to reduce the potential impacts caused by sea level rise. The three adaptation strategies listed above may be universal, however each adaptation method must be specifically tailored to the local focus area or individual property. There is no singular "one size fits all" method to adapt various communities or structures to sea level rise. The selection of an applicable and effective adaptation method requires assessment of multiple factors. These factors include time frame, scale of the response area, method of infrastructure, and type of adaptation.


*Managed Retreat (Relocation) of Historic Buildings*

There are two general time frames of response: (1) *proactive,* meaning to prepare, protect, and preserve prior to an event's occurrence; and (2) *reactive*, which is restoring damage caused by an event. These time frames can be further categorized into long-term planning, intermediate-term planning, or short-term/immediate action. Often the availability of funding determines the time frame for adaptation. For example, post-disaster funding is available from the US government after a major disaster declaration via FEMA's Hazard Mitigation Grant Program. This funding enables states and local governments to implement long-term hazard mitigation measures in the immediate aftermath of a disaster, which is not limited to flooding, but includes other natural hazards such as fires, tornadoes, and earthquakes. FEMA's Pre-Disaster Mitigation Grant Program funds pre-planning prior to an event's occurrence. These are two examples of funds available which may influence the time frame for adaptation planning.

The scale of the response area also determines the specific adaptation options considered. Adaptation methods range from *large-scale* (e.g., county or city) to *small-scale* (e.g., individual buildings or properties). Identification of a specific focus area is critical to narrowing the variety of adaptation strategies and choosing the most effective. For example, a large-scale flood protection option is the Thames Barrier in London, which can protect many properties from storm surge. A small-scale example is a flood barrier at the entrances of a building which can protect a single structure from flooding. Both examples employ "gray solutions," which utilize hard engineered structures, typically built of concrete (hence the name "gray").

The adaptation method chosen can range from *green* (e.g., natural or nature-based solutions which are built to mimic natural ecosystems) to *gray* (e.g., hard engineered structures) to *hybrid* (e.g., includes components from both green and gray methods). Examples of green infrastructure used to stabilize an eroding shoreline include beach and dune nourishment, artificial reef placement, seagrass restoration, and dune plantings. Gray infrastructure examples include seawalls, bulkheads, and stormwater drainage systems. Hybrid infrastructure examples for shoreline protection include seawalls paired with artificial reef materials at the base, living shorelines coupled with stone sills, and stormwater drains surrounded by mangrove plantings. Considerations for selection of hybrid shoreline protection include the amount of wave energy, desired environmental effects, ease of permitting, adjacent land use, and funding available. The photograph below shows the green protection strategy of a living shoreline in the foreground, with a gray protection strategy of a seawall in the background.

Another way to classify adaptation strategies is to group them into their specific applications:

*Punta Gorda's Protection Strategies for Shoreline Stabilization*

policies, emergency response, economic planning and assessment, infrastructure management, identification and monitoring, public awareness and education. Each category is outlined below with relevant examples derived from the Center for Climate Strategies Adaptation Guidebook (CCS 2011), FEMA's Protecting Building Utility Systems From Flood Damage (FEMA 2017), US Environmental Protection Agency (EPA) Climate Change Adaptation Plan (EPA 2014), the Climate Adaptation App (Bosch Slabbers 2019), and IPCC's CZMS (IPCC 1990).

1. **Policy** strategies include laws and regulations for efficient planning, as well as restrictions and permitting to account for climate change and its effects.

    a. *Planning*

        i. A Special Area Management Plan (SAMP) intends to protect significant natural resources, life and property in coastal areas.
        ii. Adaptation Action Area (AAA) designations in local government's comprehensive plans identify specific flood prone areas for the purpose of funding prioritization.
        iii. Zoning for sensitive or hazard/flood prone areas.

iv. Establishing and limiting current and future land use based on flood zones.
v. Establish site development setbacks or rolling easements.
vi. Guidelines for effective response to climate impacts.
vii. Require/enable metropolitan planning organizations to take climate change into account.
viii. Review transportation stability and durability regarding climate change.
ix. Coastal resource actions for adapting to more frequent severe storms and sea level rise.
x. Add climate change considerations to taxation and budget reform.

*b. Restrictions*

i. Prevent new construction in vulnerable zones.
ii. Enforce or institute building-codes in flood and erosion prone areas.
iii. Prohibit hard structures along the shoreline.
iv. Minimizing the extent of impervious surfaces.

*c. Permitting*

i. Refine to include climate change effects.

2. **Emergency** strategies are intended for during or immediately after an event.

*a. Public Awareness*

i. Educational programs on appropriate behavior prior to and following extreme events.

*b. Planning*

i. Review the goals, strategies and plans of emergency preparedness, response and recovery under conditions induced by climate-related disruptions.
ii. Power generators are a backup for the public power supply in case of flood events. Verify that all hospitals and vital infrastructure are prepared.

*c. Temporary Structures*

i. Sandbags can be used to protect structures or system components.
ii. Flood barriers can be assembled, moved into place, anchored, and filled with water, sand or gravel to provide self-supportive protection. An example of this type of protective flood barrier is shown below.

iii. Flood wrapping systems use plastic or other synthetic waterproof sheeting material to seal buildings and prevent water intrusion.

*Temporary Flood Barrier Protecting Building Entryway*

3. **Economic planning and assessment** strategies allow for understanding of the community's financial responses to impacts on water dependent industries and businesses.

   a. *Assessment & Planning*

      *i.* Local government can buyout properties in vulnerable areas to ensure no future development and risk is created.
      *ii.* Promote hazard insurance for homeowners and businesses.
      *iii.* Create economic incentives for individuals and businesses to reduce risk of losses through building design codes and supporting development in non-risk zones.
      *iv.* Add climate change considerations to taxation and budget reform.
      *v.* Seek federal funds for climate costs.
      *vi.* Establish short-, mid-, and long-term budgets that include adaptation strategies and capital investments over time.

4. **Infrastructure** adaptation strategies include options to prepare, protect, and restore building structures, transportation, stormwater management systems and drainage, land development, and provide proper planning.

   a. *Structures*

      i. Flood walls can be constructed to protect individual buildings/facilities.
      ii. Dikes are elongated artificially constructed embankment or levees, which protect low-lying areas against higher water levels.
      iii. Flood shelters are created in areas which experience severe flash flooding.
      iv. New and existing buildings in flood risk areas can be used as flood defense if completely integrated in the flood defense system.

*b. Transportation*

i. Raised curbs and hollow roads are used to increase the storage and transport capacity of a road instead of the water flowing into the surrounding buildings or neighborhoods.
ii. Identify and revaluate use of transportation routes in floodplains and coastal hazard zones.
iii. Establish a Climate Change and Public Infrastructure Task Force.
iv. Develop joint transportation strategies with adjacent communities, regions, and states to accommodate changing conditions and transportation system uses.
v. Reduce surfaces like roofs, roads, and parking lots so more water can infiltrate the soil and extra green space is created.
vi. Construct/raise evacuation routes above the highest expected flood levels.

*c. Land Development*

i. Creating a bypass for a river or canal can reduce flood levels by providing extra discharge capacity.
ii. Additional ditches can be used to increase drainage in low-lying areas.
iii. Improving the soil infiltration capacity means improving the permeability of the soil.
iv. Review land use plans in anticipation of change development pressures and shifts in development patterns due to climate change.
v. Reduce loss of wetlands due to hardening of estuarine shorelines.
vi. Reduce or eliminate ocean outfalls.
vii. Use beach nourishment to protect infrastructure in coastal areas.

*d. Stormwater Management System/Drainage*

i. Pumping stations are used to discharge water out of an area and increasing pump capacities allows water tables to be controlled better.
ii. Storage and settling tanks are designed to store excess runoff in urban drainage systems during wet periods, primarily if runoff exceeds the discharge capacity of the urban drainage system. The photograph to the right illustrates an example of underground storage tanks used to store excess stormwater.

*Storage Tanks for Excess Runoff (www.conteches.com)*

iii. If a combined sewer system, collecting rainwater and wastewater in one, is being used, reconstruction of separate systems can create additional capacity in storm events.
iv. Capturing runoff from a roof is a small-scale solution to increase local water storage. Larger capacity storage includes small dams within small

channels and designating large areas as flood areas to store excess discharge.

v. A rainwater tank (or rain barrel) can be used to collect and store water runoff from roofs and rain gutters for irrigation of landscaping.

*e. Infrastructure Planning*

i. Review construction standards for piers and seawalls for resilience to wave energy, storm surge (including negative surge), and future sea level rise.
ii. Verify urban house stock, including multi-family homes and public housing units, are resilient to likely climate change effects.
iii. Increase maintenance and cleaning of gutters, drainage ditches, and culverts, such as the example in the photo below.
iv. Incorporate modification to communications infrastructure to increase resiliency during routine maintenance and upgrades.
v. Adequately ensure communications infrastructure to ensure that reconstruction can occur in the event of a climate related disaster.
vi. Assess the vulnerability of special designation areas, areas of unique flora and fauna and areas of essential ecosystem goods and services. Support healthy rivers, streams and vegetation to maintain water quality.
vii. Increase environmental quality standards to enhance resilience of natural water systems.
viii. Develop morphodynamic and ecological response models of primary coastal zones according to different climate scenarios.
ix. Conduct coastal re-alignment planning conversion of land to salt marsh and grassland to provide sustainable sea defenses.

*Drainage Culvert along Punta Gorda's HarborWalk*

5. **Identification** of key infrastructure and vulnerable areas provide the ability to manage the risks prior to failure. **Monitoring** of changes in sea level rise and storm surge allow for early warning systems and ensure adequate response/evacuation plans.

   a. *Mapping*

      i. Identify and map key communications infrastructure (networks or points of production of distribution) that may be affected by climate change impacts.
      ii. Identify and map key energy infrastructure (networks, pipelines, power lines or points of production or distribution) that may be affected by climate change impacts.
      iii. Inventory and map the estuarine and ocean shoreline and its bathymetry, sediments, and vegetation.

   b. *Public Awareness*

      i. Ensure accurate information reaches residents and tourists on behaviors and uses that ensure environmental quality and ecosystem resiliency.
      ii. Identify and engage representatives of key business areas potentially vulnerable to specific climate change effects.

   c. *Monitoring*

      i. Initiate surveillance and monitoring of sea level rise related to storm surge early warning systems and ensure adequate response/evacuation plans.
      ii. Establish a series of permanent monitoring stations to measure the absolute changes in sea level rise in coastal areas and characterize the dynamics of estuarine storm surges, astronomical tides and water flow.
      iii. Conduct a shoreline impact assessment to establish baseline of data on the existing coastal resources and the projected impacts of sea level rise, including tides and weather.

   d. *Managed Retreat/Relocation*

      i. Survey vulnerable current inhabited areas; develop relocation plans and contingency measures in the event of emergencies.
      ii. Survey vulnerable current inhabited areas; develop relocation plans and contingency measures in the event of emergencies.
      iii. Develop strategies to address situations of changing ingress/egress to structures as support for access roads in areas vulnerable to sea level rise and associated hazards is withdrawn.
      iv. Investigate potential and limitations of eminent domain, vesting, grandfathering, and amortizing strategies to support retreat activities. The A.C. Freeman house is a local example of a historic structure which has been subject to Managed Retreat/Relocation, with several planned relocation moves in the building's history.

Early identification, planning, and action increase a community's resilience to climate induced disasters. New construction and community planning can be designed with flood damage prevention in mind. A more comprehensive list of a variety of adaptation options is presented in Appendix B.

## 4.2 Focus Areas for Adaptation

As defined by the Florida Adaptation Guidebook, focus areas are the selected locations which "will receive a majority of the adaptation strategy attention" (FDEP 2018). The inputs from the April 2019 public workshop helped to inform this selection, by prioritizing which vulnerable facilities were important to the citizens who attended. A summary of these prioritized facilities from the public workshop is in Appendix D.

The following criteria were also used to identify focus areas within the City of Punta Gorda:

- Parcel inundation at 3 ft of sea level rise
- Ratio of flooded acreage to non-flooded acreage at 3 ft of sea level rise
- Number of publicly owned parcels inundated
- Number of critical facilities inundated
- Number of historic properties inundated

These criteria yielded three distinct Adaptation Focus Areas for further investigation and narrowing of adaptation strategies for the City of Punta Gorda. These three regions are the Downtown Focus Area, the Fire Station Focus Area, and the US 41 Commercial Focus Area (Figure 4.1).

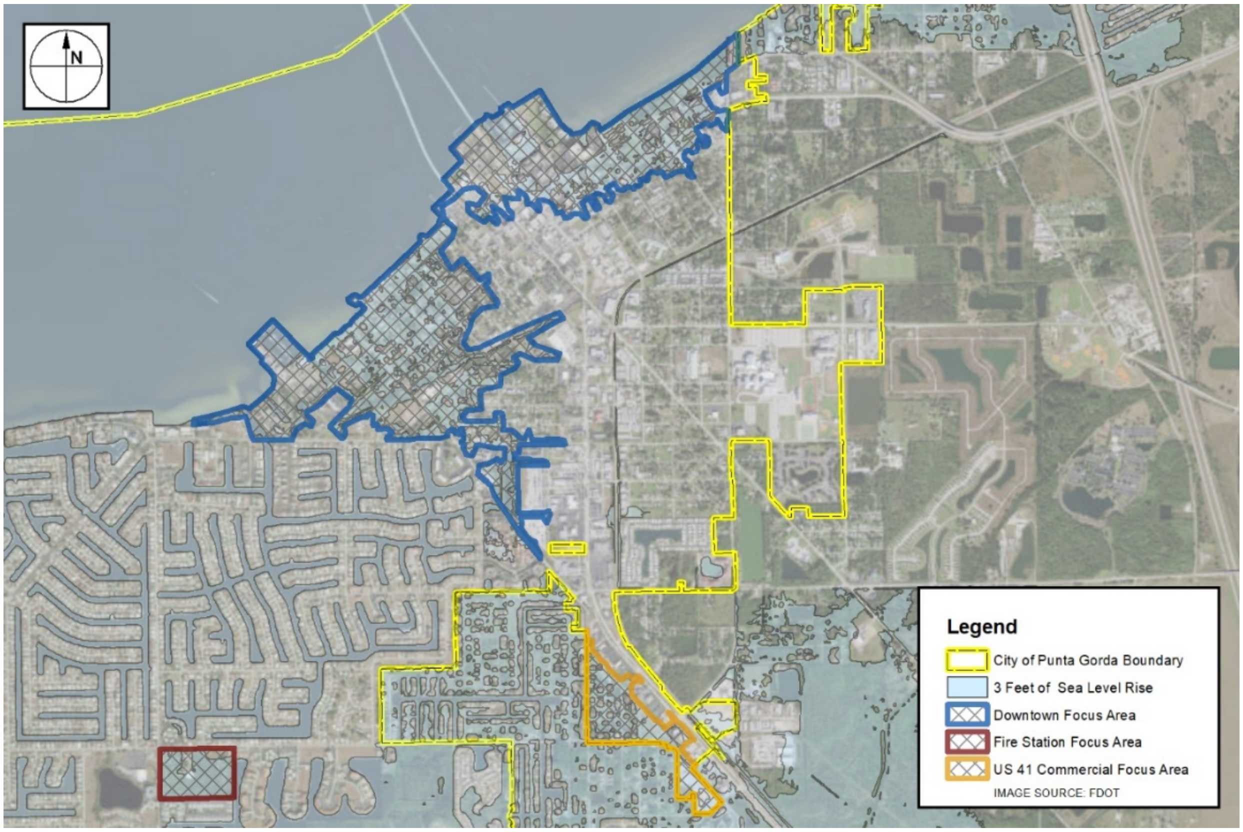



**Figure 4.1** Overview of Adaptation Focus Areas

The Downtown Focus Area, shown in Figure 4.2, borders the confluence of the Peace River with Charlotte Harbor and encompasses 423 total acres with approximately 226 acres (54%) being inundated by 3 feet of sea level rise. This focus area includes the downtown core of outdoor cafes, restaurants, art galleries, shops, and hotels, all of which are essential to the city's economy. Citizens and tourists are drawn to features like Fisherman's Village, the Harborwalk, Linear Park, Charlotte County Event and Conference Center, and Laishley Park Municipal Marina.

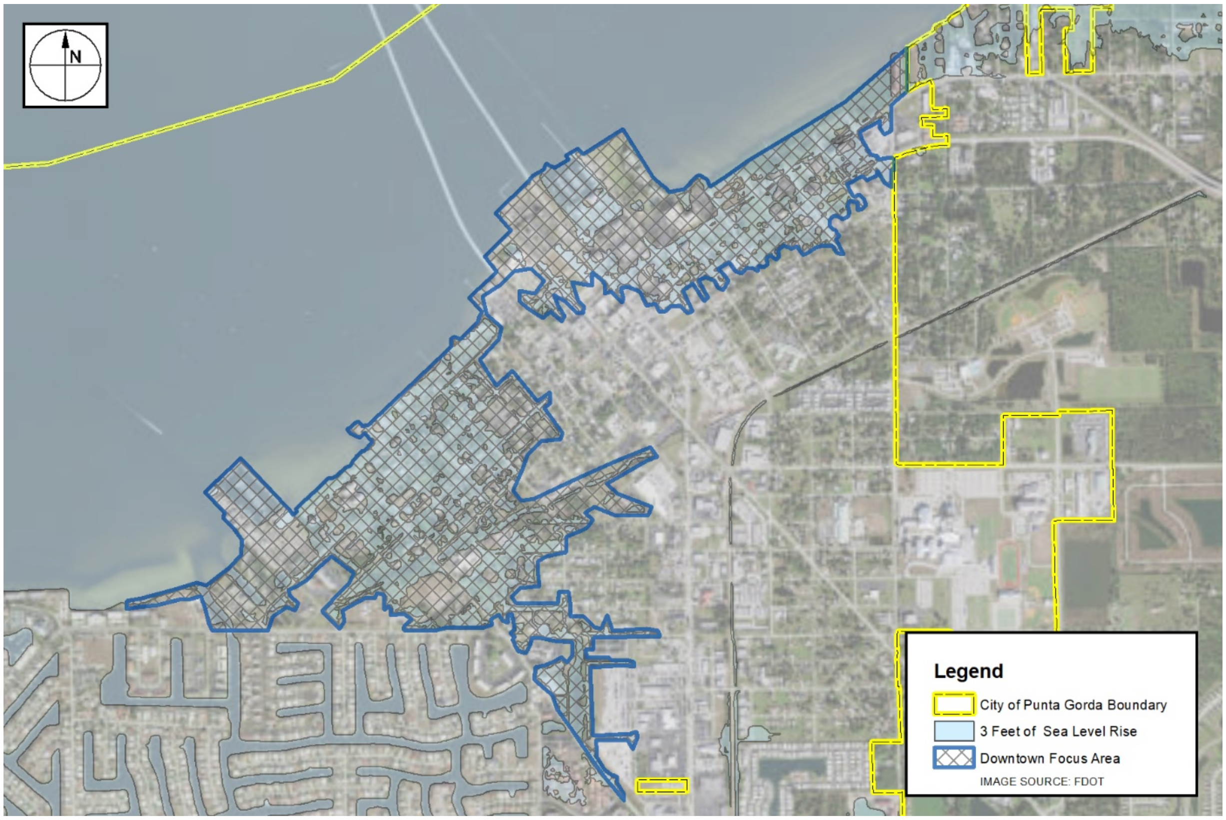



**Figure 4.2** Close-up of the Downtown Adaptation Focus Area

The eastern portion of the Downtown Focus Area proves vital to the citizens of Punta Gorda due to the concentration of medical services located here, anchored by the Bayfront Health Hospital. The hospital is the critical facility within city limits which was prioritized highest by the public workshop participants. This area also contains corridors for US Route 41 and US Route 17 that serve as major thoroughfares and emergency evacuation routes. Florida Department of Transportation (FDOT) maintains both roads.

In the western part of the Downtown Focus Area exists a high concentration of historically designated buildings both publicly and privately owned. A portion of this region is designated as a historic district by the National Register of Historic Places. In addition to the area's historic assets, this area contains a high concentration of publicly owned parcels and provides access to US 41.

The Fire Station Focus Area presented in Figure 4.3 is the second and smallest focus area. It is located in the southern portion of the Punta Gorda Isles neighborhood, on Aqui Esta Drive. The district name is derived from Punta Gorda's Fire Department Station Number 3, which is the primary structure located within. A city-owned nature park and water tower comprise the remaining area, with a canal located along the eastern border. All of the property in this focus area is owned by the city. Vulnerability analysis shows that of the 26 acres within this focus area, 21 acres (nearly 81%) would be inundated at 3 feet of sea level rise.

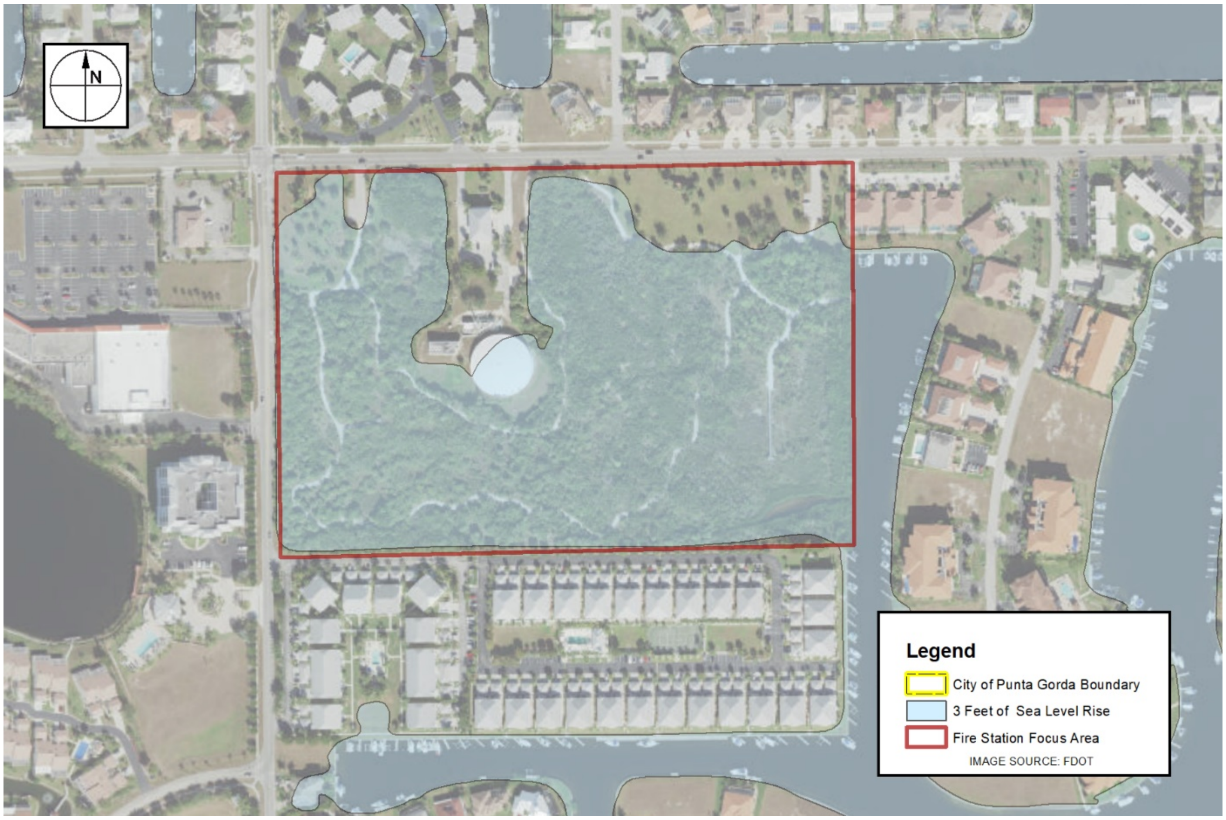



**Figure 4.3** Close-up of the Fire Station Adaptation Focus Area

The US 41 Commercial Focus Area presented in Figure 4.4 is the third and final focus area. It is located between US 41 and a section of canal neighborhoods along the City's border. This focus area totals 41 acres of private land with 35 areas (75%) being inundated at 3 feet of sea level rise. There is no publicly owned property or critical facilities located within this area, however it borders a critical evacuation route and CSX-owned railroad line. This area was chosen as an adaptation focus area due to its high ratio of flooded to non-flooded property at 3 ft of sea level rise.

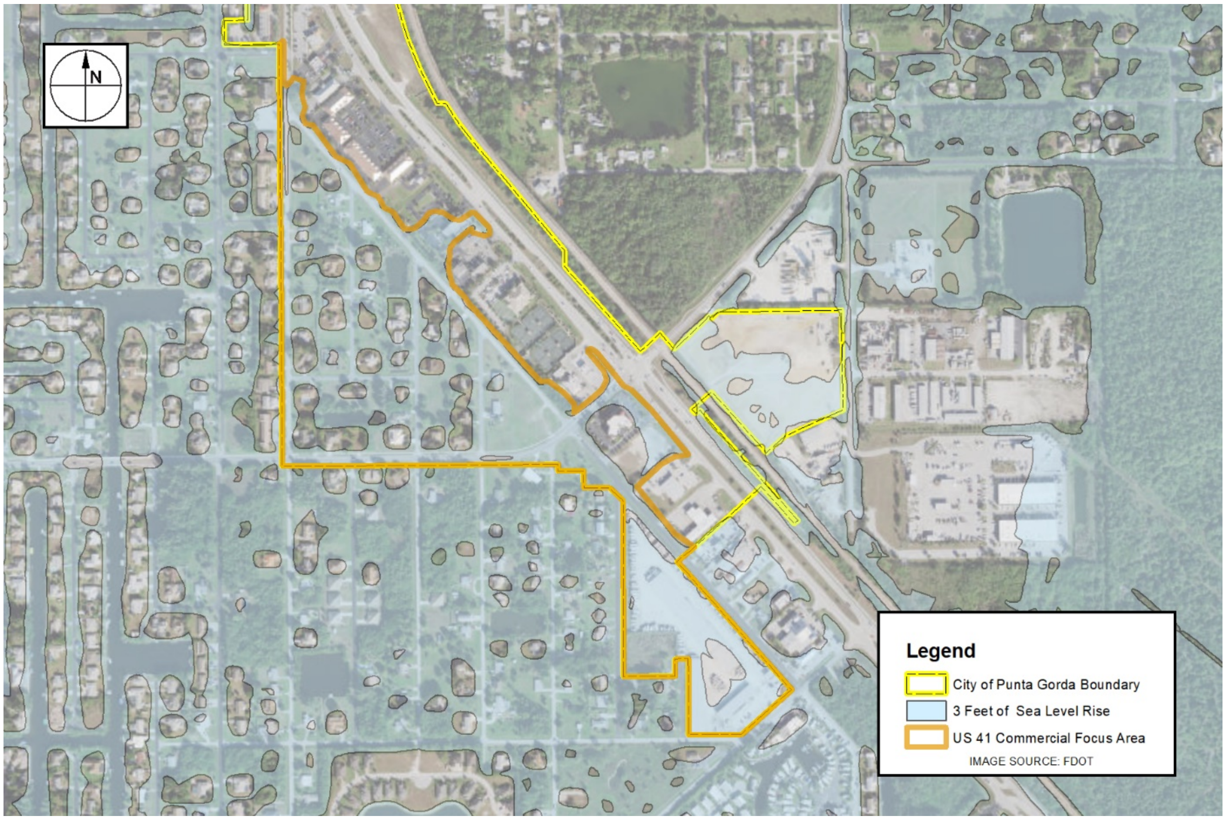



**Figure 4.4** Close-up of US 41 Commercial Adaptation Focus Area

Table 4.1 presents a summary of the numbers of essential facilities and historic buildings within each of the Focus Areas. The highest concentration of critical infrastructure is located within the Downtown Focus Area, and most concentrated in the southern portion of this region. The table also highlights the total acreage in each area and the percent of acreage which is inundated at 3 feet of sea level rise. The high percentage of flooding in the Fire Station and US 41 Commercial Focus Areas shows the importance of selecting these regions as adaptation focus areas.

**Table 4.1** Summary of Adaptation Focus Area Vulnerabilities at 3 ft of Sea Level Rise

| Focus Area | Essential Infrastructure | Historic Buildings | Publicly Owned Parcels | Total Acres | Acres Inundated | Percent Flooded |
|---|---|---|---|---|---|---|
| Downtown | 3 | 10 | 86 | 423 | 226 | 54% |
| Fire Station | 1 | 0 | 6 | 26 | 21 | 81% |
| Commercial | 0 | 0 | 0 | 47 | 35 | 75% |

## 4.3 Current Adaptation Strategies Implemented

The City of Punta Gorda, due to its proximity to the Gulf of Mexico, Charlotte Harbor, and the Peace River, is exposed to potential flood hazards from storm induced surge, rain events, and extreme tides, all of which are exacerbated by sea level rise. Because the City has experienced these flood hazards before, many adaptation strategies are already in place and well-functioning. Keeping the City resilient to future climate change requires affirming these current strategies and expanding on them. In order to inspire the continuation and development of innovative strategies, the City's current adaptations is discussed below.


**Figure 4.5** Punta Gorda Nature Park

As outlined in the Center for Climate Strategies Adaptation Guidebook, mapping vulnerable areas and developing buyouts for these lands is a central adaptation strategy (CCS 2011). The City has embraced this concept, beginning with its founder, Colonel Isaac Trabue, who required that all waterfront blocks remain undeveloped for City parks. By purchasing much of the waterfront and low-lying flood prone areas and converting them to park lands, Colonel Trabue laid the groundwork for a resilient city. The Punta Gorda Nature Park (Figure 4.5) is an example of publicly owned space that is vulnerable to flooding, but allowed to stay primarily in its natural state. Ponce De Leon Park, Trabue Park, Laishley Park, Alice Park, Shreve Park, and Gilchrist Park are other parks that act as a buffer for the city from the waters of the Peace River.

In addition to City managed parks, Charlotte Harbor Preserve State Park (Figure 4.6) hugs the perimeter of the City of Punta Gorda's southwest border. This 45,387 acre Florida State Park protects more than 100 miles of shoreline along Charlotte Harbor in Charlotte and Lee Counties

(FDEP 2019). This natural barrier is the City's first defense again dynamic wave action, rising waters, and storm surge.

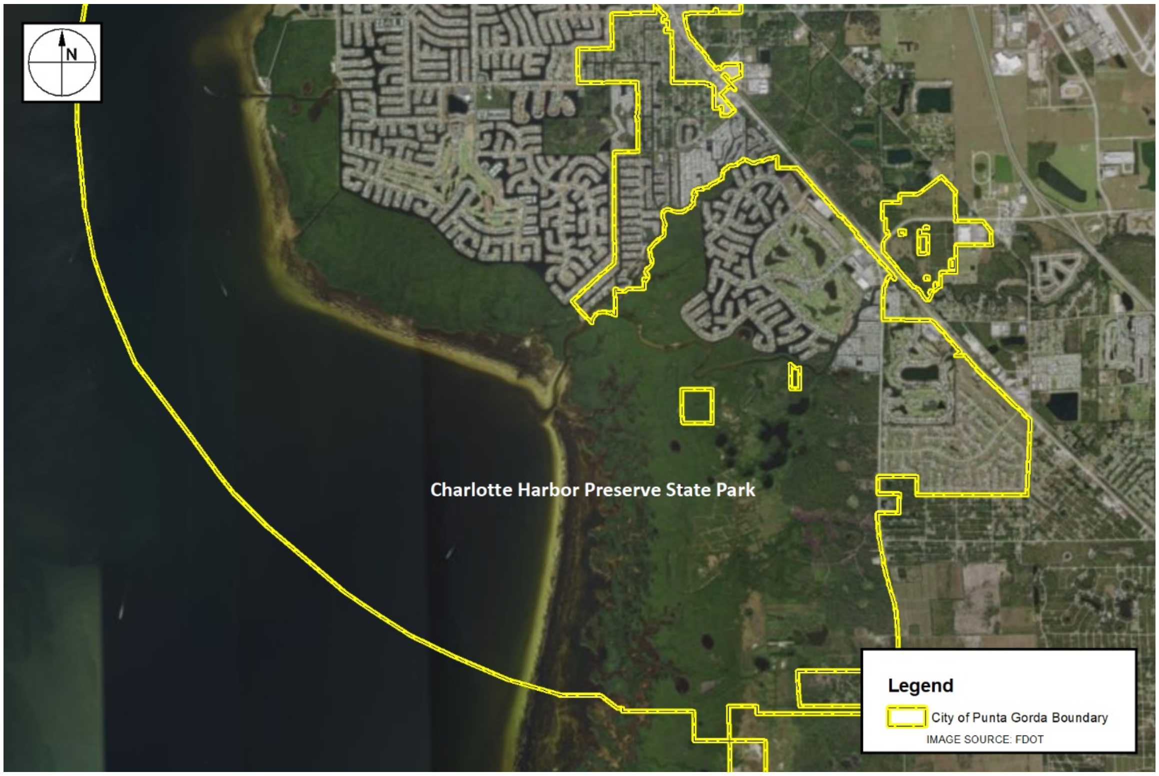



**Figure 4.6** Charlotte Harbor Preserve State Park

The implementation of living shorelines is an important addition to low wave energy coastal regions. This adaptation strategy is an erosion control technique that combines coastal habitats with natural or engineered structured systems to break up wave energy. Unlike traditional erosion control structures, such as bulkheads or seawalls that focus on deflecting wave energy away from a site and may increase erosion, living shorelines reduce energy and permit natural processes that maintain the health of the broader coastal system. These shorelines reduce the rate of surface water flow and temporarily store flood waters much like a sponge. Often referred to as nature's kidneys, these living shorelines filter and trap sediments and pollutants, increase dissolved oxygen levels, and reduce nutrient levels improving the overall water quality. Appendix C provides technical guidance for living shorelines in Punta Gorda.

Currently, the City of Punta Gorda has numerous living shorelines in place in varying states of developments. These adaptations range from naturally occurring mangrove forests that thrive on the water's edge to juvenile mangroves transforming a 'grey' strategy into a green one that will eventually adapt to changes in the sea level. The city has also implemented living shorelines in the form of oyster beds that not only provide long term protection for the shoreline, but also enhance the ecological habitat in the region (Photograph 4.1). These artificial oyster reefs pictured provide protective benefits to the shoreline while also creating habitat and recruiting species to the surrounding waters. These reefs were installed by volunteers led by the Charlotte Harbor National Estuary Partnership (CHNEP) as a community resilience initiative.

**Photograph 4.1** Artificial Oyster Reefs Implemented by CHNEP

When stormwater drains become inundated due to high water levels from a combination of high tide, onshore winds, stormwater runoff, and sea level rise, these waters travel into the stormwater pipes and can cause “sunny day” or “nuisance” flooding. In order to combat this type of flooding, the City of Punta Gorda installed ten check valves, called TideFlex duckbill valves (Photograph 4.2). As of May 2019, these valves have been installed in the stormwater infrastructure at Chasteen Street South, Berry Street South, West Retta Esplanade, Berry Street North, Dooly Street, Chasten Street North, McGregor Street, Nesbit Street, Milus Street, and M.L. King (Figure 4.7).

**Photograph 4.2** Stormwater Check Valve for Backflow Prevention


**Figure 4.7** City of Punta Gorda TideFlex Valve Locations

These check valves provide prevent backflow, only allowing water to flow out of the stormwater drains when enough line pressure exists in the discharge pipe.

Site and building specific adaptation strategies are already implemented at many publicly owned buildings within the City of Punta Gorda, as well as in the Historic District. Simply elevating critical electrical and mechanical elements of vulnerable buildings can be a cost-effective way to avoid damage caused by flooding as seen in Photograph 4.3. If possible, the entire structure can be elevated above the flood levels expected at future sea level rise scenarios. Many of the historic homes in the city use this adaptation strategy.

**Photograph 4.3** Elevation of Backup Generator at Historic Charlotte County Courthouse

A relatively low-cost option to retrofit an existing structure to withstand flood damage is wet floodproofing. In this alternative, the crawlspace, basement, or attached garage of a building is adapted to allow water to flow into it, flooding the structure as the water rises. An advantage of this option is that the building does not sustain extensive structural damage since the hydrostatic pressure of the water pushing on the building's exterior walls is equalized by the water pressure inside the building. This method also prevents a house from becoming buoyant and floating off its foundation. Many of the low-lying public restrooms situated along the waterfront in the City of Punta Gorda were built or retrofit with this adaptation measure (Photograph 4.4).

**Photograph 4.4** Flood Vents for Wet Floodproofing at Gilchrist Park

Another relatively cost-effective measure to prevent flood damage is dry floodproofing where the building is sealed to prevent water from entering. The only type of construction that can be used in dry floodproofing is masonry. Dry floodproofing may only be used for retrofitting structures which are on a concrete slab or have a crawlspace. It is not recommended in a beachfront area which is subject to excessive wind and wave forces due to hurricanes. It is also not recommended in an area which is subject to flash flooding or moderate to fast velocity flooding. An example of dry floodproofing is shown in Photograph 4.5

**Photograph 4.5** Dry Floodproofed Mechanical Systems at County Tax Collector's Office

## 4.4 Recommended Strategies for Focus Areas

Specific recommended adaptation strategies are provided for each of the Adaptation Focus Areas defined in Section 4.2. The strategies discussed here refer to those listed in Appendix B and Section 4.1.

### 4.4.1 *Downtown Focus Area*

The Punta Gorda Downtown Focus Area is the largest of the three focus areas and contains the most critical facilities, most historically significant buildings, and largest number of publicly owned parcels compared to the other focus areas. In addition, this area contains both US 41 and Highway 17, which provide important emergency evacuation routes for the city.

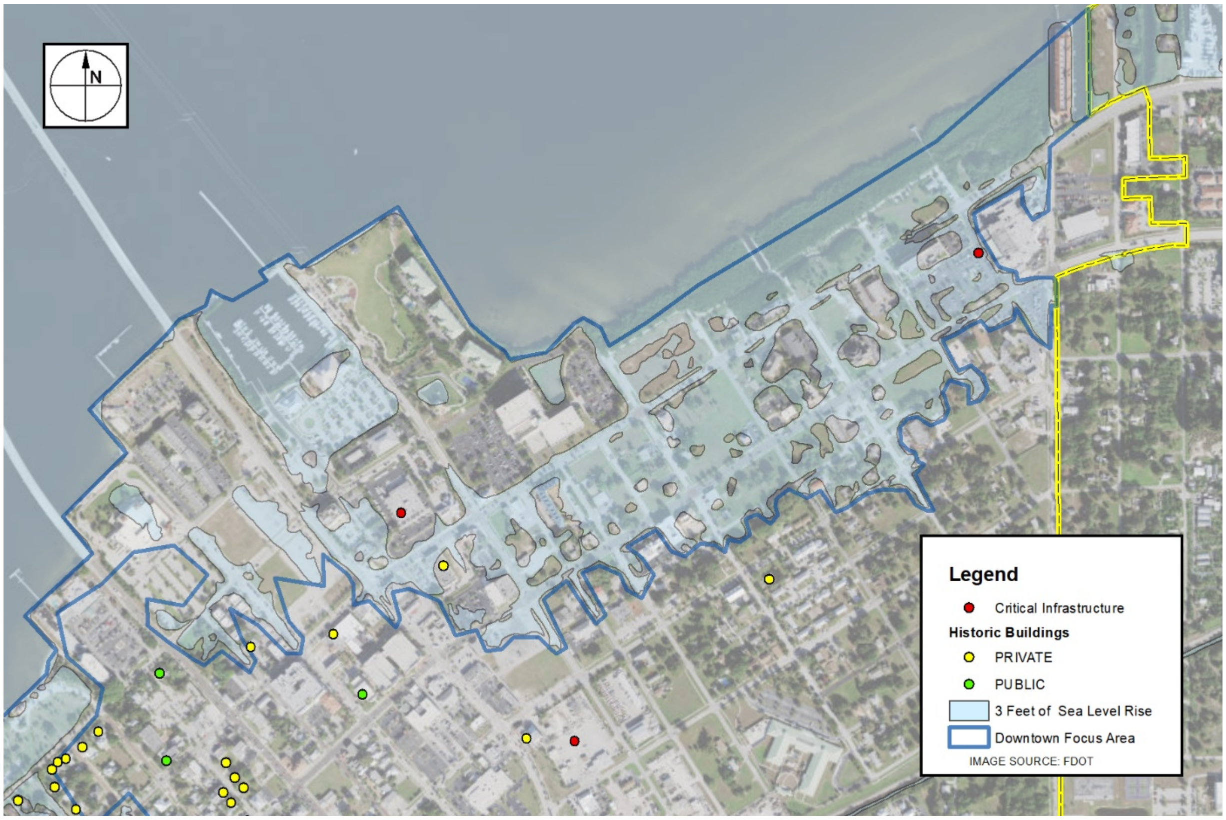



**Figure 4.8** Downtown Focus Area, East of US 41

The critical infrastructure in this focus area which is affected by 3 feet of sea level rise include the privately-owned Bayfront Health Hospital, the United States Postal Service office, and a wastewater lift station on McGregor Street. None of these properties are fully inundated at 3 feet of sea level rise, however transportation to them would be impeded by roadways that are flooded. It is also important to note that the Punta Gorda wastewater station and tanks on Henry Street are not included in this focus area but may be of importance in future city planning.

The flooding of the access roads and properties surrounding Bayfront Health Hospital are the most concerning of the issues in the eastern portion of the Downtown Focus Area (Figure 4.8).

*Bayfront Health located within one block of the river (https://www.bayfrontcharlotte.com/punta-gorda)*

Without accurate FFE for the privately-owned hospital, it is unclear whether the building would be flooded at 3 ft of sea level rise, but transportation to and from the hospital would be hindered at this flood scenario. While the Managed Retreat/Relocation strategy is the most prudent recommendation for this critical facility, it may not be economically feasible in the short-term but is the most practical long-term adaptation option. For the intermediate time frame, the 1.5 ft sea level rise scenario shows the inundation does not extend south of westbound US 17 (Marion Avenue). Therefore, the facilities south of Marion Avenue are not immediately threatened by sea level rise, but are at risk of flooding due to storm surge and extreme rain events.

If the hospital, McGregor Street lift station, and United States Postal Service office remain in their current locations, long-term protection strategies should be further investigated. One protective action could be to raise a portion of Marion Avenue from Cooper Street westward to US 41 North to an elevation high enough to act as a physical barrier to water flowing in from the coast. Another recommended protection strategy involves using temporary emergency flood barriers at each low-lying entrance to the hospital, due to the hospital's proximity to the Peace River.

Sandbags can be used as a temporary flood barrier but are not recommended as they have the disadvantage of potentially transforming the sand to hazardous material once saturated by floodwaters which contain a multitude of toxins. Another drawback of a temporary flood barrier is the inaccessibility to the building once deployed, which is not ideal for an essential hospital emergency room.

The "green boundary" which the City of Punta Gorda maintains on the northern coast of the downtown focus area is beneficial not only for beautifying the city and enhancing shoreline habitats, but also for protecting inland properties from wave damage due to storms. Due to sea level rise, flooding caused by storm events starts from a higher baseline water level than in the past. For example, if a storm identical to Hurricane Donna were to occur in 2019, the storm surge would be approximately 7 inches higher merely due to sea level rise. The harmful wind-driven waves which accompany a hurricane are proven to dissipate as they travel over vegetation. The same wind-driven waves build in size when traveling over open paved areas, such as roads and parking lots. Thus, a coast lined with vegetation such as mangroves and cordgrass reacts better at slowing dynamic wave action than one lined with vertical seawalls and roads.

The City of Punta Gorda's waterfront parks are an adaptation strategy which works and can be expanded. We recommend that additional vegetation be added along the coastline offshore of the City's waterfront parks to enhance the city's resilience to flood events. Adding living shorelines offshore of existing seawalls helps to reduce waves impacting the coast and potentially damaging inland property We also recommend encouraging mangrove growth by properly and minimally trimming mangroves, according to FDEP regulations. Appendix C provides technical guidance specific to the City of Punta Gorda for the proper design, location, and construction of living shoreline measures.

*Mangroves Planted Offshore of a Concrete Seawall (www.floridalivingshorelines.com)*

The western portion of the Downtown Focus Area (Figure 4.9) includes the Historic District and contains the highest concentration of historic properties in the city. This area is low-lying and especially prone to flooding. Many houses in this area were elevated after Hurricane Charley, most likely due to FEMA's National Flood Insurance Program (NFIP) rules for substantial damage. If a structure located in a FEMA Special Flood Hazard Area (SFHA) is determined to be substantially damaged, it must be brought into compliance with local floodplain management regulations. These regulations typically require either the elevation at some height relative to the Base Flood Elevation (BFE) or possibly floodproofing the structure (FEMA 2019). While elevating a house is an acceptable adaptation option which falls into the Accommodate category, it changes the character of the neighborhood and is not always an ideal option.

An alternative adaptation strategy for substantially damaged or repetitive loss properties is for the municipality to buy the property, demolish it, convert it into a park or other public space, and change the zoning to prohibit others from building on it. Another policy-driven strategy is the identification of Adaptation Action Areas (AAA) which allow a local government to prioritize funding and potentially apply for specialized grants for those areas at high flood risk due to sea level rise. AAAs are different from the Coastal High Hazard Area (CHHA), but some cities in Florida have combined the two designations, creating AAAs from CHHAs. CHHAs are defined by FEMA as SFHAs along the coasts that have additional hazards due to wind and wave action. These areas are identified on Flood Insurance Rate Maps (FIRMs) as zones V or VE (FEMA 2019).

We recommend the two policy changes discussed in the previous paragraph for consideration for the Downtown Focus Area, especially the western portion where many historic buildings exist. The preservation of the integrity of this unique district classified by the National Register of Historic Properties should advance prioritization of this area for future policy amendments, either in the City's Comprehensive Plan, or other planning documents.

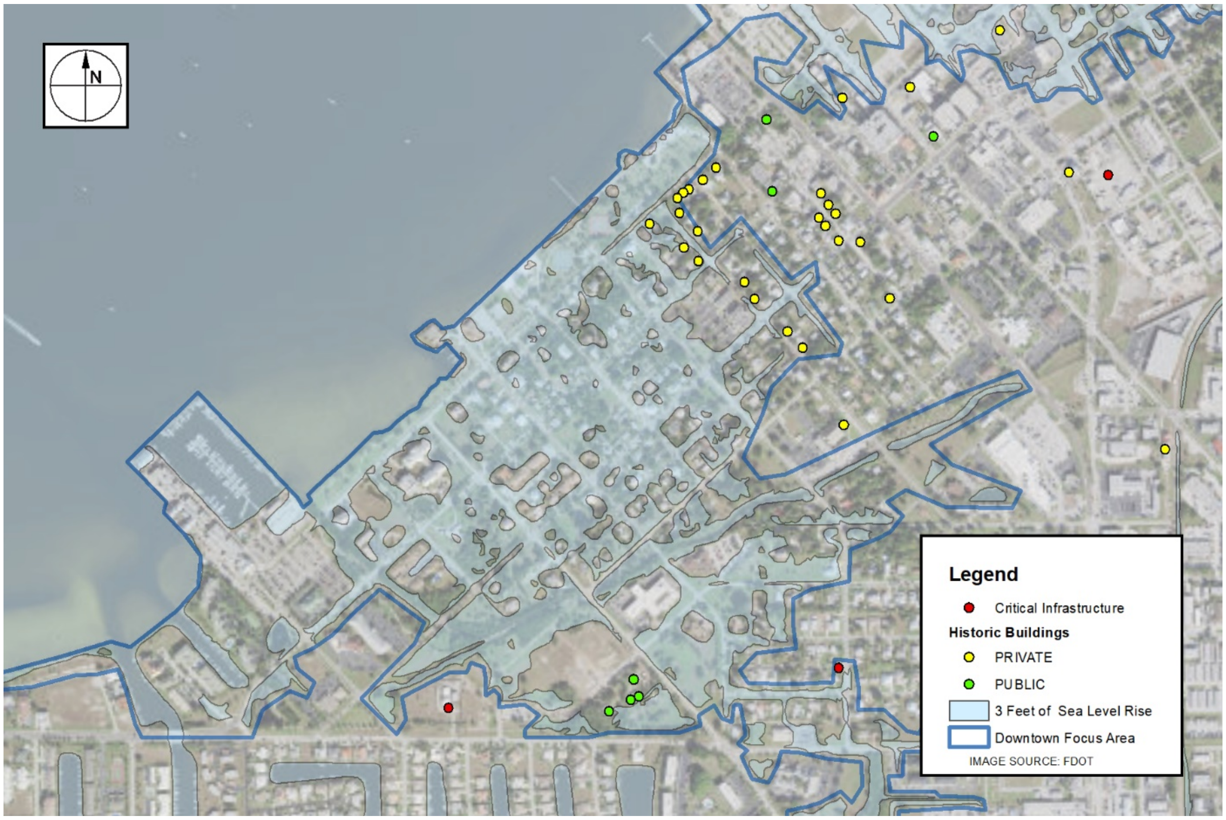



**Figure 4.9** Downtown Focus Area, West of US 41

The southwest corner of the Downtown Focus Area, when modeled with 3 feet of sea level rise, shows potential vulnerability to flooding and requires adaptive measures. The canal located between Shreve Street and Magdalena Street at the center of Figure 4.10 is tidally influenced and allows water to backflow into the adjacent properties. A possible short-term strategy to prevent flooding in this area is the installation of one-way stormwater valves which only allow the flow of water in one direction. These check valves, discussed in Section 4.3, allow stormwater to flow out, but prevent backflow from the canal due to high tides, storm surge, or sea level rise.

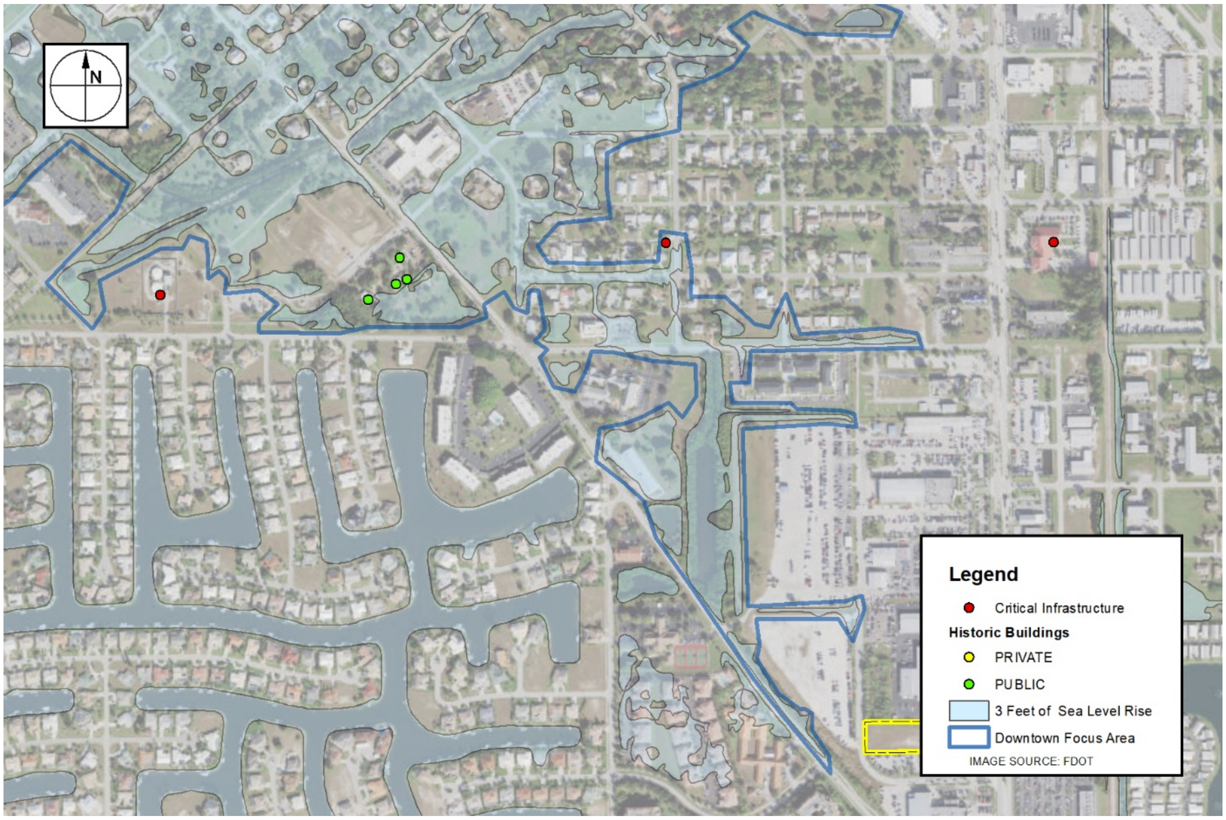



**Figure 4.10** Downtown Focus Area, Southwest Near the Punta Gorda Library

A possible long-term solution to combat flooding in this area is the installation of wet wells in conjunction with pumps (Figure 4.11). While underground cisterns for stormwater are not normally considered in Florida due to the high water table, this adaptation option should be considered.

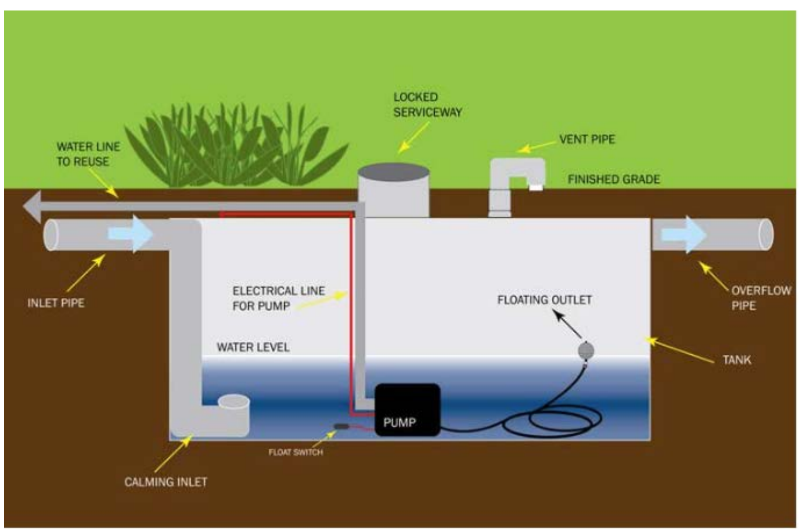



**Figure 4.11** Typical Components of an Underground Rainwater Cistern
*(Source: www.conteches.com)*

For this specific canal area, the city has an easement along the south side of Henry St adjacent to the Good Shepherd Preschool and across the street from the Punta Gorda Library. The easement appears to be a swale for stormwater runoff with an adjacent berm. This swale, a linear depression running parallel to the road, is likely to overflow due to high tide or storm surge, since it's tidally connected to the canal. For a long-term adaptation solution, we suggest replacing this swale with a buried high-capacity stormwater pipe with a check valve, or investigate using a system of linear cisterns.

These stormwater improvements suggested above could possibly provide protection again future flooding within this focus area but would require further study of the watershed which feeds these stormwater components. Specifically, the elevation of all stormwater outfalls should be assessed as part of a stormwater master plan review and these elevations compared to future sea level rise scenarios. The addition of numerous check valves where the stormwater system interfaces with a tidally influenced water body may provide for a short-term solution. Long-term solutions, although expensive, include removing swales to prevent overflow of floodwater to adjacent properties and creating wet wells with pumps for temporary storage of stormwater. Cisterns for storing excess stormwater runoff could be incorporated under city-owned parking lots or open park space.

The complexity of factors that contribute to coastal flooding should be analyzed in order to fully address the city's specific vulnerabilities. As the sea level rises, storm water infrastructure that relies on gravity to move water through the pipes can be compromised as the outfalls are partially or completely submerged (Figure 4.12). A high-water event combined with sea level rise can prolong storm induced flooding. This prolonged exposure to saltwater can cause damage to the city's stormwater infrastructure.

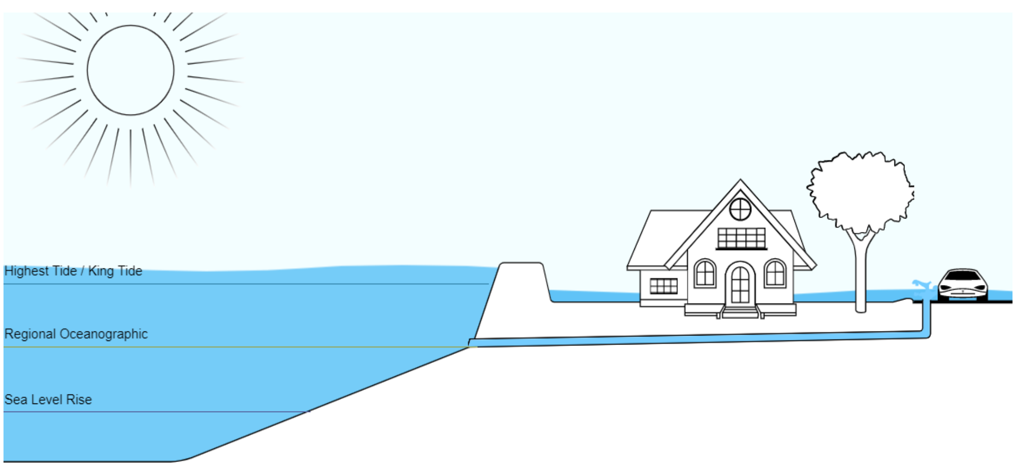



**Figure 4.12** Coastal Flooding due to Stormwater Drainage Inundation
*(https://coast.noaa.gov/stormwater-floods/understand/)*

Currently, the City of Punta Gorda infrequently experiences nuisance flooding during king tides. Due to the City's extensive tidally influenced canals and the proximity to Charlotte Harbor, the frequency of this flooding will increase over time as sea level rises. Therefore, the city should address and implement stormwater management improvements throughout this focus area.

### 4.4.2 *US 41 Commercial Focus Area*

The US 41 Commercial Focus Area poses a unique challenge for applying adaptation strategies due to its location on the edge of the city limits. The City of Punta Gorda's boundary causes this focus area to be a peninsula surrounded by Charlotte County property. Since US 41 runs northwest through this focus area, it provides a significant degree of linear protection against flooding originating from the northwest. Due to FDOT roadway construction elevation standards that range between 5 and 6 ft NAVD, the primary flood exposure to this area is from the southwest. The main source of flood water in this focus area is from water overtopping low lying areas that are hydrologically connected to the Punta Gorda Canal System.

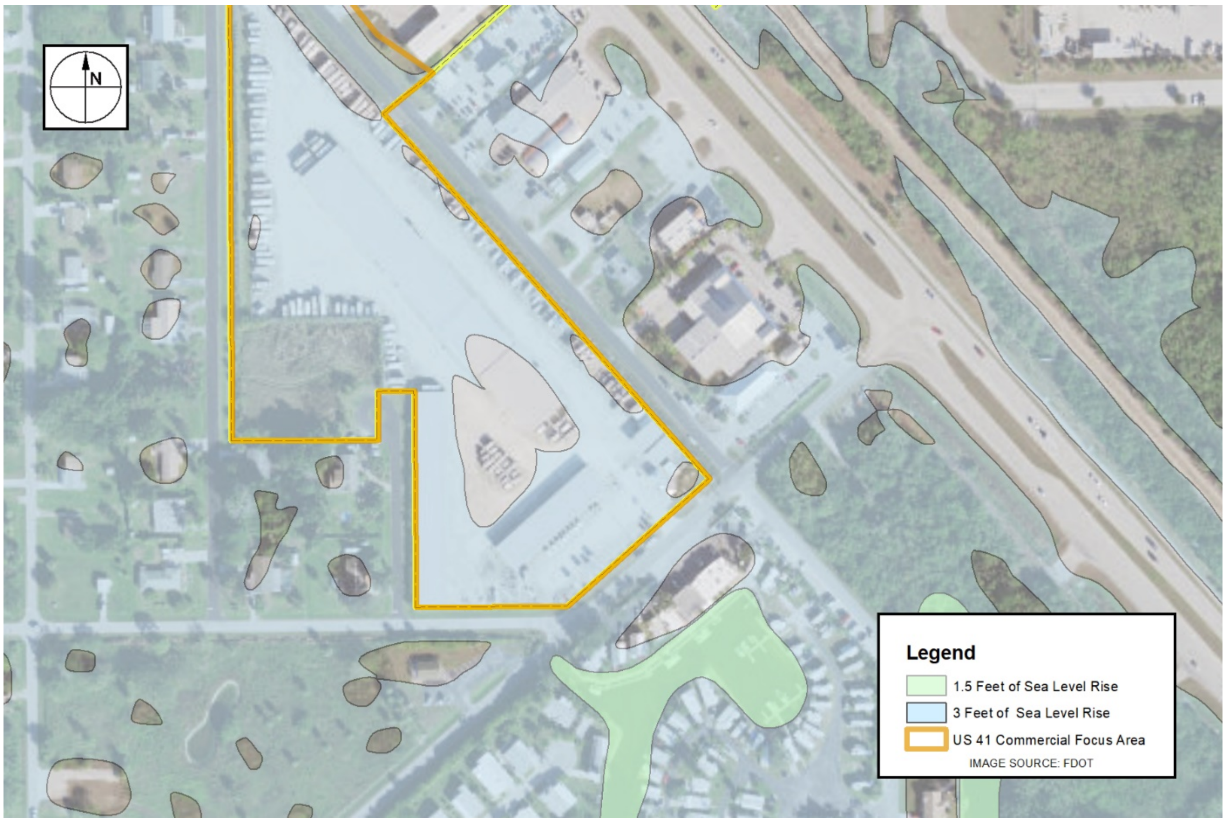



**Figure 4.13** US 41 Commercial Focus Area, South

The most significant vulnerability in this focus area is first shown at 1.5 ft of sea level rise and is exacerbated at 3 ft of sea level rise. A canal leading to the Punta Gorda RV Resort intersects a low-lying area on Rio Villa Drive at the border of the City of Punta Gorda and Charlotte County (Figure 4.13). At 3 ft of sea level rise, this canal allows water to overtop the roadway and move into the City of Punta Gorda Boundaries. Currently, there are two shallow swales on either side of Rio Villa Drive that provide drainage for the area.

Future adaptation strategies for this issue will require coordination with Charlotte County and could include a variety of measures. An available short-term solution for this problematic area would be to deepen the two swales that already exist giving the storm water and rising water due to sea level rise a path to follow. Unfortunately, this is only a short term or "band aid" solution. The City could also implement large catch basins and pumps to collect and disperse water from these areas or use these two strategies in concert. Finally, the City could recommend that Charlotte County raise the seawalls in the canal system in the Punta Gorda RV Park to prevent water from overtopping this system.

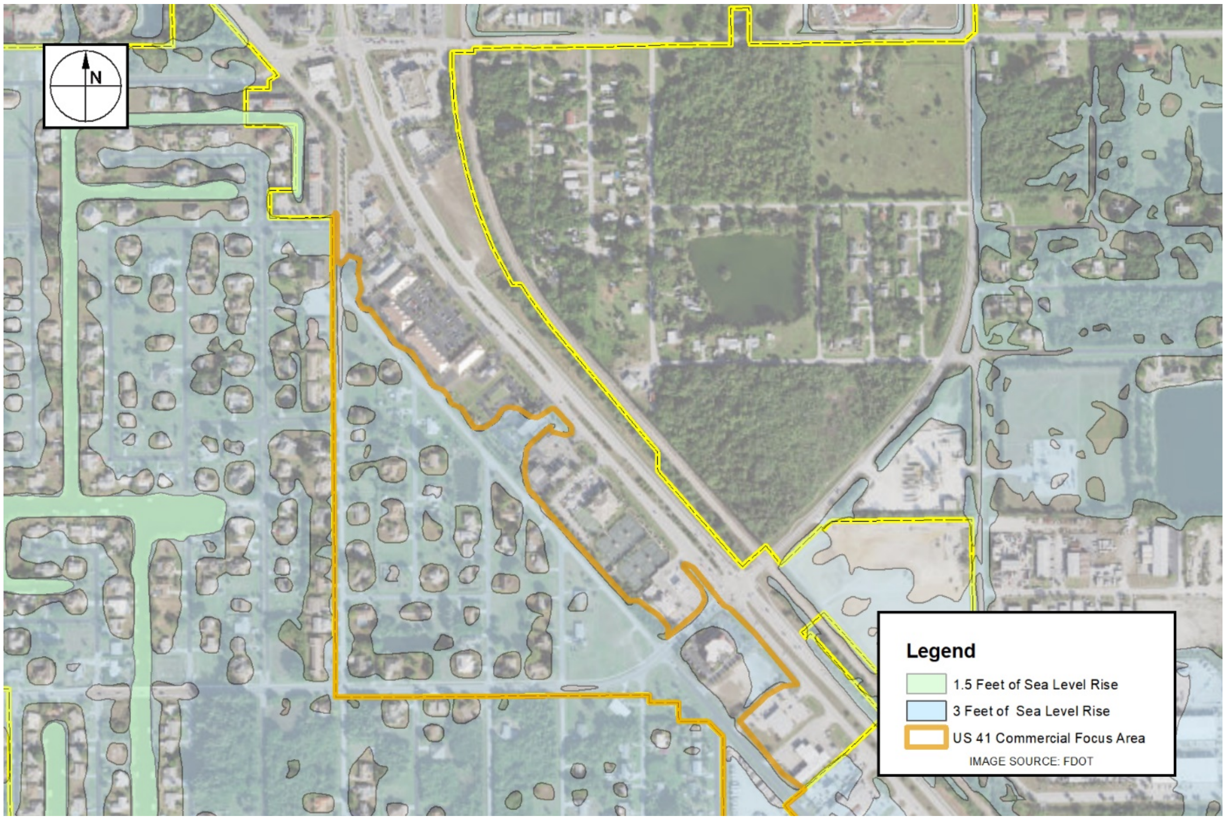



**Figure 4.14** US 41 Commercial Focus Area, North

The second identified vulnerable area is located at the southwest border of the US 41 Commercial Focus Area (Figure 4.14). As the sea level rises to 3 ft, the water appears to overtop many of the neighborhood canal systems and hydrologically move to areas of low land elevation. In order to prevent this flooding, it will again require coordination with Charlotte County since most of the flood water appears to originate from outside the Punta Gorda city limits. Possible adaptation strategies include raising the sea walls within the canal systems, installing robust catch basins and pumping stations, or buying out and rededicating this vulnerable area to natural open space.

Both vulnerable zones in this focus area could benefit from long-term monitoring of water levels within the canal system as well as monitoring and data collection of conditions during events that could stress the current system. Creating a robust system to monitor points of vulnerability during extreme tides, storm induced surge, and rain could be beneficial for better understanding how the current systems perform under these conditions and aid in future long term planning.

### 4.4.3 *Fire Station Focus Area*

The Fire Station Focus Area offers the City of Punta Gorda a unique opportunity to continue the preservation of city owned land as natural parks. Punta Gorda Nature Park currently occupies most of this focus area and provides a buffer for the centrally located buildings and water tank. As an adaptive strategy, we recommend that the city retains this vulnerable area as predominantly nature park land and restrict any further development in this area.


**Figure 4.15** Fire Station III Focus Area

Since Fire Department Station III is already located on this portion on land and its central location in the Punta Gorda Isles neighborhood is vital to the efficient emergency response for its citizens, the City of Punta Gorda must protect the station from future higher water levels. At 3 ft of sea level rise, Fire Station III will not be susceptible to flooding due to its 5.9 ft FFE and 5.84 LAG (all elevations in NAVD88). The two cross streets which provide access to the Fire Station, Aqui Esta Drive and Bal Harbor Boulevard also remain above water in the 3 feet sea level rise scenario.

In addition to retaining the designation to park land, the City could also raise the borders of the canal system that acts as a barrier to the tidally influenced waters contained within and that eventually connect to the Gulf of Mexico. Again, monitoring water levels at these vulnerable areas would be helpful to understand storm effects. Enhancing and monitoring the mangrove living shoreline on the east side of the focus area is recommended.

# 5.0 RECOMMENDATIONS

## 5.1 Suggested Changes to Comprehensive Plan

This section contains specific language to be added to the City's Comprehensive Plan, written in the format of Punta Gorda's current plan.

GOAL 2B.7: Coastal Resilience: To increase the City's resilience to the impacts of climate change and sea level rise by developing and implementing adaptation strategies and measures in order to protect human life, natural systems and resources and adapt public infrastructure, services, and public and private property.

Objective 2B.7.1: Punta Gorda will develop and implement adaptation strategies for areas vulnerable to coastal flooding, tidal events, storm surge, flash floods, stormwater runoff, salt water intrusion and other impacts related to climate change or exacerbated by sea level rise, with the intent to increase the City's comprehensive adaptability and resiliency capacities.

*Measurement: Identify public investments, infrastructure and assets at risk from rising sea levels, and develop adaptation strategies for vulnerable areas and assets.*

Policy 2B.7.1.1: Identify public investments and infrastructure at risk to sea level rise and other climate related impacts. Assess the vulnerability to public facilities and services, including but not limited to water and wastewater facilities, stormwater systems, roads, bridges, governmental buildings, hospitals, transit infrastructure and other assets.

Policy 2B.7.1.2: Adaptation strategies may include, but not be limited to:

a. Accommodation
b. Protection
c. Managed retreat/relocation
d. Other strategies

Objective 2B.7.2: The City will consider identifying and designating Adaptation Action Areas (AAAs), as provided by Section 163.3164(1), Florida Statutes. The City will develop specific adaptation strategies for properties located in AAAs.

*Measurement: Identify and designate areas within the City which are at risk from coastal flooding and prioritize funding for infrastructure and adaptation planning for these AAAs.*

Policy 2B.7.1.4.: Considerations for AAA designation may include, but not be limited to:

a. Areas which experience tidal flooding
b. Areas which have a hydrological connection to coastal waters
c. Locations which are within areas designated as evacuation zones for storm surge

d. Other areas impacted by stormwater/flood control issues

Policy 2B.7.1.5: As a basis for the designation of AAAs, the City will utilize the best available data and resources in order to identify and understand the risks, vulnerabilities and opportunities to formulate timely and effective adaptation strategies.

## 5.2 Future Work Needed

We recommend that that the City of Punta Gorda acquire updated LiDAR data and more complete FFE data for publicly-owned buildings. The lack of elevation data for Charlotte County schools and Punta Gorda Housing Authority properties hindered a more complete vulnerability study. Similar data for federal and state-owned property within the city limits, which are not included in this study, would result in a more comprehensive analysis. Additionally, the elevations of critical roadways, particularly evacuation routes, should be added for further adaptation planning.

The climate adaptation plan should be maintained and updated periodically as a 'living document' that continually evolves. Updates to the IPCC, National Climate Assessment, and sea level rise projections are published every 5 to 7 years; with the next update of the IPCC anticipated in 2021. As those updates become available, the City should re-evaluate flood thresholds used in this vulnerability analysis. The three storm surge scenarios of 4%, 1%, and 0.2% annual chance showed fairly similar inundation areas. We recommend using a higher frequency flood, such as the 10% annual chance flood, for future work.

Given the amount of water frontage and available City owned park space, we recommend that the City develop a living shoreline pilot study at Laishley Park, using the technical guidance document found in Appendix C. We also recommend that any previously initiated and ongoing living shoreline studies be evaluated and modified to align with the criteria developed in the living shoreline guidance document.

We prepared a summary matrix (Appendix E) of funding alternatives, consisting of 21 potential grant options that fit the City's needs. We identified the top three grants that best align with the City's goals, objectives, and identified adaptation strategies. We recommend that the City pursue the grants listed below to update the Climate Adaptation plan with additional data outlined above, develop an implementation plan, and pursue development of a living shoreline pilot study.

### 5.2.1 *Recommended Grants*

**Florida Department of Environmental Protection (FDEP)**
Coastal Partnership Initiative (CPI) Grant Program
https://floridadep.gov/rcp/fcmp/content/grants

Funding limits: No more than $30,000 and no less than $10,000, for planning, design and coordination activities; and No more than $60,000 and no less than $10,000 for construction projects, habitat restoration, invasive exotic plant removal or land acquisition.

The Coastal Partnership Initiative grant program was developed to promote the protection and effective management of Florida's coastal resources at the local level. The Florida Coastal Management Program (FCMP) makes NOAA funds available, on a competitive basis, to eligible local governments. Eligible local governments are defined as Florida's 35 coastal counties and all municipalities within their boundaries that are required to include a coastal element in their local comprehensive plan. Florida's public colleges and universities, regional planning councils, national estuary programs and nonprofit groups also may apply if an eligible local government agrees to participate as a partner.

Each year, the FCMP publishes a CPI Brochure and a "Notice of Availability of Funds" in the Florida Administrative Register to solicit CPI applications from eligible entities. CPI grants provide support for innovative, local, coastal management projects in four program areas:

- Resilient Communities
- Public Access
- Working Waterfronts
- Coastal Stewardship

Eligible entities may apply for grants for community projects such as habitat restoration, park planning and improvements, waterfront revitalization, and improving communities' resiliency to coastal hazards.

**US Department of the Treasury**

The Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act of 2012 (RESTORE Act)
https://www.treasury.gov/services/restore-act/Pages/Direct%20Component/Direct-Component.aspx

The RESTORE Act established a new Trust Fund in the Treasury of the United States, known as the Gulf Coast Restoration Trust Fund. Eighty percent of the civil penalties paid after July 6, 2012, under the Federal Water Pollution Control Act in connection with the Deepwater Horizon oil spill will be deposited into the Trust Fund and invested.

The Department of the Treasury-administered Direct Component makes 35 percent of the civil penalties deposited into the Trust Fund available to four Gulf Coast states, 23 Florida counties, and 20 Louisiana parishes. The Direct Component is governed by the RESTORE Act final rule at 31 CFR Part 34, effective on February 12, 2016 after publication on December 14, 2015. Further, grant recipients under the RESTORE Act must comply with the guidance issued by the Office of Management and Budget entitled, "Part 200 – Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards" at 79 CFR 75880 (December 19, 2014.)

As provided in the RESTORE Act and final rule, activities, programs, and projects that are eligible for grants awarded under the Direct Component (eligible activities) include:

- Restoration and protection of the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches and coastal wetlands of the Gulf Coast Region;
- Mitigation of damage to fish, wildlife and natural resources;

- Implementation of a Federally approved marine, coastal, or comprehensive conservation management plan, including fisheries monitoring;
- Workforce development and job creation;
- Improvements to or on state parks located in coastal areas affected by the Deepwater Horizon oil spill;
- Infrastructure projects benefitting the economy or ecological resources, including port infrastructure;
- Coastal flood protection and related infrastructure;
- Planning assistance;
- Promotion of tourism in the Gulf Coast Region, including promotion of recreational fishing;
- Promotion of the consumption of seafood harvested from the Gulf Coast Region; and
- Administrative costs.

The RESTORE Act specifies who may apply to receive funds under the Direct Component, administered by Treasury. Treasury's regulations list the Direct Component eligible states, counties, and parishes who may apply:

- In Alabama, the Alabama Gulf Coast Recovery Council or such administrative agent as it may designate;
- In Florida, the Florida counties of Bay, Charlotte, Citrus, Collier, Dixie, Escambia, Franklin, Gulf, Hernando, Hillsborough, Jefferson, Lee, Levy, Manatee, Monroe, Okaloosa, Santa Rosa, Pasco, Pinellas, Sarasota, Taylor, Wakulla, and Walton;
- In Louisiana, the Coastal Protection and Restoration Authority Board of Louisiana through the Coastal Protection and Restoration Authority of Louisiana;
- In Louisiana, the Louisiana parishes of Ascension, Assumption, Calcasieu, Cameron, Iberia, Jefferson, Lafourche, Livingston, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, St. Martin, St. Mary, St. Tammany, Tangipahoa, Terrebonne, and Vermilion;
- In Mississippi, the Mississippi Department of Environmental Quality; and
- In Texas, the Office of the Governor or an appointee of the Office of the Governor.

The RESTORE Act and the Treasury final rule direct the state, county, and parish applicants to prepare multiyear implementation plans that prioritize eligible activities for Direct Component funds and to obtain broad-based participation from individuals, businesses, Indian tribes, and non-profit organizations as part of preparing their multiyear plans. The state, county, or parish applicants may periodically update their plans by following the same steps, including obtaining public input, prior to submitting their revised plans to Treasury. A private individual may choose to seek consideration of its proposal by contacting the state, county, or parish applicant, based on the proposed project's geographic location. The Direct Component FAQs provide details about this process.

Under the RESTORE Act, Gulf Coast region means:

- In the Gulf Coast States, the coastal zones defined under section 304 of the Coastal Zone Management Act of 1972 that border the Gulf of Mexico;
- Land within the coastal zones described in paragraph (1) of this definition that is held in trust by, or the use of which is by law subject solely to the discretion of, the Federal Government or officers or agents of the Federal Government;

- Any adjacent land, water, and watersheds, that are within 25 miles of the coastal zone described in paragraphs (1) and (2) of this definition; and
- All Federal waters in the Gulf of Mexico.

The Treasury rule explains further that Direct Component activities are carried out in the Gulf Coast Region when, in the reasonable judgment of the eligible entity applying to Treasury for a grant, each severable part of the activity is primarily designed to restore or protect that geographic area. The state, county, or parish must demonstrate that the activity will be carried out in the Gulf Coast Region when they apply for a grant.

Under the RESTORE Act, activities designed to protect or restore natural resources must be based on best available science. Best available science means science that maximizes the quality, objectivity, and integrity of information, including statistical information; uses peer-reviewed and publicly available data; and clearly documents and communicates risks and uncertainties in the scientific basis for such projects.

A state, county, or parish applicant must look at the nature of the activity, rather than the title of the eligible activity, when deciding whether this requirement applies. They must explain in their application how the activity is based on the "best available science" and cite peer-reviewed, objective, methodologically sound literature sources that support the conclusion that the proposed scope of work is an effective way to achieve the stated objectives that are set out in the RESTORE Act.

**Florida Department of Economic Opportunity (FDEO)**
Community Planning Technical Assistance Grant
http://www.floridajobs.org/community-planning-and-development/programs/community-planning-table-of-contents/technical-assistance/community-planning-technical-assistance-grant

The Florida Department of Economic Opportunity (DEO) anticipates that the Florida Legislature will appropriate funding for Community Planning Technical Assistance Grants. The grants provide communities the opportunity to develop innovative planning and development strategies to promote a diverse economy, vibrant rural and suburban areas and meet the requirements of the Community Planning Act, while protecting environmentally sensitive areas. The grants can also be used for disaster recovery or resiliency planning and economic development by communities impacted by Hurricanes Irma and Michael.

Community Planning Technical Assistance Grants are available to:

- Counties and municipalities; and
- Regional planning councils that propose projects on behalf of or for the benefit of counties, municipalities or the region and that have support, in writing, from the counties or municipalities affected by the proposed grant project.

Grant awards typically range from $25,000 to $40,000, but award amounts may vary.
Funding is contingent upon an appropriation from the Legislature.

Projects are developed by the county, municipality or regional planning council and generally relate to community planning and economic development strategies that implement the requirements in the Community Planning Act. Communities impacted by Hurricanes Irma and

Michael are encouraged to apply for projects related to disaster recovery or resiliency. Applicants are encouraged to seek funding for innovative, creative or unique approaches to planning and development.

Past Grant Projects

Examples of projects funded in prior years include the following:

- Priority Action Plan for the Avon Park Air Force Range Sentinel Landscape Program;
- Strategic plan for agricultural sustainability and food production;
- Strategic plan and sites inventory for designation of a freight logistics zone;
- Rail preservation plan for long-term multi-modal transportation uses;
- Sea level rise impacts to stormwater outfalls in the Indian River Lagoon;
- Visual imaging for public projects;
- Community redevelopment area plans and finding of necessity reports;
- Transportation corridor plans, complete streets plans and bicycle/pedestrian plans;
- Master plans for recreation, neighborhoods, infrastructure, urban design, etc.; and
- Amendments to comprehensive plans and land development regulations.

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